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Fred R. Dacimo
Vice President
License Renewal

June 26, 2008
Indian Point Units 2 & 3
Docket Nos. 50-247 & 50-286
NL-08-103

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

SUBJECT: **Reply to NRC Request for Additional Information Regarding License Renewal Application – Inaccessible or Underground Cables**

Reference: NRC letter dated May 28, 2008; "Request for Additional Information for the Review of the Indian Point Nuclear Generating Unit Nos. 2 and 3, License Renewal Application – Inaccessible or Underground Cables"

Dear Sir or Madam:

Entergy Nuclear Operations, Inc is providing, in Attachment I, the additional information requested in the referenced letter pertaining to NRC review of the License Renewal Application for Indian Point 2 and Indian Point 3. The additional information provided in this transmittal addresses staff questions regarding Inaccessible or Underground Cables.

There are no new commitments identified in this submittal. If you have any questions or require additional information, please contact Mr. R. Walpole, Manager, Licensing at (914) 734-6710.

I declare under penalty of perjury that the foregoing is true and correct. Executed on 6/26/08

Sincerely,

Fred R. Dacimo
Vice President
License Renewal

Attachment:

1. Reply to NRC Request for Additional Information Regarding License Renewal Application – Inaccessible or Underground Cables

cc: Mr. Bo M. Pham, NRC Environmental Project Manager
Ms. Kimberly Green, NRC Safety Project Manager
Mr. John P. Boska, NRC NRR Senior Project Manager
Mr. Samuel J. Collins, Regional Administrator, NRC Region I
Mr. Sherwin E. Turk, NRC Office of General Counsel, Special Counsel
IPEC NRC Senior Resident Inspectors Office
Mr. Paul D. Tonko, President, NYSERDA
Mr. Paul Eddy, New York State Dept. of Public Service

ATTACHMENT I TO NL-08-103

REPLY TO NRC REQUEST FOR ADDITIONAL INFORMATION

REGARDING

LICENSE RENEWAL APPLICATION

Inaccessible or Underground Cables

ENTERGY NUCLEAR OPERATIONS, INC
INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 and 3
DOCKETS 50-247 and 50-286

**INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 AND 3
LICENSE RENEWAL APPLICATION
REQUEST FOR ADDITIONAL INFORMATION
INACCESSIBLE OR UNDERGROUND POWER CABLES
RAI 3.6.2.3-2**

In LRA Table 3.6.2-1, the applicant states that 138kV direct burial insulated transmission cables (passive electrical for station blackout (SBO) recovery) have no aging effects requiring management and indicates (by Note J) for material, environment, aging effect, and aging management program (AMP) that neither the component nor the material and environment combination is evaluated in the GALL Report for meeting the component's electrical intended function. The plant-specific Note 602 for this item in LRA Table 3.6.2-1 states that it is not subject to water treeing, since it is designed for continuously wet conditions. Industry and plant operating experience has not provided any information on failures of this type of cable. In addition, in response to the audit team's question concerning the qualification of this cable for continuous submerged condition, the applicant stated that the aging effects caused by moisture and voltage stress are not applicable to this cable because the lead sheath prevents moisture intrusion.
Based on an initial review of the licensee's responses to Generic Letter 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients," the staff notes that several licensees have identified failures of XLPE cables in low and medium voltage applications. The high voltage cables could have the same failure mechanisms if the underground cables are susceptible to moisture, water, and condensation environment or have manufacturing defects or damage caused by shipping and installation, or exposure to electrical transients and abnormal operating conditions. The likelihood of failure from any of these causes increases over time as the cable insulation degrades. 10 CFR 54.21(a)(3) requires that components within the scope of license renewal and subject to an AMR must be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation. Therefore, the staff requests the applicant to provide technical justification of why an aging management program is not required to manage the potential loss of dielectric strength leading to reduced insulation resistance and electrical failure due to aging mechanisms such as moisture intrusion, water treeing, elevated operating temperature, voltage stress, and galvanic corrosion. In order to complete its review, the staff requires responses to the following requests for additional information.

1. Explain why an AMP is not required to manage the potential loss of dielectric strength leading to reduced insulation resistance and electrical failure due to aging mechanisms such as moisture and water intrusion, water treeing, elevated operating temperature, voltage stress, and galvanic corrosion. The operating experience has shown that manufacturing defects, and damage caused by shipping and installation are contributing causes resulting in water treeing and insulation breakdown.

Response to #1:

An AMP is not required for this 138 kV underground transmission cable because the cable is not susceptible to the listed aging mechanisms.

The main components of the IP2 138 kV solid dielectric transmission cable are an extruded 0.125" polyethylene (PE) jacket, a 0.125" lead sheath, copper woven fabric expanding (swellable) tape, an extruded insulation shield, cross-linked polyethylene (XLPE) insulation, an extruded conductor shield, and a compacted 750 MCM copper conductor. Radial water sealing is achieved by the corrosion resistant lead sheath and longitudinal water sealing is achieved with a water swelling material under the lead sheath. The cable is designed for direct burial, but is installed in an underground duct bank. The purchase specification for the cable required that the cable and joint design be impervious to both water and hydrocarbon based liquids, so that neither water nor hydrocarbon based liquids will have any deleterious effect on any part of the cable or joints. Association of Edison Illuminating Companies (AEIC) Specification CS7, "Specification for Crosslinked Polyethylene Insulated Shielded Power Cables Rated 69 Through 138 KV," which was used as the reference for the cable purchase specification, recommends that power cables susceptible to water treeing operated in moist environments be manufactured with an effective moisture barrier such as a metallic sheath. The cable purchase specification required the cable be supplied with a moisture barrier, which was a metallic (lead) sheath. The manufacturer was to guarantee that the solid dielectric cable system would pass an initial high potential proof test.

Moisture Intrusion and Water Treeing

The potential aging effect related to moisture intrusion that is applicable to this cable is similar to the potential aging effect for inaccessible medium-voltage cables, which is listed in NUREG-1801, Table VI as localized damage and breakdown of insulation leading to electrical failure/ moisture intrusion, water trees. As stated in LRA Table 3.6.1, reduced insulation resistance (IR) is considered equivalent to the aging effect listed for this item (breakdown of insulation). The environment contributing to this potential aging effect is stated in the EPRI electrical handbook and NUREG-1801, Table VI as adverse localized environment caused by exposure to moisture and voltage. The IP2 138 kV cable is energized greater than 25% of the time, so it is exposed to significant voltage. The cable is installed in an underground duct bank, so it is potentially exposed to significant moisture. The IP2 cable is installed in a duct bank within the Buchanan substation. Based on this information the 138 kV solid dielectric transmission cable is not installed in a continuously wet condition, but it is assumed the cable is exposed to signification moisture (wet for more than a few days).

In short, since the lead sheath of the IP2 138 kV solid dielectric transmission cable prevents moisture intrusion into the XLPE insulation, the insulation will not develop water trees. There are no aging effects due to aging mechanisms such as moisture and water intrusion or water treeing. Since there are no aging effects, an aging management program is not required.

Elevated Operating Temperature

The cable design precludes elevated operating temperature. The IP2 138 kV solid dielectric transmission cable rating based on temperature considerations and installation method (including conductor configuration) is 575 amps continuous. The worst-case continuous load is about 330 amps. The worst case continuous load is less than 60% of the rating of the cable, so there is ample design margin. Based on the available design margin, elevated operating temperature will not create aging effects requiring management.

Voltage Stress

Voltage stress is not a significant aging mechanism. Voltage stress associated with moisture intrusion was previously discussed. Voltage stress that is not associated with moisture intrusion is precluded by the design of the circuit. Voltage stress due to switching transients is accounted for in the cable design. The maximum operational voltage is 145 kV and the cable rating is 245 kV. The minimum impulse withstand voltage for this cable is 815 kV, and the BIL rating is 650 kV. Therefore, voltage stress will not create aging effects requiring management.

Galvanic Corrosion

Galvanic corrosion is not an applicable aging mechanism since there are no dissimilar metal connections within the IP2 138 kV solid dielectric transmission cable. The conductor and the insulation have an extruded shield. The lead sheath is not in direct contact with another conducting material. The potential galvanic corrosion associated with a submarine cable between the extruded lead sheath and the copper armor wires is not applicable to the IP2 cable, since there is not a layer of armor wires. Therefore, galvanic corrosion of the cable will not create aging effects requiring management.

Other Mechanisms

Manufacturing defects or damage caused by shipping and installation are possible mechanisms contributing to water treeing and insulation breakdown; however, these are event-driven mechanisms not aging mechanisms. These conditions are minimized by receipt inspections and post-installation testing. These events result in premature failures, which have not been experienced by the IP2 138 kV solid dielectric transmission cable, which was installed in late 1994.

2. State whether if any testing was performed on the cable during receipt and post-installation (include the type of testing that was performed on the cable). If so, describe the capabilities of the testing method performed on the cable, the testing results, and state if the testing identified any problems. State whether a current testing or maintenance program exists for this cable system, and if so, describe that program.

Response to #2:

The purchase specification required the solid dielectric cable system to meet the specifications in AEIC CS7. AEIC CS7 required the items to pass an initial high potential proof test. The cable was tested at the manufacturing plant using 60-Hz ac voltage. The shielded cable was required to meet the corona extinction level voltage established in the purchase specification. The shielded cables are to be free of partial discharge at voltages well above operating voltages. In addition to these factory tests, a dc high-potential test after installation was required. The cable passed the AEIC CS7-87 test specifications.

The specifications and installation procedures specified receipt inspection and post-installation testing.

The current maintenance program for the IP2 138 kV solid dielectric transmission cable performed by IP2 includes a walkdown of the IP2 138 kV offsite power feeder from the IP2 station aux transformer to the Buchanan substation breakers, which includes inspection of the accessible portions of the 138 kV solid dielectric underground transmission cable. There are no periodic tests performed under the IP2 maintenance program; however, IP2 continuously monitors these cables for voltage and load.

3. Provide details of the original cable specifications including procurement specification (include all applicable references) to support that the subject cable is comparable to submarine cable and/or that the cable is supplied with a moisture barrier or water sealant swelling material applied under the lead sheath as specified in your letter dated October 11, 2007, in response to the LRA audit team's question. Also, describe in detail the differences between the subject cable and a submarine cable.

Response to #3:

The purchase specification for the IP2 138 kV solid dielectric transmission cable required that the cable and joint design be impervious to water and hydrocarbon based liquids, so that neither water nor hydrocarbon based liquids shall have any deleterious effect on any part of the cable or joints. To achieve the required resistance to moisture intrusion, the purchase specification invoked an industry standard specification that recommends a metallic sheath for cable exposed to moisture. The cable specification required the cable be supplied with a moisture barrier, which is achieved by the 0.125" lead sheath and the copper woven fabric (swellable) tape. Radial water sealing is achieved by the corrosion resistant lead sheath, and longitudinal water sealing is achieved by the water swelling material (tape) under the lead sheath. The cable is designed for direct burial, but is installed in an underground duct bank. The plant drawing for the cable confirms that the features required by the specification are indeed part of the IP2 138 kV solid dielectric transmission cable.

As defined in an IEEE standard for high voltage submarine or lead sheathed power cable systems, an insulated high voltage submarine cable requires a metallic water barrier to protect the dielectric insulation from exposure to moisture. This metallic barrier is usually an extruded lead sheath. The lead sheath must be protected against longitudinal stresses, which is achieved with a second layer of metal tapes or armor wires or both. In the presence of water there is a risk of galvanic corrosion between lead and the metal of the reinforcing tape. To prevent galvanic corrosion in a submarine cable, a second moisture barrier is required. This moisture barrier is called the anticorrosion jacket, and consists of a thick layer of PE or PVC. Armor wires are wrapped over this jacket to provide abrasion resistance on gravel, heavy silt/mud, and rocky portions of the seabed.

Based on the plant drawing, the construction of the IP2 138 kV solid dielectric transmission cable is the same as a submarine cable without the layer of armor wires, and its associated anticorrosion barrier. Therefore, the IP2 138 kV solid dielectric transmission cable is comparable to a submarine cable for protecting the dielectric insulation from exposure to moisture.

4. Provide documentation showing that the cable can operate for the duration of the period of extended operation in submerged and wet conditions. If no periodic testing is proposed for this cable, explain how you plan to monitor the degradation of the cable or the condition of the conductor insulation (loss of dielectric strength) to preclude any potential cable failure such that the cable will perform its intended function for the period of extended operation as required by 10 CFR 54.21(a)(3).

Response to #4:

As stated in the previous sections of the response to this RAI, the extruded lead sheath of the IP2 138 kV solid dielectric transmission cable prevents exposure of the XLPE insulation to moisture and voltage stress. The EPRI electrical handbook and NUREG-1801, Section XI.E3 state that continuous wetting and continuous energization are not significant concerns for submarine cables, and the IP2 138 kV solid dielectric transmission cable has the same features as a submarine cable for preventing moisture intrusion. Therefore, there are no aging effects associated with moisture and voltage stress requiring management during the period of extended operation.

Routine operational monitoring provides further assurance that the cable will remain capable of performing its intended function throughout the period of extended operation. Because the cable serves no safety function, postulation of a single failure when called upon to perform its intended function is not required. The cable serves one of two credited sources of offsite power recovery. As it is normally energized, an electrical failure would be readily apparent allowing prompt corrective action to restore its ability to perform its intended function. Multiple sources of offsite power are potentially available for station blackout recovery in addition to the two credited sources.

5. Describe the AEIC or other specification that is applicable to the IP2/IP3 lead sheath power cables that are designed to be installed in wet environments for extended periods. Also, describe the conditions for which the cable was tested in accordance with specification AEIC CS7 with respect to operability in wet/submerged/humid conditions.

Response to #5:

The Association of Edison Illuminating Companies (AEIC) standard CS7-93, Specification for Crosslinked Polyethylene Insulated Shielded Power Cables Rated 69 Through 138 KV, was used as the reference for the 138 kV solid dielectric transmission cable purchase specification. The AEIC CS7-93 specification outlines design considerations and testing of XLPE cable systems. Design considerations include environment, insulation thickness, shielding methods, and voltage ratings. Testing is provided for standard routine tests, sample tests, type tests, and after laying tests that are to be performed in accordance with the standard.

The AEIC CS7 specification recommends a metallic sheath when the cable is to be exposed to moisture. Since XLPE insulated cables are susceptible to water treeing when operated in moist environments, the recommended design includes water blocked conductors, tree retardant insulation compounds, moisture resistant overall cable jackets, and an effective moisture barrier such as a metallic sheath. The cable purchase specification required the design features discussed in CS7 to preclude water treeing. Routine tests of XLPE cables and accessories include PD-measurement test, high-voltage test of main insulation, electrical test of over-sheath (if required), and visual inspection. Sample tests carried out according the applicable standard (CS7-93) include conductor examination, extruded conductor shielding and insulation shield examination, electrical resistance of conductor, check of dimensions, structural stability, void and contaminant determination, capacitance test, hot set test, and electrical tests. The after laying or post-installation tests include DC voltage test of the over-sheath, and AC voltage test of the main insulation.

In addition to the production sampling tests specified in AEIC CS7, the purchase specification directed that a ten foot long sample of the cable from the structural stability tests be tested as follows to demonstrate the effectiveness of the longitudinal water blocking of the cable core and conductor. The specification directed that a ring of the cable jacket be removed at the center of the cable and the exposed cable core be subjected to water at a pressure of 3 psig for a period of one hour. The test specified that there be no evidence of water at the ends of the cable sample after a period of one hour.

The cable is not safety-related and hence there is no requirement for EQ type testing with respect to wet environments. The cable is typical of cables widely used in the power industry for long term transmission and distribution service in potentially wetted environments including salt water. Because the cables are not in a safety-related application where single failure considerations apply, the design and testing are appropriate for this service.

6. Identify the material, environment, aging mechanism, and aging effect for the pot assembly (termination ends) for this cable. Identify details of periodic visual inspections and walkdowns performed to date or planned for the period of extended operation to monitor for oil leakage, oil testing performed or any indications or alarms provided in the control room to indicate the potential loss of oil. Explain how effects of aging will be managed during the period of extended operation.

Response to #6:

The IP2 138 kV solid dielectric transmission cable has oil filled pothead connections on each end. The potheads are sealed, and filled with oil pressurized with a local nitrogen tank. A pressure switch that alarms in the Buchanan substation control room continuously monitors the pressure of the oil. The Buchanan substation control room alarm re-flashes in the Indian Point control room.

The oil in the pothead prevents moisture and oxygen intrusion into the connection, but does not contribute to the basic impulse level (BIL) rating for the pothead, nor does the oil provide insulation for the connection. Therefore, the oil does not require a specific dielectric strength to support the connection intended function. Because the oil prevents moisture and oxygen intrusion, corrosion of this connection is not an applicable aging mechanism.

Routine maintenance includes periodic visual inspections of the potheads including the seal between the pothead and the 138 kV solid dielectric cables, and between the pothead and the nitrogen connections. The pothead visual inspections are performed at least once per year. This visual inspection combined with the continuous monitoring ensures an environment is maintained to preclude moisture and oxygen.