

**UNITED STATES
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD**

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In re:

Docket Nos. 50-247-LR; 50-286-LR

License Renewal Application Submitted by

ASLBP No. 07-858-03-LR-BD01

Entergy Nuclear Indian Point 2, LLC,
Entergy Nuclear Indian Point 3, LLC, and
Entergy Nuclear Operations, Inc.

DPR-26, DPR-64

December 15, 2011

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**STATE OF NEW YORK'S
INITIAL STATEMENT OF POSITION
CONTENTIONS NYS-6 AND 7**

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PRELIMINARY STATEMENT

In accordance with 10 C.F.R. Section 2.1207(a)(1) and the Atomic Safety and Licensing Board's ("Board") July 1, 2010 Memorandum and Order, the State of New York ("New York") submits its Initial Statement of Position on New York's admitted Contentions 6 and 7 challenging Entergy's failure to provide an adequate and specific program to manage the effects of aging on non-environmentally qualified ("non-EQ") inaccessible low- and medium-voltage power cables¹ that are exposed to adverse localized environmental conditions.

Entergy's License Renewal Application ("LRA") discusses the aging management of non-environmentally qualified inaccessible cables that are exposed to significant moisture. As Earle C. Bascom III, P.E. establishes in his testimony and accompanying report, Entergy's discussion fails to demonstrate that it has an adequate Aging Management Program ("AMP") because it is so devoid of essential detail that it is difficult, if not impossible, to discern what Entergy will actually do to insure the cables' continuing ability to transmit power. The LRA does not specify the location or number of the relevant cables, does not identify their function, does not describe their physical characteristics, does not identify the cable condition monitoring tests that will be used, does not explain the criteria for determining whether the test results are acceptable, and does not identify what corrective actions, if any, Entergy will take if a defective cable is found. Without this essential detail, Entergy has not demonstrated and the Board cannot

¹ Since the deficiencies in Entergy's Aging Management Program for non-environmentally qualified inaccessible low- and medium-voltage cables are the same, the discussion in this pleading will refer to both types of cables as "non-environmentally qualified inaccessible cables" unless the voltage of the cable is relevant to the point being made.

determine that the AMP for non-EQ inaccessible low and medium voltage power cables that are exposed to significant moisture will adequately manage the effects of aging during the license renewal period.

In addition, Entergy's LRA contains no plan to manage the effects of other localized adverse environmental conditions, such as excessive heat, on inaccessible non-EQ power cables, and no explanation of why such a plan is not necessary. For these reasons, Entergy's LRA is legally deficient and should be denied.

Contentions 6 and 7 are supported by this Statement of Position and by the Report and Pre-Filed Testimony of Mr. Bascom. Mr. Bascom is a professional engineer specializing in underground cable systems and has twenty-one years of experience consulting for utilities. Mr. Bascom has authored a reference manual for underground cable fault location and has participated in other research projects for the Electric Power Research Institute, the research arm of the utility industry.

Mr. Bascom provides background information about the construction and function of electric cables, the problems that can arise when inaccessible cables are subject to adverse environments that they were not designed to withstand, and the ways in which an effective Aging Management Program can prevent these problems from occurring or can discover them in time to mitigate their consequences. Mr. Bascom analyzes Entergy's AMP for non-EQ inaccessible power cables and concludes that its absence of any information about critical factors, such as cable types, cable tests, cable test acceptance criteria and corrective measures makes it impossible for Entergy to demonstrate that the AMP will assure that the cables will continue to function during the license renewal period.

Mr. Bascom's Report and Pre-Filed testimony is based, in part, on his own twenty-one years of experience with underground cable systems and upon his review of a report contracted by the Sandia National Laboratory, *SAND 96-0344, Aging Management Guideline for Commercial Nuclear Power Plants - Electrical Cables and Terminations* (September 1996) ("SAND96-0344"), Exh. NYS000156 and a guidance document prepared by the Brookhaven National Laboratory for the NRC, *NUREG/CR-7000, BNL-NUREG -90318-200, Essential Elements of an Electric Cable Condition Monitoring Program* ("NUREG/CR-7000"), Exh. NYS000148. NUREG/CR-7000 was prepared shortly before the December 2010 GALL was issued and both reports support Mr. Bascom's factual analyses.²

PROPOSED FINDINGS OF FACT

This Statement of Position along with its supporting evidence provides ample bases for the Board to find the following facts regarding NYS-6 and 7:

1. The conductor insulation of non-EQ inaccessible low and medium-voltage power cables that are exposed to wetting or submergence can degrade to the point of cable failure and a circuit breakdown.
2. Tests can be done on non-EQ inaccessible power cables exposed to wetting or submergence to assess the condition of the conductor insulation in order to determine whether cables should be repaired or replaced before they fail.
3. The effectiveness of a particular testing technique depends on the characteristics of the particular cable, such as its cable voltage rating, its cable

² Mr. Bascom also reviewed seven documents discussing and analyzing the phenomenon of water-treeing in cable insulation (Exhs. NYS000139 - 000145), and two technical reports by the Electric Power Research Institute about the aging management of medium voltage cables in nuclear power plants (Exhs. NYS000158 and 000159).

insulation/jacket material, and its cable location.

4. Testing a cable with a testing technique that is not appropriate for the cables' characteristics, will not provide accurate information about the condition of the conductor insulation

5. Entergy has provided no information about the characteristics of any of the non-EQ inaccessible power cables that are exposed to wetting or submergence.

6. Entergy has provided no information about the cable condition tests it will use or any criteria for making that determination.

7. Cable condition tests have acceptance criteria that are defined by the type of test performed and the type of cable tested.

8. Unrealistically lenient acceptance criteria can result in false positives -- that is, to conclusions that tested cable insulation is intact when it is in fact degrading.

9. Entergy has provided no information about the acceptance criteria it will use for different types of cable monitoring tests.

10. The insulation of non-EQ inaccessible low and medium voltage cables that are exposed to heat that is greater than their rated temperature can degrade to the point of cable failure and a circuit breakdown.

11. A cable's insulation may degrade to failure within days to months if the heat to which it is exposed is substantially greater than its rated temperature.

12. There are methods to detect hot spots on inaccessible cables at an early stage before serious cable insulation degradation occurs.

13. Entergy has not provided any Aging Management Program to assure the continued function during the license renewal period of non-EQ inaccessible low and

medium voltage cables exposed to heat above their rated temperature.

LEGAL FRAMEWORK

The NRC’s regulations require Entergy to “demonstrate that the effects of aging will be adequately managed so that the intended function(s) will be maintained consistent with the CLB for the period of extended operation.” 10 C.F.R. § 54.21(a)(3). Systems, structures, and components (“SSCs”) requiring an aging management review perform an intended function, as described in § 54.4:

(1) Safety-related systems, structures, and components which are those relied upon to remain functional during and following design-basis events (as defined in 10 CFR 50.49 (b)(1)) to ensure the following functions--

- (i) The integrity of the reactor coolant pressure boundary;
- (ii) The capability to shut down the reactor and maintain it in a safe shutdown condition; or
- (iii) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to those referred to in § 50.34(a)(1), § 50.67(b)(2), or § 100.11 of this chapter, as applicable.

(2) All nonsafety-related systems, structures, and components whose failure could prevent satisfactory accomplishment of any of the functions identified in paragraphs (a)(1)(i), (ii), or (iii) of this section.

(3) All systems, structures, and components relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the Commission’s regulations for fire protection (10 CFR 50.48), environmental qualification (10 CFR 50.49), pressurized thermal shock (10 CFR 50.61), anticipated transients without scram (10 CFR 50.62), and station blackout (10 CFR 50.63).

10 C.F.R. §§ 54.4(1)-(3); *see also Entergy Nuclear Generation Company and Entergy Nuclear Operations, Inc.* (Pilgrim Nuclear Power Station), CLI 10-14, ___ N.R.C. ___

(June 17, 2010) slip op. at 5-8. Therefore, those non-EQ³ qualified inaccessible low and medium voltage cables that are safety-related, or which are nonsafety related but whose failure could affect the reactor pressure boundary's integrity, the capability to safely shut down the plant, or the capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures, must be the subject of an aging management program in license renewal.

The ultimate burden of proof in any adjudicatory proceeding remains with the applicant throughout the proceeding. *See, e.g., Duke Power Co.* (Catawba Nuclear station, Units 1 and 2), CLI-83-19, 17 N.R.C. 1041, 1048 (1983), citing *Consumers Power Co.* (Midland Plant, Units 1 and 2), ALAB-283, 2 N.R.C. 11, 17 (1975); *AmerGen Energy Co., LLC* (Oyster Creek Nuclear Generating Station), CLI-09-07, 69 N.R.C. 235, 263 (2009) (the applicant must demonstrate that it satisfies the "reasonable assurance standard" by a preponderance of the evidence); *Virginia Electric & Power Company* (North Anna Power station, Units 1, 2, 3 & 4), ALAB-256, 1 N.R.C. 10, 17, n.18 (1975).

The NRC has issued several versions of a NUREG document, entitled Generic Aging Lessons Learned ("GALL") which offers an applicant guidance on Aging Management Programs for in-scope SSCs. *See* NUREG 1801 ("GALL Report"). The Commission has stated that a "license renewal applicant's use of an aging management program identified in the GALL Report constitutes reasonable assurance that it will manage the targeted aging effect during the renewal period." *AmerGen Energy Co.*

³ The cables at issue are not subject to the environmental qualifications of 10 CFR § 50.49 because they are purportedly located in a mild environment - that is, an environment that would at no time be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences. CFR § 50.49(c)(3).

(Oyster Creek Nuclear Generating Station), CLI-08-23, 68 N.R.C. 461, 468 (2008)). The GALL Report, however, is merely a guidance document and consistency with GALL does not foreclose a challenge to the adequacy of an AMP. *Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc.* (Vermont Yankee Nuclear Power Station), CLI-10-17, ___ N.R.C. ___, ___ (July 8, 2010) slip op. at 46-47. Moreover, an applicant's mere assertion that it will comply with GALL does not fulfill its duty to “demonstrate” that it has an adequate AMP. *Id.* at 45 (“We do not simply take the applicant at its word.”)

The State now submits this testimony to show that Entergy has not met its burden of demonstrating that the effects of aging on the intended function(s) of non-EQ inaccessible low and medium voltage cables exposed to adverse localized environments will be adequately managed during the period of extended operation.

PROCEDURAL HISTORY

A. The Board’s Admission of Contentions 6 and 7

On November 30, 2007, the State of New York submitted a Petition to Intervene to this Board, which included proposed contentions regarding critical deficiencies in Entergy's Indian Point relicensing application with respect to public safety, health and the environment. Among those proposed contentions were Contentions 6 and 7, which read in their entirety:

The license renewal application for IP2 and IP3 fails to comply with the requirements of 10 C.F.R. §§ 54.21(a) and 54.29 because applicant has not proposed a specific plan for aging management of non-environmentally qualified inaccessible medium-voltage cables and wiring for which such aging management is required.

The license renewal application for IP2 and IP3 fails to comply with the requirements of 10 C.F.R. §§ 54.21(a) and 54.29 because applicant has not

proposed a specific plan for aging management of non-environmentally qualified inaccessible low-voltage cables and wiring for which such aging management is required.

New York State Notice of Intention to Participate and Petition to Intervene, Contentions 6 and 7, at pp. 92-103 (Nov. 30, 2007)(ML073400187). In Contention 6, the State asserted that Entergy's alleged AMP for non-EQ inaccessible medium voltage cables lacked any detail and thus did not demonstrate to the Board that the effects of aging would be adequately managed during the extended period of operation. Specifically, Entergy failed to identify which cables it covered, did not address or commit to any of the specific recommendations for the aging management of medium voltage cables contained in a report contracted by the Sandia National Laboratory and did not commit to testing the cables using one of the methods recommended by the NRC in Generic Letter 2007-01. *Id.* at 94-100. In Contention 7, the State asserted that Entergy's LRA did not contain any AMP for non-EQ inaccessible low voltage cables. *Id.* at 100-103.

On January 22, 2008, Entergy filed an Answer opposing the admission of Contentions 6 and 7. *Answer of Entergy Nuclear Operations, Inc. Opposing New York State Notice of Intention to Participate and Petition to Intervene*, section on NYS-6 and 7, at 56-68 (Jan. 22, 2008) (ML080300149). In responding to Contention 6, Entergy contended that its AMP for non-EQ Inaccessible Medium-Voltage Cables was acceptable because it "will be consistent with the program attributes described in GALL Report, Section XI.E3." *Id.* at 61, *citing*, LRA, Appendix B.1.23. However, the 2005 GALL's AMP for non-EQ inaccessible medium voltage power cables exposed to significant moisture contained only two specific attributes -- the inspection of manholes for water accumulation every two years and the testing of the condition of the cables every ten

years. NUREG 1801, Rev. 1, Vol. 2, *Generic Aging Lessons Learned (GALL Report)* Section XI.E3 at page XI E-8 (September 2005)(ML052110006) ("Sept. 2005 GALL Report"), (Exh. NYS000146).

In opposing the admissibility of Contention 7, Entergy cited to LRA § 2.5 and Appendix B 1.25 to claim that it had, in fact, provided an AMP for non-EQ inaccessible low-voltage cables in its LRA. Entergy's Answer at 65-66.

Also on January 22, 2008, NRC Staff opposed the admission of Contentions 6 and 7. *NRC Staff's Response to Petitions for Leave to Intervene*, section on NYS-6 and 7 at 38 - 44. (Jan. 22, 2008)(ML080230543). In responding to Contention 6, the Staff claimed that Entergy satisfied 10 CFR § 54.21(a)(3) by agreeing to develop a program that incorporates the GALL's attributes and was not required to include the actual AMP in its LRA. Indeed, the Staff acknowledged that Entergy had not submitted an actual AMP for non-EQ inaccessible medium voltage power cables. *Id.* at 39-40. In response to Contention 7, Staff argued in the alternative -- that neither 10 CFR § 54.21(a) nor § 54.29 require Entergy to propose a specific plan for non-EQ inaccessible low voltage cables⁴ and that Section B.1.25 of the LRA purportedly addresses non-EQ inaccessible low voltage cables. *Id.* at 43.

On February 22, 2008, the State responded to Entergy's and Staff's opposition. *State of New York's Reply in Support of Petition to Intervene*, Contentions 6 and 7, at 42-

⁴ Staff's position that no specific AMP is required for non-EQ inaccessible low-voltage cables is startling, considering that Entergy told Staff that all of Indian Point's safety-related power cables are low voltage. See *Entergy Amendment 1 to License Renewal Application*, December 18, 2007, Attachment 3 (Entergy's Response to NRC Amp Audit) at 32-33 (ML073650195), Exh. NYS000159.

58 (Feb. 22, 2008) (ML080600444). As to Contention 6, the State asserted that Entergy's promise to implement a program without providing any details of the program to be implemented does not meet the requirements of 10 CFR §§ 54.21 and 54.29 because it illegally removes from Board and intervenor review a component of the AMP that is subject to such review. *Id.* at 43. As to contention 7, the State pointed out that the sections of the LRA cited by Entergy and Staff as containing an AMP for non-EQ inaccessible low voltage cables addresses *accessible* not *inaccessible* cables and does not mention low voltage cables at all.

On July 31, 2008, the Board admitted and consolidated Contentions 6 and 7 with respect to Entergy's failure to provide a specific plan for the aging management of non-EQ inaccessible medium voltage cables and its failure to provide any plan for non-EQ inaccessible low voltage cables. The Board stated that "we do not comprehend how a commitment to develop a program can *demonstrate* that the effects of aging will be adequately managed." (Emphasis in original). *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), LBP-08-13, 68 N.R.C. 43 (July 31, 2008) slip op. at 41 (ML082130436). The Board thus implicitly recognized that the 2005 GALL did not contain a specific program for the aging management of non-EQ inaccessible cables at Indian Point, and that Entergy's mere commitment to incorporate the 2005 GALL's attributes was therefore insufficient to demonstrate that the effects of aging would be adequately managed at Indian Point during the period of extended operation.

B. The December 2010 Revised GALL

After the initial and revised GALLs were issued in 2001 and 2005, the NRC learned that some cables that were qualified for 40 years were failing substantially before

the end of their qualified life. The NRC conducted a detailed review of the problem and issued a Generic Letter in 2007 to all current licensees, informing them that "in the absence of adequate monitoring of cable insulation, equipment could fail abruptly during service, causing plant transients or disabling accident mitigation systems." NRC Generic Letter 2007-01, *Inaccessible or Underground Power Cable Failures That Disable Accident Mitigation Systems or Cause Plant Transients*, (Feb. 7, 2007) ("Generic Letter 2007-01")(ML070360665), Exh. NYS000149. The Generic Letter also asked licensees to provide a history of inaccessible or underground power cable failures for all voltage cables and to describe their inspection, testing and monitoring programs to detect the degradation of inaccessible or underground power cables. *Id.* at 4.

After obtaining licensee responses to the Generic Letter, the NRC identified an increasing trend of cable failures beginning in the sixth (6th) through tenth (10th) years of service and concluded that moisture intrusion into inaccessible cables is the predominant factor contributing to cable failure. *Request For Additional Information For The Review Of The Indian Point Nuclear Generating Unit Number 2 and 3, License Renewal Application*, Feb. 10, 2011 (ML103490041) ("RAI") at 5, Exh. NYS000150.

In December 2010, the NRC issued the new GALL (ML103490041) which incorporated information about cable failures contained in the licensee responses to Generic Letter 2007-01. NUREG-1801, Rev. 2, *Generic Aging Lessons Learned (GALL) Report*, Final Report (Dec. 2010) (ML103490041) ("New GALL") Exh. NYS000147. The New GALL's AMP for non-EQ inaccessible cables was expanded to include low as well as medium voltage non-EQ cables exposed to significant moisture and contains

more stringent proposals for manhole inspections and cable testing.⁵ It proposes periodic inspection of cables in manholes based on plant-specific operating experience with water accumulation in the manholes, with inspections to be done at least annually, instead of every two years; additional manhole inspections after events such as heavy rain or flooding; manhole inspection frequencies adjusted based on the results of prior inspections; testing the condition of the cables' insulation at least once every six years, instead of every ten years; and test frequencies adjusted based on test results and operating experience. *Id.* at XI E3-2.

The New GALL states that the specific type of cable test should be capable of detecting reduced cable insulation resistance due to wetting or submergence and contains a list of tests, one or more of which the NRC determined an applicant can use with "reasonable confidence" to detect deterioration of the insulation system due to wetting or submergence. The tests identified include, but are not limited to Dielectric Loss (Dissipation Factor/Power Factor), AC Voltage Withstand, Partial Discharge, Step Voltage, Time Domain Reflectometry, Insulation Resistance and Polarization Index, and Line Resonance Analysis.⁶ *Id.* It also added a section entitled "Monitoring and Trending" which stated that "trending actions are included as a part of this AMP" because "results that are trendable provide additional information on the rate of cable insulation

⁵ Revision 2 of the GALL in December 2010, *supra* at 12, belies the Staff's disingenuous assertion at the outset of this proceeding that the 2005 GALL already contained an AMP for non-EQ inaccessible low voltage cables. *See NRC Staff's Response to Petitions for Leave to Intervene*, (Feb. 22, 2008) (ML080600444) at 43.

⁶ In January 2010, approximately one year before the issuance of the new GALL, the NRC issued the guidance *Essential Elements of An Electric Cable Condition Monitoring Program*, NUREG/CR-7000, (ML100540050)("NUREG/CR-7000") which contained detailed information about numerous cable condition testing methods, including the methods that were eventually included in the new GALL. Exh. NYS000148.

degradation." *Id.* at XI E3-3. The New GALL does not contain any AMP for non EQ inaccessible low and medium voltage power cables that are exposed to other localized adverse environmental conditions, such as excessive heat.

C. Entergy's Supplemental LRA

On February 10, 2011, NRC Staff sent Entergy a Request for Additional Information. *Request For Additional Information For The Review Of The Indian Point Nuclear Generating Unit Number 2 and 3, License Renewal Application ("RAI 3.0.3.1.2-1")*, Feb. 10, 2011)(ML110190809), Exh. NYS000150. Staff asked Entergy to explain how it would manage the effects of aging on *low* as well as medium voltage cables and to explain how its proposed AMP for medium-voltage cables incorporates recent industry and plant specific operating experience. *Id.* at page 6.⁷

By letters dated March 28, July 14, July 27 and August 9, 2011, Entergy supplemented its LRA to incorporate the more stringent manhole inspection and cable testing schedule in the New GALL's AMP for non-EQ, inaccessible low and medium voltage power cables exposed to significant moisture. *Entergy Response (NL-11-032) to Request for Additional Information (RAI), Aging Management Programs, Indian Point Nuclear Generating Unit Nos. 2 and 3*, (Mar. 28, 2011))(ML110960360) (" Entergy March 28 Response"), Exh. NYS000151; *Entergy Response (NL-11-074) to RAI for the Review of the Indian Point Nuclear Generating Units Nos. 2 and 3*, (July 14, 2011)

⁷ During a June 6, 2011 Pre-Hearing Conference, NRC Staff informed the Board and the parties that: "We are informed by GALL Rev 2, but we are not directly applying it to Indian Point." Transcript of June 6, 2011 Conference, at 978 (ML11160A030). Although it is not clear what Staff means to convey by that cryptic comment, Staff's questions to Entergy in the March 28, 2011 RAI suggest that Staff is directly applying the New GALL (i.e., Rev. 2) to Entergy's AMP for non-EQ inaccessible power cables.

(ML11201A160) ("Entergy July 14 Response"), Exh. NYS000152; *Entergy Response (NL-11-090) to RAI for the Review of the Indian Point Nuclear Generating Units Nos. 2 and 3*, (July 27, 2011) (ML11215A128) ("Entergy July 27 Response"), Exh. NYS000153; *Entergy Response (NL-11-096) to RAI for the Review of the Indian Point Nuclear Generating Units Nos. 2 and 3*, (August 9, 2011) (ML11229A803) ("Entergy August Response"), Exh. NYS000154.

In sum, Entergy's new AMP applies to medium and low voltage cables and requires: (i) periodic inspection of manholes for water accumulation based on specific operating experience with water accumulation but at least annually, instead of every two years; (ii) event driven inspections of manholes after heavy rain or flooding; (iii) increased frequency of periodic manhole inspections if necessary based on previous inspection results; (iv) cable testing at least every six years, instead of every ten, to provide information about the condition of the conductor insulation; and (v) increased frequency of periodic cable testing, if necessary, based on test results and operating experience. Entergy March 28 Response, Exh. NYS000151. Entergy's revised AMP states that it "will be implemented prior to the period of extended operation." *Id.*, Attachment 1 at 12. This implementation schedule is consistent with NRC guidance to its staff reviewers of license renewal applications. That guidance, *Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants ("SRP")*, NUREG 1800, Final Report, December 2010(ML103490036), Exh. NYS000161, states that the first tests or first inspections for license renewal required by the AMP for non-EQ inaccessible power cables are to be "*completed* prior to the period of extended operation." *Id.* at Table 3.0-1, *FSAR Supplement for Aging Management of Applicable Systems at*

3.05-3.05-06 (Emphasis added).

In its revised AMP, Entergy provides no information about the location of the relevant cables, or their number, or the number of cable circuits, or the lengths of the cables or their function, or their physical characteristics, or the appropriate cable condition monitoring tests, or the acceptance criteria for the appropriate cable tests or the corrective actions, if any, if cables do not meet the acceptance criteria. Nor did Entergy amend its LRA to include an AMP for non-EQ inaccessible low and medium voltage cables exposed to other localized adverse environmental conditions, such as heat.

On August 30, 2011, the NRC Staff issued a Supplement to its Safety Evaluation Report for IP 2 and 3 and found that Entergy's AMP for Non-EQ Inaccessible Low and Medium Voltage Power Cables was acceptable. NUREG -1930, *Safety Evaluation Report Related to the License Renewal of Indian Point Nuclear Generating Unit Nos. 2 and 3*, Supplement No. 1, Docket Nos. 50-247 and 50-286 (August 2011) at 3-5 through 3-8 (ML11201A033), Exh. NYS000160.

POINT I

ENTERGY'S REVISED AMP FOR NON-EQ INACCESSIBLE LOW AND MEDIUM VOLTAGE POWER CABLES EXPOSED TO SIGNIFICANT MOISTURE DOES NOT DEMONSTRATE THAT THE EFFECTS OF AGING ON THE CABLES' INTENDED FUNCTION WILL BE ADEQUATELY MANAGED FOR THE PERIOD OF EXTENDED OPERATION

Entergy's revised AMP for non-EQ inaccessible low and medium voltage cables exposed to significant moisture suffers from the same defect as its initial AMP -- it fails to provide a specific program that demonstrates to the Board that Entergy will adequately manage the cables' aging during the period of extended operation. To be sure, the revised AMP specifically incorporates the New GALL's more stringent versions of the specific

requirements that were contained in the 2005 GALL; it now applies to both non-EQ low and medium voltage cables and will incorporate the more stringent inspection and testing schedule contained in the New GALL. However, just as in its initial AMP, for everything else Entergy simply says its AMP will be consistent with the program contained in the New GALL.

However, the New GALL does not itself contain a specific aging management program for non-EQ inaccessible cables. Rather, it directs the Applicant to create such a plan for its facility to insure that the cables will continue to perform their intended function during the period of extended operation and provides guidance to the Applicant about how that might be accomplished. In particular, the New GALL expresses a major concern that "failures of deteriorated cable systems . . . might be induced during accident conditions," and that these cables therefore require an aging management program. New GALL at XI E3-1, Exh. NYS000147. Because the guidance in the GALL is based on "generic aging lessons learned," it is the Applicant's responsibility to apply the GALL's guidance to its specific situation in a specific aging management program that achieves the GALL's goals. As the Commission stated in *Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. (Vermont Yankee Nuclear Power Station)*, CLI-10-17, __N.R.C. __ (July 8, 2010) slip op. at 46-47, an Applicant may commit to implement an AMP that is consistent with the GALL, "but must demonstrate *prior* to issuance of a renewed license" that its AMP is in fact consistent with GALL. (Emphasis in original).

Moreover, as the Board has already held in this proceeding, a promise to create such a specific plan in the future cannot *demonstrate* before the license is renewed that the aging effect will be adequately managed. *Entergy Nuclear Operations, Inc.* (Indian

Point Nuclear Generating Units 2 and 3), LBP-08-13, at 41, 68 N.R.C. 43 (July 31, 2008).

Entergy thus cannot simply rely on its commitment to incorporate the New GALL's attributes in a plan yet to be created to demonstrate that it will adequately manage the effects of aging on non-EQ inaccessible cables exposed to significant moisture. It must now present a plan that includes its criteria for designating the relevant cables, and selecting among the possible cable tests and possible corrective measures presented in the New GALL and must demonstrate that its plan meets the goals and objectives of GALL. Thus, for instance, because the New GALL requires a plan that provides reasonable assurance that the component will perform its intended function for the period of extended operation, and avoid a deteriorated cable failure during an accident, the lower cost or greater ease of implementation of a cable test or a corrective measure cannot be selection criteria unless they provide the same level of assurance as more expensive or more difficult measures.

A. Entergy Must Describe The Corrective Actions It Will Take After Inspections Reveal that Water is Accumulating in Manholes or Other Accessible Locations of Inaccessible Cable Circuits

Preventing cable insulation degradation caused by moisture in the first instance is a more effective aging management program than testing the condition of cables whose insulation has already degraded and determining whether to repair or replace them.

Because water trees⁸ cannot form in a cable in the absence of water, and electrical trees

⁸ Moisture can migrate into the insulation of cables that are not qualified to be wetted or submerged, and form channels in the insulation that resemble trees. A partial discharge of electricity can occur at the location of these "water trees." These partial electrical discharges will eventually burn the water tree channels, and form "electrical trees" which eventually will cause a break-down in the insulation and a cable failure.

do not generally form in the absence of water trees, a robust program for preventing water accumulation in the raceways is essential. Bascom Report at 26; Pre-Filed Testimony at 24. Entergy's AMP does not describe such a program. Entergy simply adopts the schedule of manhole inspections contained in the New GALL and otherwise states that the AMP will be consistent with the New GALL's attributes.

However, the New GALL lists some corrective measures such as installation of permanent drainage systems, installation of sump pumps and alarms, more frequent cable testing or manhole inspections or replacement of the affected cable. Entergy does not mention any of these corrective measures, much less commit to any of them. In order to demonstrate that the aging effects caused by moisture will be adequately managed, Entergy must describe and justify the criteria it will use to determine whether drainage systems or sump pumps will be installed to prevent moisture from accumulating in the cable circuits, or whether cables will be replaced that have been consistently submerged during the periodic manhole inspections or whether additional manhole inspections will be the only corrective measure when water is observed. Without describing its corrective measure criteria, Entergy leaves open the possibility that it will do nothing to prevent cables from being repetitively exposed to significant moisture. Entergy has therefore not demonstrated that it will adequately manage the effects of aging.

B. Entergy Must Describe the Characteristics of the Relevant Cables, and Select A Cable Testing Method that is Appropriate for the Cable's Characteristics

The New GALL lists eight techniques, one or more of which an applicant can use "to assess the condition of the cable insulation with reasonable confidence." New GALL at XI E3-1, Exh. NYS000147. However, these techniques are not fungible; some will

Bascom Report at 12-13; Pre-Filed Testimony at 13-14.

work on certain types of cables but not on others or will not provide sufficient information about the condition of the insulation through the cable's length. As the Brookhaven National Laboratory stated in a report about cable monitoring tests prepared for the NRC, "the characteristics of the cable to be monitored must be considered in selecting an appropriate technique." The relevant cable characteristics identified by Brookhaven include cable voltage rating, cable insulation/jacket material, cable shielding and cable location. NUREG/CR-7000 at 3-20, Exh. NYS000148.

If Entergy had produced a specific aging management program, it would have described the relevant cables and explained which of these tests it would use on which type of cables. It did not. In its revised AMP, Entergy provides no information about the characteristics of the non-EQ cables exposed to significant moisture nor does it select cable monitoring tests that are appropriate for those characteristics. Echoing its initial insufficient AMP, Entergy simply states that its revised AMP will be consistent with the New GALL when the New GALL simply provides a list of test methods from which the Applicant must select an appropriate one. Entergy's failure to describe the relevant cable types and to select appropriate cable condition test methods for each type of cable prevents the Board from determining whether Entergy will select an effective test for a particular type of cable.

The critical characteristic in determining the appropriate cable condition monitoring test is whether the cable is shielded or unshielded. As set forth in Earle Bascom's Expert Report and testimony, some tests, such as Partial Discharge ("PD") or Time Domain Reflectometry ("TDR") provide the most information about the condition of non-EQ inaccessible medium voltage *shielded* cables because both methods can

localize the possible problems in a cable and, to an extent, evaluate the severity of the insulation degradation caused by water intrusion, water trees or electrical trees. They are generally non-destructive because the tests can be performed with up to rated voltage. Bascom Report at 18; Pre-Filed Testimony at 19.

However, as Mr. Bascom testifies, the condition of the insulation of *unshielded* cables cannot be successfully assessed by PD or TDR past a few hundred feet because signal loss becomes too great at greater lengths. Because low voltage cables are generally unshielded, neither PD nor TDR is an appropriate method to test the condition of their insulation. Bascom Report at 18, 20; Pre-Filed Testimony at 21-22; NUREG/CR- 7000 at 3-8, Exh. NYS000148. Similarly, PD testing on cables with helical-taped metallic shields becomes less effective as the shielding ages while metallic shield wires provide better long term consistency in testing. Bascom Report at 18, 20; Pre-Filed Testimony at 21-22. Thus, Entergy must provide in its AMP objective criteria for the use of PD or TDR testing to insure that these tests will be used only where appropriate on shielded cables and thus be capable of providing accurate information about the integrity of the conductor insulation.

The condition of the conductor insulation of unshielded low-voltage cables can be tested with voltage withstand tests, such as AC Voltage Withstand or Very Low Frequency (VLF). Bascom Report at 17,19; Pre-Filed Testimony at 17-18, 22. These are considered "pass/fail" tests. The cable is exposed to a high test voltage to demonstrate that the insulation can withstand a voltage potential higher than expected during service. If the cable withstands the high voltage, then it has "passed" the test and can remain in

service. NUREG/CR-7000 at 3-7, Exh. NYS000148. If it fails, then it must be repaired or replaced. Bascom Report at 17; Pre-Filed Testimony at 17.

As Mr. Bascom explains in his report and testimony, water trees do not necessarily cause an insulation break-down that leads to cable failure; in contrast, electrical trees eventually will. Thus, cables containing water trees may pass a voltage withstand test even though the water trees will eventually convert to electrical trees and cause a cable failure in the future. Bascom Report at 12-14; Pre-Filed Testimony at 18. VLF testing is a more appropriate voltage withstand test than AC Voltage Withstand because it more effectively converts water trees into electrical trees during the testing, thus driving the cable to failure so that a repair or replacement can be done when the cable is not in operation. Bascom Report at 19; Pre-Filed Testimony at 15,18. Because VLF is not specifically included in the New GALL's list of cable monitoring tests, although it is also not excluded, Entergy's commitment that its program will be "implemented consistent with" the New GALL is likely to result in it failing to select an appropriate test for low voltage cables.

C. Entergy Must Explain Whether it Will Select Tests With Trendable Results Where Possible

The Board must also know whether the condition of the cable can be compared from test to test -- that is, whether the selected test's results are "trendable." While recognizing that not all test methods yield trendable results, the New GALL states that "trending actions" are part of the AMP for non-EQ inaccessible cables because trendable results "provide additional information on the rate of cable insulation degradation." New GALL at XI E3-3, Exh. NYS000147. If Entergy knew the rate of cable insulation degradation, it could know which cables to repair or replace *before* they failed. By

stating that "trending actions" are part of the AMP, the new GALL directs a license renewal applicant, such as Entergy, to select tests, wherever possible, with trendable results based on a cable's relative performance on the test over time.⁹ For example, Voltage Withstand Tests can be used on both shielded and unshielded cables. If Entergy were to select a Voltage Withstand test for its shielded cables, the pass/fail results cannot be trended because the test reveals nothing about the condition of the cable's insulation, but only whether it withstood the voltage on a particular occasion. Bascom Report at 25; Pre-filed Testimony at 20-21.

If, on the other hand, Entergy selected PD or TDR for its shielded cables, it could compare results from test to test on the same circuit to see if there are any changes in the traces. Bascom Report at 25; Pre-Filed Testimony at 21. Because Entergy has not committed in its AMP to use trendable tests whenever possible – i.e. whenever such tests are capable of providing accurate information about the condition of the cable's insulation -- Entergy has not demonstrated that it will proactively repair or replace degrading cables whenever possible and thus prevent them from failing during operation, when safety functions may be compromised.

D. Entergy Must Describe in the Revised AMP the Criteria It Will Use to Determine Whether the Results of the Cable Testing Are Acceptable

The New GALL's AMP for Non-EQ Inaccessible Cables has a section entitled "Acceptance Criteria" which states that "the acceptance criteria for each test are defined by the specific type of test performed and the specific cable tested." New GALL at XI

⁹ By contrast, other sections of the New GALL, such as Section XI.E.2 (the AMP for insulation on non-EQ cables used in instrumentation circuits) specifically state that "trending actions are *not* included in this AMP because the ability to trend tests is dependent on the specific type of test chosen." New GALL at XI E2-2 (Emphasis added), Exh. NYS000147.

E3-3, Exh. NYS000147. Because Entergy's revised AMP fails to specify the cable types or test methods, it also fails to define its acceptance criteria for tested cables. Thus it cannot be determined whether Entergy will interpret the test results in a way that leaves degraded cables in place that should be replaced or repaired. For example, if Entergy plans to use AC Voltage Withstand or VLF testing on particular cables, but has not specified what test voltages it will use on the cables based on their respective voltage classes, Entergy could apply a voltage below the cable's rated voltage so that a passing grade would be meaningless. Bascom Report at 26; Pre-Filed Testimony at 28.

Similarly, in the Partial Discharge Test, the partial discharges that occur at the location of degraded insulation are measured in picocoulombs. If Entergy applies the PD test to certain cables, it must explain what level of picocoulomb discharge is acceptable and what level is not. Otherwise, Entergy could select as an acceptance criterion, an unusually high partial discharge level that allows degraded cables to pass the PD test that would otherwise fail if an appropriate acceptance criterion were selected. Bascom Report at 26; Pre-Filed Testimony at 28. Because Entergy does not specify its criteria for determining when a cable has reached a level of degradation that requires a cable replacement, or the level of degradation that would require only more frequent re-inspection, Entergy cannot demonstrate that its AMP will meet the safety requirements of Part 54.

E. Entergy Must Describe in the Revised AMP, the Corrective Actions it Will Take If Insulation Degradation is Discovered as a Result of Cable Condition Monitoring Tests

The New GALL requires corrective action on non-EQ inaccessible low and medium voltage cables when "the test acceptance criteria are not met." New GALL at

XI.E3-3, Exh. NYS000147. Entergy has not, and, in fact, cannot describe when corrective action will be triggered because such actions depend on defined acceptance criteria, (which Entergy has failed to specify) for particular cable testing methods (which Entergy has failed to select).

Entergy's promise that its revised AMP will be implemented consistent with the New Gall cannot substitute for providing a specific corrective action plan. For example, the New GALL states that corrective actions after failed cable tests "may include, but are not limited to . . . more frequent cable testing or replacement of the affected cable." *Id.* In its revised AMP, Entergy has not specified under what circumstances its corrective action will be "more frequent cable testing" as opposed to "replacement of the affected cables" or justified the criteria it will use. It thus has not demonstrated that it will adequately manage the effects of aging because it has not explained its criteria for replacement of degraded cables.

F. Entergy Has Not Demonstrated That It Will Be Capable of Testing All the Non-EQ Inaccessible Power Cables Before the Period of Extended Operation

NRC Guidance for staff reviewing license renewal applications states that the cable tests and manhole inspections required by the AMP for non-EQ Inaccessible Power Cables must be completed before the period of extended operation. NUREG -1800, Rev. 2, Final Report, December 2010, *Standard Review Plan for Review of License Renewal Applications For Nuclear Power Plants*, Table 3.0-1 at page 3.0-5, Exh. NYS000161.

Entergy in its revised AMP commits to implementing those tests before the period of extended operation. However, Entergy has not provided information about the number of cables that need to be tested, and it is therefore not possible to know whether Entergy can accomplish this testing before the period of extended operation.

Entergy has provided no evidence that it has already begun the cable testing program. If it had, it should be disclosing the existence of documents related to the testing and no such documents have been disclosed. In the absence of any evidence to the contrary, the Board should assume that Entergy has not yet tested any of the relevant cables. Therefore, all the relevant cables must be tested before the periods of extended operation for IP 2 and 3. The current license for IP 2 expires in September 28, 2013 and for IP 3 in December 12, 2015, and if their licenses are renewed, their periods of extended operation begin after those dates. Thus, for IP 2, Entergy has approximately 20 months to complete the testing.

As Mr. Bascom explains in his report and pre-filed testimony, three to five partial discharge tests might be performed in a normal work day, depending on the accessibility of the cables, the locations of terminals, and the calibration of equipment, and allowing time for setup. Five to ten voltage withstand tests might be performed in a normal work day. Bascom Report at 24; Pre-Filed Testimony at 25-26.

Because Entergy has not specified the number of relevant cables, it is not clear how long the testing would take or whether Entergy is able to schedule enough hours of planned outage to accommodate the testing.

POINT II

ENTERGY HAS NOT PROVIDED AN AMP FOR NON-EQ INACCESSIBLE LOW AND MEDIUM VOLTAGE POWER CABLES EXPOSED TO EXCESSIVE HEAT

Entergy has not provided an AMP for non-EQ inaccessible power cables that are exposed to adverse localized environments such as excessive temperature or radiation as well as moisture. Nor has it shown that such an AMP is not necessary by demonstrating

that none of its inaccessible power cables are exposed to adverse localized environments other than moisture. Instead, Entergy's LRA simply echoes the language of Section XI.E1 of the New GALL's AMP for *accessible* non-EQ cables exposed to excessive temperature or radiation. That AMP proposes visual inspection of accessible cables every ten years for insulation surface anomalies, and the shielding, relocation or replacement of cables with severe anomalies that have been correlated with insulation degradation. Obviously inaccessible cables cannot be visually inspected and the only mention of them in the AMP for accessible cables is the suggestion that if an unacceptable condition is identified in an accessible cable, that the plant operator determine whether the same unacceptable condition applies to *inaccessible* cables. New GALL at XI E1-1, Exh. NYS000147. It provides no guidance about how that determination should be made and no corrective action should an unacceptable condition be found.

Because Entergy's LRA merely echoes the language of Section XI.E1 of the New GALL that is applicable to *accessible* cables, Entergy has not provided an AMP for inaccessible cables exposed to adverse environmental conditions such as excessive heat. As Mr. Bascom testifies, and states in his report, a non-EQ cable's insulation can be degraded by thermal stress whenever adverse temperature conditions cause it to operate above the cable system's normal rated temperature for an extended period of time. Bascom Report at 27-29; Pre-Filed Testimony at 29-34. This can occur in three situations. The thermal resistance of the soil through which the underground cable passes may be too high for the heat generated by the current to pass out of the cable and into the surrounding soil. The cable may pass through a localized environment that is hotter than

it was designed to withstand. Heat from other cables in close proximity, particularly in underground conduits, will cause the temperature to rise in the vicinity of the subject cable and cause a mutual heating effect. Bascom Report at 28-29; Pre-Filed Testimony at 30.

Nor is thermal stress on cable insulation an academic or hypothetical problem. The Sandia Report, *Aging Management Guideline for Commercial Nuclear Power Plants - Electrical Cable and Terminations*, described "thermal aging and embrittlement of insulation" as "one of the most significant aging mechanisms for low-voltage cable" (ML003759038). SAND96-0344 at 1-3, Exh. NYS000156. Because all of Indian Point's safety-related power cables are low voltage, Entergy's failure to present a specific plan to manage the effects of thermal aging of cable insulation on inaccessible low-voltage cables is a major failure to meet its burden to demonstrate to the Board that its safety-related low voltage cables will continue to perform their intended function during the license renewal period.

Mr. Bascom also explains that the location of hot spots in an inaccessible cable system can be identified with trendable cable condition monitoring tests that can be applied to inaccessible cables, just as the NRC suggests that infrared thermography be applied to accessible ones. For example, the inaccessible cables could be retrofitted with a fiber optic sensor that provides temperature readings along the length of the cable every meter (3.3 feet). The results of this test method, known as Distributed Temperature Sensing (DTS), can be compared over time and can reveal whether a hot spot in a cable is getting worse. DTS temperature sensing can also provide continuous temperature monitoring and thus give advance warning of an impending over-temperature condition

and the location of that condition. Bascom Report at 29-30; Pre-Filed Testimony at 32-33.

Discrete thermocouple temperature monitoring at known hot spots at inaccessible locations can also be used as an alternative to thermographic testing on accessible cables. The test is less comprehensive than DTS testing and requires that the sensors be installed at critical locations which must be determined in advance, but the results can be trended from test to test. Bascom Report at 29-30; Pre-Filed Testimony at 32-33. Entergy can identify the critical locations to be monitored through the use of an integrated approach that may include (a) the review of Environmental Qualification (EQ) zone maps that show radiation levels and temperatures for various plant areas, (b) consultations with plant staff who are cognizant of plant conditions, (c) the review of relevant plant-specific and industry operating experience. *See* New GALL at XI E1-1, Exh. NYS000147.

In sum, Entergy has neither provided an AMP for non-EQ inaccessible cables exposed to localized adverse condition such as excessive heat nor explained why such an AMP is not necessary at Indian Point Units 2 and 3. Its LRA is therefore deficient.

CONCLUSION

For all the reasons stated, Entergy's license renewal application should be denied because the application does not demonstrate that the effects of aging on non-EQ inaccessible low and medium voltage cables exposed to adverse localized environments will be adequately managed during the period of extended operation.

Respectfully submitted,

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