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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket Nos. 50-247-LR and 50-286-LR
ENTERGY NUCLEAR OPERATIONS, INC.	)	
(Indian Point Nuclear Generating Units 2 and 3)	)	March 28, 2012

APPLICANT'S STATEMENT OF POSITION REGARDING CONTENTION NYS-8 (ELECTRICAL TRANSFORMERS)

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Pursuant to 10 C.F.R. § 2.1207(a)(1) and the Atomic Safety and Licensing Board's ("Board") Order Granting NRC Staff's Unopposed Time Extension Motion and Directing Filing of Status Updates,[1] Entergy Nuclear Operations, Inc. ("Entergy") submits this Statement of Position ("Statement") on New York State ("NYS") contention NYS-8 concerning electrical transformers. This Statement is supported by the Direct Testimony of Applicant Witnesses Roger Rucker, Steven Dobbs, John Craig, and Thomas McCaffrey Regarding Contention NYS-8 (Electrical Transformers) ("Entergy Test.") (ENT000091), and the exhibits thereto (Entergy Exhibits ENT00015A-B and ENT000090 through ENT00130A-B). As discussed below, NYS-8 lacks merit and should be resolved in Entergy's favor.

I. PRELIMINARY STATEMENT

NYS claims that transformers should be subject to aging management review ("AMR") under 10 C.F.R. Part 54 because they allegedly function "without moving parts or without a

[1] Licensing Board Order Granting NRC Staff's Unopposed Time Extension Motion and Directing Filing of Status Updates at 1 (Feb. 16, 2012) (unpublished).

change in configuration or properties."[2] This position contravenes established scientific principles and long-standing regulatory precedent. NRC and industry guidance documents have long classified transformers as active components that are excluded from AMR, and the NRC has *never* reached a different conclusion in approving 40 license renewal applications for 71 reactor units to date.[3]

As Entergy's experts explain in the testimony filed on Entergy's behalf, the exclusion of transformers from Part 54 AMR has sound technical and regulatory bases. Transformers perform the intended function of transforming and supplying voltage and current to electrical busses.[4] When a transformer is energized from another electrical source, it changes from an idle state to an active state, and the electrical and magnetic properties of the transformer change.[5] These changes in electric and magnetic properties are integral to transformer operation, necessary for performance of the transformer's intended function, and can be directly measured or observed.[6]

A transformer is more similar to other electrical components in the AMR-excluded list in 10 C.F.R. § 54.21 because its terminal voltages and currents—like those of a power supply, battery charger, or power inverter—change as the transformer performs its intended function (*i.e.*, transformation of the input voltage and current to some other form and/or value of voltage and

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[2] *See* New York State Notice of Intention to Participate and Petition to Intervene at 103 (Nov. 30, 2007) ("NYS Pet."); *see also* Pre-Filed Written Testimony of Dr. Robert C. Degeneff Regarding Contention NYS-8 at 17:3-17:7 (Dec. 12, 2011) ("Degeneff Test.") (NYS000003); Report of Dr. Robert C. Degeneff in Support of Contention NYS-8, at 23 (Dec. 12, 2011) ("Degeneff Report") (NYS000005).

[3] Entergy Test. at A24 (ENT000091).

[4] *Id.*

[5] *Id.*

[6] *Id.*

current) and can be directly measured and monitored.[7] Therefore, transformers properly are excluded from AMR under 10 C.F.R. Part 54.[8]

NYS's contrary arguments are technically unsound. First, NYS's proffered expert, Dr. Robert Degeneff, uses the terms "static" and "passive" interchangeably, even though the term "static" is not used in Part 54 or its regulatory history, or in NRC guidance implementing Section 54.21.[9] Moreover, he relies on definitions of those terms that are not applicable to the classification of components under Section 54.21(a)(1) for reasons explained further below.[10] Simply put, the classification of transformers as passive components under Part 54 is erroneous.[11]

In addition, Dr. Degeneff's comparisons of transformers to components explicitly listed in Section 54.21(a)(1)(i) are technically unsound and inconsistent.[12] These defects in Dr. Degeneff's component comparisons seem to stem from his failure to utilize a definition of "property" that is consistent with the Part 54 meaning of that term.[13]

Entergy's testimony identifies and explains numerous examples of Dr. Degeneff's flawed conclusions.[14] A key example is Dr. Degeneff's flawed analogy between a pipe and a transformer.[15] Dr. Degeneff posits that pressure and flow are properties of water (or other fluids) in a pipe and, similarly, that voltage and current in a transformer are properties of electricity.[16]

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7 *Id.*

8 *Id.*

9 *Id.*

10 *Id.*

11 *Id.*

12 *Id.*

13 *Id.*

14 *See id.* at A77-95.

15 *See* Degeneff Test. at 18:19-19:17 (NYS000003).

16 *Id.* at 19:15-19:23.

However, as Entergy's expert explains, a "property" is something that is inherent to an object.[17] Pressure and flow are *not* properties of water, and voltage and current are *not* properties of electricity, because they all must be created by some external force.[18] Using Dr. Degeneff's pipe analogy, the change in water pressure in the pipe is actually due to the forces exerted on the fluid by the pipe; *i.e.*, water pressure is *not* a property of the fluid itself as Dr. Degeneff asserts.[19] In comparison, a transformer's terminal voltages and currents are properties of the transformer, not properties of the electricity passing through it.[20] Specifically, the terminal voltages and currents of the transformer are a direct result of transformer operation and depend on the terminal characteristics of the transformer, which themselves depend upon the magnetic characteristics of the transformer and the changing magnetic field.[21]

NYS's argument that age-related degradation in transformers is not readily monitored also lacks support. Degradation of a transformer's ability to perform its *intended function* is readily monitorable by a change in the electrical performance of the transformer and the associated circuits.[22] For example, at IPEC, station operators monitor the in-service performance of large power transformers of the type cited by NYS by directly and continuously monitoring the status of voltage on the electrical busses.[23] If voltage conditions are outside the defined acceptable range, then operators in the control room are promptly alerted of the situation.[24] The circumstances

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17 Entergy Test. at A47 (ENT000091).

18 *Id.* at A50, A52.

19 *See id.* at A78.

20 *See id.* at A53, A68, A73.

21 *See id.* at A78.

22 *Id.* at A24, A55.

23 *See id.* at A116.

24 *Id.* at A116.

regarding the various examples of past transformer failure events at IPEC and other plants cited by NYS reinforce that the loss of functionality of large power transformers is readily detected by licensees and addressed under current programs and procedures. The functionality of those transformers is addressed as part of the current licensing basis for IPEC and through ongoing NRC regulatory processes, including the maintenance rule in 10 C.F.R. § 50.65.

Contrary to NYS's position, Part 54 focuses on component *functionality*, not on managing any and all postulated or potential aging mechanisms.[25] The Commission emphasized this point in the 1995 revisions to Part 54.[26] The Commission expressly "concluded that the focus on identification of aging mechanisms is not necessary because regardless of the aging mechanism, only those that lead to degraded component performance or condition (*i.e.*, potential loss of functionality) are of concern."[27]

In the 1995 rulemaking, the Commission further concluded that Part 50 programs and activities, including those required by the maintenance rule (10 C.F.R. § 50.65), along with the ongoing regulatory process, are adequate to manage the effects of aging on the functionality of active components.[28] Transformers—as active components—are no exception. Entergy has implemented performance monitoring and preventive maintenance programs designed to minimize loss of transformer functionality due to aging degradation mechanisms, including those mechanisms cited by NYS's expert.[29] Those programs, which are fully consistent with industry

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[25] *Id.*. at A35.

[26] *See* Final Rule, Nuclear Power Plant License Renewal; Revisions, 60 Fed. Reg. 22,461, 22,471, 22,475-476. (May 8, 1995) ("1995 License Renewal SOC") (NYS000016).

[27] *Id.* at 22,488.

[28] *Id.* at 22,471-72; *see also Entergy Nuclear Generation Co.* (Pilgrim Nuclear Power Station), CLI-10-14, 71 NRC 449, 454 (2010) (*quoting* 1995 License Renewal SOC, 60 Fed. Reg. at 22,472) ("Existing regulatory programs . . . can be expected to 'directly detect the effects of aging' on active functions").

[29] *Id.* at A108, A114.

guidance, are part of ongoing IPEC operations and subject to ongoing NRC oversight and inspections.[30]

Finally, NYS's statement that periodic replacement is not generally scheduled for transformers is irrelevant. As explained below, transformers must be considered active components under 10 C.F.R. §54.21(a)(1)(i) because they perform their intended functions through readily monitorable changes in their configuration or properties.[31] Consequently, they are not subject to AMR. In any event, IPEC has instituted large power transformer maintenance and replacement strategies that are consistent with maintenance rule requirements and industry guidelines.[32]

In conclusion, NYS has not met its burden to provide sufficient evidence to support its claim that transformers are "passive" components that require an AMP under Part 54. In contrast, Entergy's testimony demonstrates, by a preponderance of the evidence, that transformers are appropriately excluded from AMR under Part 54.

II. PROCEDURAL HISTORY OF CONTENTION NYS-8

On April 23, 2007, Entergy filed its application to renew the operating licenses for IP2 and IP3 for 20 years beyond their current expiration dates of September 28, 2013, and December 12, 2015, respectively. After a notice of opportunity for hearing was published in the *Federal Register* on August 1, 2007,[33] NYS filed a petition to intervene, proposing a number of

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30 *Id.* at A118.

31 *Id.* at A24.

32 *Id.*

33 Notice of Acceptance for Docketing of the Application and Notice of Opportunity for Hearing Regarding Renewal of Facility Operating License Nos. DPR-26 and DPR-64 for an Additional 20-Year Period, 72 Fed. Reg. 42,134 (Aug. 1, 2007).

contentions.[34]

NYS-8 alleged that the LRA violates 10 C.F.R. §§ 54.21(a) and 54.29 because it does not include an AMP for each electrical transformer whose proper function is important for plant safety.[35] As support, NYS relied principally on the declaration of Mr. Paul Blanch.[36] NYS and Mr. Blanch claimed that the management of these transformers is within the scope of license renewal because transformers allegedly perform their safety function without moving parts or without a change in configuration or properties.[37] They further claimed that a failure to properly manage these transformers may compromise (1) the integrity of the reactor coolant pressure boundary; (2) the capability to shut down the reactor and maintain it in a safe shutdown condition; or (3) the ability to prevent or mitigate the consequences of accidents.[38]

On January 22, 2008, Entergy and the NRC Staff filed answers opposing the admission of NYS-8.[39] Citing the list of AMR-excluded components in § 54.21(a)(1)(i), NRC-approved guidance, and extensive regulatory precedent, they contended that transformers are properly excluded from an AMR under Part 54.[40]

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34 *See* NYS Pet. at 103; *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 & 3), LBP-08-13, 68 NRC 43, 57-58 (2008).

35 *Id.* at 103.

36 *See* Declaration of Paul Blanch (Nov. 28, 2007) ("Nov. 2007 Blanch Decl.").

37 NYS Pet. at 103.

38 *Id.* at 103-04.

39 Answer of Entergy Nuclear Operations, Inc. Opposing New York State Notice of Intention to Participate and Petition to Intervene at 69-73 (Jan. 22, 2008) ("Entergy Answer"); NRC Staff's Response to Petitions for Leave to Intervene Filed by (1) Connecticut Attorney General Richard Blumenthal, (2) Connecticut Residents Opposed to Relicensing of Indian Point, and Nancy Burton, (3) Hudson River Sloop Clearwater, Inc., (4) the State of New York, (5) Riverkeeper, Inc., (6) the Town of Cortlandt, and (7) Westchester County (Jan. 22, 2008) at 44-46 ("NRC Staff Answer").

40 Entergy Answer at 70; NRC Staff Answer at 45.

On July 31, 2008, the Board admitted NYS-8 "to the extent that it questions the need for an AMP for safety-related electrical transformers that are required for compliance with 10 C.F.R. §§ 50.48 and 50.63."[41] The Board further noted that:

> 10 C.F.R. § 54.21(a)(1)(i) lists components that require AMPs and also excludes other components that do not require AMPs. In addressing this contention, the Board will require, *inter alia*, representations from the parties to help us determine *whether transformers are more similar to the included, or to the excluded, component examples*.[42]

The Board also cited the need for an explanation on how a transformer changes its configuration or properties in performing its functions.[43]

On August 14, 2009, Entergy filed a motion for summary disposition of NYS-8 supported by three expert declarations.[44] Entergy contended that, because transformers perform their intended functions through changes in their voltage and current properties, they are properly excluded from an AMR under Part 54, consistent with the NRC Staff's long-standing regulatory position and Commission guidance contained in the 1995 License Renewal SOC. In its September 14, 2010 answer, the NRC Staff supported Entergy's motion in full.[45] Thereafter, on September 23, 2009, New York filed its opposition.[46] NYS maintained its position that transformers perform "passive" intended functions, and that current NRC-mandated monitoring programs (in lieu of AMPs) cannot effectively address the effects of aging-related degradation.

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41 *Indian Point*, LBP-08-13, 68 NRC at 89.

42 *Id.* (emphasis added).

43 *Id.*

44 Applicant's Motion for Summary Disposition of New York State's Contention 8 (Electrical Transformers) (Aug. 14, 2009).

45 NRC Staff's Answer to Applicant's Motion for Summary Disposition of New York Contention 8 (Sept. 14, 2009).

46 Response of the State of New York to Entergy's Summary Disposition Motion and NRC Staff's Supporting Answer (Sept. 23, 2009).

The Board denied Entergy's Motion on November 3, 2009, finding that there remained a genuine issue of material fact; *i.e.*, whether transformers perform their intended function "without a change in their configuration or properties,"[47] stating that it would resolve NYS-8 after a hearing on the merits.

On December 12, 2011, pursuant to the Board's Order Granting Unopposed Motion to Amend the Scheduling Order,[48] NYS filed its initial statement of position, the prefiled testimony of Dr. Robert Degeneff, and numerous exhibits related to NYS-8, including a report prepared by Dr. Degeneff.[49] Dr. Degeneff is the President of Utility Systems Technologies, Inc. in Latham, NY. According to his *curriculum vitae*, he holds a doctorate of engineering in electrical power engineering and has experience working, teaching, and researching in the power engineering field, with an emphasis on the electrical behavior and design of power transformers. However, Dr. Degeneff's *curriculum vitae* reflects no experience specific to the nuclear power industry or nuclear regulation, including the NRC's regulations in 10 C.F.R. Parts 50 and 54.[50]

NYS's principal arguments in support of NYS-8 are: (1) transformers are "passive" or "static" devices; (2) transformers are more similar to the AMR-included components than to the AMR-excluded components listed in § 54.21(a)(1)(i); (3) an AMP for transformers is required because age-related degradation in transformers is not "readily monitored;" and (4) transformers are not subject to replacement based on a qualified life or specified time period.[51]

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47 Licensing Board Memorandum and Order (Ruling on Motions for Summary Disposition) (Nov. 3, 2009) at 6 (unpublished).

48 Licensing Board Order Granting Unopposed Motion by the State of New York and Riverkeeper, Inc. to Amend the Scheduling Order at 1 (November 17, 2011) (unpublished) ("Amended Scheduling Order").

49 *See* New York State Initial Statement of Position, Contention NYS-8 ("NYS-8 Statement of Position") (NYS000002); Degeneff Test. (NYS000003); *Curriculum Vitae* of Dr. Robert C. Degeneff (NYS000004); Degeneff Report (NYS000005); *see also* Exhs. NYS000006 through NYS000044.

50 *See Curriculum Vitae* of Dr. Robert C. Degeneff (NYS000004).

51 *See generally*, NYS-8 Statement of Position (NYS000002).

Dr. Degeneff offers his testimony and associated report in support of NYS's arguments. He summarizes his opinion as follows:

> The transformer is a static device as defined by the IEEE [Institute of Electrical and Electronics Engineers] and its Transformers Committee. A transformer does not change its configuration nor its properties when it is performing its intended operation. Neither the physical and electrical configuration nor physical and electrical properties of a transformer change while it is operating. The transformer certainly does not change "state" when it is operating. Each of a transformer's key properties demonstrates that it is a passive device, which is long-lived if properly maintained and monitored by an aging management program that goes beyond the sort of remote monitoring up until now contemplated by Entergy.[52]

As demonstrated in Entergy's testimony on NYS-8 and summarized below, Dr. Degeneff's opinion, which draws from testimony prepared by NYS's former consultant (Mr. Paul Blanch) earlier in this proceeding, lacks a sound technical and factual foundation.[53]

III. APPLICABLE LEGAL AND REGULATORY STANDARDS

A. 10 C.F.R. Part 54 Requirements

Under the governing regulations in Part 54, the review of license renewal applications is confined to matters relevant to the period of extended operation requested by the applicant. The Commission has stated that "[a]djudicatory hearings in individual license renewal proceedings will share the same scope of issues as our NRC Staff review, for our hearing process (like our Staff's review) necessarily examines only the questions our safety rules make pertinent."[54] The Commission has specifically limited its license renewal safety review to the matters specified in 10 C.F.R. §§ 54.21 and 54.29(a)(2), which focus on the management of aging of certain systems,

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[52] Degeneff Test. at 42:12-23.

[53] Although Mr. Blanch submitted declarations in support of NYS's original contention and its opposition to Entergy's 2009 motion for summary disposition of that contention, he did not submit any testimony on NYS-8.

[54] *Fla. Power & Light Co.* (Turkey Point Nuclear Generating Plant, Units 3 and 4), CLI-01-17, 54 NRC 3, 10 (2001); *see also* 1995 License Renewal SOC at 22,482 n.2 (NYS000016).

structures, and components ("SSCs"), and the review of time-limited aging analyses.[55]

10 C.F.R. § 54.4(a)(1)-(3) outline the three general categories of SSCs within the scope of license renewal. The first category consists of "safety-related" SSCs.[56] These are SSCs relied upon to remain functional during and following design-basis events to ensure the integrity of the reactor coolant pressure boundary, the capability to shut down the reactor and maintain it in a safe shutdown condition, or 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.[57]

The second category consists of all non-safety-related SSCs whose failure could prevent satisfactory accomplishment of any of the safety functions identified above.[58] For example, SSCs in this category would include non-safety auxiliary systems whose failure could impact the function of safety-related systems.

The third category consists of all SSCs relied on in safety analyses or plant evaluations to perform a function that demonstrates compliance with the NRC's regulations for fire protection (10 C.F.R. § 50.48), environmental qualification (10 C.F.R. § 50.49), pressurized thermal shock (10 C.F.R. § 50.61), anticipated transients without scram (10 C.F.R. § 50.62), and station blackout (10 C.F.R. § 50.63).[59] These SSCs would include, for example, equipment necessary to meet

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55 *See Turkey Point*, CLI-01-17, 54 NRC at 7-8; *Duke Energy Corp.* (McGuire Nuclear Station, Units I and 2), CLI-02-26, 56 NRC 358, 363 (2002).

56 10 C.F.R. § 54.4(a)(1).

57 *See* 10 C.F.R. § 50.2 (defining "safety-related").

58 10 C.F.R. § 54.4(a)(2).

59 10 C.F.R. § 54.4(a)(3).

these regulations, as defined in a plant's final safety analysis report, such as a plant's fire protection systems.[60]

From among these three categories of in-scope SSCs, applicants must identify and list, in an integrated plant assessment, those structures and components subject to AMR. If a structure or component performs no intended function as defined in 10 C.F.R. § 54.4(a)(1)-(3), then it is not subject to AMR. 10 C.F.R. § 54.4(b). Section 54.21(a)(1)(i), in turn, further limits the structures and components subject to AMR to those structures and components that "perform an intended function [as defined in § 54.4(a)(1)-(3)] . . . without moving parts or without a change in configuration or properties" and that are not subject to replacement based on a qualified life or specified time period.[61]

Given the foregoing requirements, LRA preparation involves the following sequential, two-step process: (1) identification of the SSCs within the scope of the license renewal rule (as defined in 10 C.F.R. § 54.4) (also known as "scoping") and then, among those in-scope SSCs, (2) identification of the structures and components that are subject to AMR (also known as "screening").[62] Screening is part of an applicant's integrated plant assessment ("IPA") as defined in 10 C.F.R. § 54.21(a) and is performed to determine which structures and components in the scope of license renewal require AMR.[63] Section 54.21(a)(1)(i) also provides, as examples, lists of structures and components that do and do not require AMR under that regulation (referred to herein and in Entergy's testimony as the "AMR-included" and "AMR-excluded" lists).[64]

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60 Entergy Test. at A26 (ENT000091).

61 10 C.F.R. § 54.21(a)(i)-(ii).

62 Entergy Test. at A27 (ENT000091).

63 *Id.*

64 10 C.F.R. § 54.21(1)(1)(i); *see also* Entergy Test. at A28 & Tbl. 1 (ENT000091).

B. The Reasonable Assurance Standard

For safety issues, pursuant to Section 54.29(a), the NRC will issue a renewed license if it finds that actions have been identified and have been or will be taken by the applicant, such that there is *reasonable assurance* that the activities authorized by the renewed license will continue to be conducted in accordance with the CLB.[65]

Longstanding precedent makes clear that the reasonable assurance standard does not require an applicant to meet an "absolute" or "beyond a reasonable doubt" standard.[66] Rather, the Commission takes a case-by-case approach, applying sound technical judgment and verifying the applicant's compliance with Commission regulations.[67]

C. Commission Guidance on the Purpose and Application of the License Renewal Rule As Relevant to Electrical Transformers

1. Part 54 Regulatory History

The Commission publishes Statements of Consideration ("SOC") for major rules and amendments. The SOC accompanying the Commission's 1995 revisions to Part 54 provides information from the NRC Commissioners regarding the clarification of the intent or basis of the rule, including historical context and supplementary information regarding the rule.[68] Language in

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[65] 10 C.F.R. § 54.29(a).

[66] *AmerGen Energy Co. LLC* (License Renewal for Oyster Creek Generating Station), CLI-09-07, 69 NRC 235, 263 (2009), *aff'd sub nom. N.J. Envtl. Fed'n v. NRC*, 645 F.3d 220 (3d Cir. 2011); *Commonwealth Edison Co.* (Zion Station, Units 1 & 2), ALAB-616, 12 NRC 419, 421 (1980); *N. Anna Envtl. Coal. v. NRC*, 533 F.2d 655, 667-68 (D.C. Cir. 1976) (rejecting the argument that reasonable assurance requires proof beyond a reasonable doubt and noting that the licensing board equated "reasonable assurance" with "a clear preponderance of the evidence").

[67] *See Oyster Creek*, CLI-09-07, 69 NRC at 263; *Pilgrim*, CLI-10-14, 71 NRC at 465.

[68] *See* Entergy Test. at A33 (ENT000091) EPRI 1013475, at xxii; *see also id.* at 2-1, 5-9 to 5-10, 8-6, App. B at B-10 to -11, B-18 to B-19; NUREG-1800, Rev. 1 at 2.1-6 to 2.1-10.

the SOC addressing a regulation, having been at least implicitly endorsed by the Commission itself, is entitled to "special weight."[69]

The 1995 License Renewal SOC makes clear that the objective of the license renewal rule is "to supplement the regulatory process, if warranted, to provide sufficient assurance that adequate safety will be assured during the extended period of operation."[70] Licensees are required by Part 50 to develop and implement programs that ensure that conditions adverse to quality, including degraded SSCs, are promptly identified and corrected.[71] These licensee programs include self-inspection, maintenance, and technical specification surveillance programs that monitor performance and condition of plant SSCs.[72]

Importantly, the Commission concluded that "the existing regulatory process, existing licensee programs and activities, and the maintenance rule provide the basis for generically excluding structures and components that perform *active functions* from an aging management review."[73] The Commission expects existing programs and requirements, including required maintenance programs, to "directly detect" the effects of aging on structures and components performing "active" required functions.[74] Consequently, a Part 54 AMR does not encompass all aging-related issues, but only aging-related degradation of "passive" structures and components that perform intended functions.[75] Structures and components are properly categorized as "passive" only if "they perform their intended function without moving parts or without a change

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69 *Long Island Lighting Co.* (Shoreham Nuclear Power Station, Unit 1), ALAB-900, 28 NRC 275, 290-91 (1988), *review declined*, CLI-88-11, 28 NRC 603 (1988).

70 1995 License Renewal SOC at 22,464 (NYS000016).

71 *Id.* at 22,475.

72 *Id.*

73 *Id.* at 22,476 (emphasis added).

74 *Pilgrim*, CLI-10-14, 71 NRC at 454 (*citing* 1995 License Renewal SOC at 22,472).

75 *Id.*

in configuration or properties *and* the effects of aging degradation for these components *are not readily monitorable*."[76]

In 10 C.F.R. § 54.21(a)(1)(i), clarification "for which aging degradation is not readily monitored" is not expressly included. Instead, two lists of components are provided.[77] These lists provide clarification by listing examples of (1) components that are included in an AMR because aging degradation in them is not readily monitored, and (2) components that are excluded from an AMR because aging degradation in them is readily monitored.[78]

In defining "active" (AMR-excluded) and "passive" (AMR-included) components, the Commission explained that "active functions" include those functions "where the parameter of concern (required function), including any design margins, can be directly measured or observed."[79] For example, a pump or valve has moving parts, an electrical relay can change its configuration, and a battery experiences monitorable changes in its terminal voltages.[80] Therefore, the performance or condition of these components is "readily monitored" and would not be captured by the description of AMR-included components in § 54.21(a)(1)(i).[81] For passive components, "the relationship between the measurable parameters and the required function is less directly verified."[82]

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76 1995 License Renewal SOC at 22,477; *see also Pilgrim*, CLI-10-14, 71 NRC at 454 (*citing* 1995 SOC, 60 Fed. Reg. at 22,471-72; 22,476-77) ("Detrimental effects of aging on passive functions of structures and components are less apparent than aging effects on active functions of structures and components.").

77 *See* 10 C.F.R. § 54.21(a)(1)(i)*;* 1995 License Renewal SOC at 22, 471, 22,477; Entergy Test. at A56.

78 Entergy Test. at A56 (ENT000091).

79 1995 License Renewal SOC at 22,471.

80 *Pilgrim*, CLI-10-14, 71 NRC at 454 n.17 (*citing* 1995 License Renewal SOC at 22,472).

81 1995 License Renewal SOC at 22,477.

82 *Id.* at 22,471.

In summary, in revising Part 54, the Commission emphasized its reliance on licensee monitoring and maintenance programs and its associated shift in focus from "managing aging mechanisms" to "managing the effects of aging on *functionality*."[83] Structures and components are classified as "active" if the changes in their properties "can be directly measured or observed."[84] Structures and components are classified as "passive" if aging-related changes in their properties are "not readily monitored."[85] Only passive components require AMR under Part 54.

2. The Commission's Recent *Seabrook* Ruling

In a decision (CLI-12-05) issued only weeks ago, the Commission cited extensively to the 1995 License Renewal SOC in reiterating the principles set forth above in the specific context of electrical transformers.[86] Specifically, in the *Seabrook* license renewal proceeding, the Commission reversed the Board's admission of a contention essentially identical to NYS-8 and supported by NYS's former consultant (Mr. Paul Blanch).[87] Quoting the 1995 License Renewal SOC, the Commission emphasized that "[f]unctional degradation resulting from the effects of aging on *active* functions is more readily determinable, and existing programs and requirements are expected to directly detect the effects of aging."[88] The Commission further emphasized that, in the 1995 License Renewal SOC, it had devoted "significant discussion" to defining a passive component to include only those components that perform an intended function without moving

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83 *Id.* at 22,476 (emphasis added).

84 *Id.* at 22,471.

85 *Id.* at 22,477.

86 *NextEra Energy Seabrook, LLC* (Seabrook Station, Unit 1), CLI-12-05, 75 NRC __, slip op. (Mar. 8, 2012)

87 *See id.*, slip op. at 18-27.

88 *Id.*, slip op. at 3 n.10 (emphasis added).

parts or without a change in configuration or properties *and* for which aging degradation is not readily monitored.[89]

Notably, the Commission also stated that "[l]ongstanding Staff guidance directly addresses the classification of electrical transformers for the purposes of license renewal, and has found them to be 'active' components."[90] The Commission discussed additional guidance issued by the Staff in 1997, in which the Staff addressed specifically whether electrical transformers (among other electrical components) are subject to AMR.[91] As summarized by the Commission:

> In its guidance, the Staff observed that 10 C.F.R. § 54.21(a)(1)(i) expressly excludes a variety of electrical and instrumentation and control components from an aging management review for license renewal, and stated that the exclusion "is not limited to" only these components. The Staff went on to state that it had considered aging management review requirements for transformers (among other components), and concluded that transformers are not subject to an aging management review. The Staff reasoned that transformers performed their intended function through a "change in state," by "stepping down voltage from a higher to a lower value, stepping up voltage to a higher value, or providing isolation to a load." The Staff also observed that degradation of a transformer's ability to perform its intended function would be "readily monitorable by a change in the electrical performance of the transformer and the associated circuits." Ultimately, the Staff recommended that NEI revise its guidance to indicate that transformers (among other components) do not require an aging management review. NEI's current guidance reflects the Staff position on transformers.[92]

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89 *Id.*, slip op. at 20 (*citing* 1995 License Renewal SOC at 22,477).

90 *Id.*, slip op. at 23-24.

91 *Id.*, slip op. at 20-21, 24 (discussing and quoting Letter from C.I. Grimes, Office of Nuclear Reactor Regulation, to D.J. Walters, NEI, "Determination of Aging Management Review for Electrical Components," Attach. at 1-4 (Sept. 19, 1997) ("Grimes Letter") (ENT000097)).

92 *Id.*, slip op at 21 (citations omitted).

In dismissing the intervenors' contention as lacking support, the Commission noted that the intervenors had "disregard[ed]" this Staff guidance and relied only on conclusory statements.[93] Thus, the Commission implicitly endorsed the Staff's 1997 guidance concerning transformers.

D. Burden of Proof

At the hearing stage, an intervenor has the initial "burden of going forward"; *i.e.*, it must provide sufficient evidence to support the claims made in the admitted contention.[94] The mere admission of the contention does not satisfy that burden.[95] Moreover, an intervenor cannot meet its burden by relying on unsupported allegations and speculation.[96] Rather, it must introduce sufficient evidence during the hearing phase to establish a *prima facie* case.[97] If the intervenor does establish a *prima facie* case, then the burden shifts to the applicant to provide sufficient evidence to rebut the intervenor's contention.[98] To prevail, the applicant's position must be supported by a preponderance of the evidence.[99]

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93 *Id.*, slip op. at 24.

94 *Oyster Creek*, CLI-09-07, 69 NRC at 269 (quoting *Consumers Power Co*. (Midland Plant, Units 1 & 2), ALAB-123, 6 AEC 331, 345 (1973) ("The ultimate burden of proof on the question of whether the permit or license should be issued is, of course, upon the applicant. But where, as here, one of the other parties contends that, for a specific reason . . . the permit or license should be denied, that party has the *burden of going forward* with evidence to buttress that contention. Once he has introduced sufficient evidence to establish a *prima facie* case, the burden then shifts to the applicant who, as part of his overall burden of proof, must provide a sufficient rebuttal to satisfy the Board that it should reject the contention as a basis for denial of the permit or license." (emphasis in original))); *see also Vt. Yankee Nuclear Power Corp. v. Natural Res. Def. Council*, 435 U.S. 519, 554 (1978) (upholding this threshold test for intervenor participation in licensing proceedings); *Phila. Elec. Co.* (Limerick Generating Station, Units 1 & 2), ALAB-262, 1 NRC 163, 191 (1975) (holding that the intervenors had the burden of introducing evidence to demonstrate that the basis for their contention was more than theoretical).

95 *See Oyster Creek*, CLI-09-07, 69 NRC at 268-70.

96 *See id.*; *see also Phila. Elec. Co.* (Limerick Generating station, Units 1 and 2), ALAB-857, 25 NRC 7, 13 (1987) (stating that an Intervenor may not merely assert a need for more current information without having raised any questions concerning the accuracy of the applicant's submitted facts).

97 *See Midland*, ALAB-123, 6 AEC at 345.

98 *See, e.g.*, *La. Power & Light Co.* (Waterford Steam Electric Station, Unit 3), ALAB-732, 17 NRC 1076, 1093 (1983) (citing *Midland*, ALAB-123, 6 AEC at 345).

99 *Pac. Gas & Elec. Co.* (Diablo Canyon Nuclear Power Plant, Units 1 & 2), ALAB-763, 19 NRC 571, 577 (1984).

IV. ARGUMENT

A. Energy's Witnesses

Entergy's testimony on NYS-8 is sponsored by the witnesses identified below. The testimony, opinions, and evidence presented by these Entergy witnesses are based on their technical and regulatory expertise, professional experience, and personal knowledge of the issues raised in NYS-8. Collectively, these witnesses will demonstrate that NYS-8 lacks merit.

1. Mr. Roger B. Rucker

Mr. Rucker is an independent Engineering Consultant in Russellville, Arkansas who focuses on electrical and instrumentation and control ("I&C") applications in nuclear power plants, particularly as they relate to operating license renewal. He holds a Bachelor of Science degree in Electrical Engineering from the University of Arkansas. Mr. Rucker is a licensed Professional Engineer in the State of Arkansas with over 22 years of experience. He provides technical services to Entergy's License Renewal Services Division at its Arkansas Nuclear One office. He is the License Renewal Electrical Lead for several Entergy nuclear power plant license renewals (including IPEC license renewal). Mr. Rucker's professional qualifications are described more fully in Entergy's testimony and in his *curriculum vitae* (ENT000092).[100]

Mr. Rucker prepared several documents that support the LRA. Those documents include the electrical AMR report, as well as the electrical portions of the (1) aging management program ("AMP") evaluation report, (2) scoping and screening report, and (3) operating experience review reports.[101] His testimony describes the processes that Entergy used to identify IPEC SSCs within the scope of the license renewal rule, and to determine which in-scope structures and components are subject to AMR.

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[100] Entergy Test. at A3 (ENT000091); *Curriculum Vitae* of Roger B. Rucker (ENT000092).

[101] Entergy Test. at A4 (ENT000091).

2. Dr. Steven E. Dobbs

Dr. Dobbs is an independent Engineering Consultant in Russellville, Arkansas with over 35 years of professional experience. He provides engineering consulting services with respect to electronics and computer applications, including their use in nuclear power plants. He holds a Ph.D. in Electrical Engineering, and has taught classes in Electrical Machinery that examined the theory and operation of transformers. Dr. Dobbs' professional qualifications are described more fully in Entergy's testimony and in his *curriculum vitae* (ENT000093).[102]

Dr. Dobbs' testimony provides a comprehensive explanation of why transformers must be classified as AMR-excluded components, and why this classification comports with the definitions of "active" and "passive" components provided in the Commission's 1995 License Renewal SOC and as implemented in 10 C.F.R. § 54.21. In particular, Dr. Dobbs demonstrates that a transformer's internal magnetic field and terminal voltages and currents are properties of the transformer that change as the transformer performs its intended function. He further shows that, like the AMR-excluded electrical components listed in § 54.21(a)(1)(i), transformers have terminal voltages and currents that can be directly measured or observed during operation. In doing so, Dr. Dobbs identifies numerous errors and inconsistencies in the testimony of NYS's proffered expert, including the use of inapplicable terms and technically-flawed comparisons of transformers to other electrical and non-electrical components.

3. Mr. John W. Craig

Mr. Craig is a Senior Nuclear Safety Consultant with Talisman International, LLC in Washington, D.C. A nuclear engineer by training, he has over 35 years of experience in nuclear regulatory and safety matters. As the former NRC Director of the License Renewal and

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[102] *Id.* at A7; *Curriculum Vitae* of Steven E. Dobbs (ENT000093).

Environmental Project Directorate responsible for managing license renewal activities in the Office of Nuclear Reactor Regulation ("NRR"), Mr. Craig has extensive knowledge of the NRC's license renewal regulations and process. Also, during his tenure as the NRR Associate Director for Inspection and Programs, NRR, he managed NRC inspection and oversight activities for all U.S. civilian nuclear power reactors. His professional qualifications are described more fully in Entergy's testimony and in his *curriculum vitae* (ENT000094).[103]

In conjunction with Mr. Rucker and Dr. Dobbs, Mr. Craig will testify that transformers are properly excluded from AMR under Part 54 because they perform readily monitored (active) intended functions. He will further testify that this conclusion is fully consistent with long-standing regulatory precedent, as manifested in key Staff correspondence and all NRC license renewal approvals to date. Mr. Craig also will explain how transformer operation and performance are appropriately addressed by current NRC Part 50 requirements (including the maintenance rule in 10 C.F.R. § 50.65) and ongoing NRC regulatory oversight programs.

4. Mr. Thomas S. McCaffrey

Mr. McCaffrey is the Design Engineering Manager at IPEC. He is responsible for the design engineering staff that maintains the IP2 and IP3 design bases and performs modifications of this equipment for the station. Mr. McCaffrey is a licensed Professional Engineer in the State of New York with approximately 20 years of experience, most of which has been in the nuclear power industry. By virtue of his IPEC-specific engineering experience and responsibilities, he is very familiar with IPEC electrical systems and Entergy fleet/site programs or procedures

[103] Entergy Test. at A10 (ENT000091); *Curriculum Vitae* of John W. Craig (ENT000094).

applicable to those systems. His professional qualifications are described more fully in Entergy's testimony and in his *curriculum vitae* (ENT000095).[104]

Mr. McCaffrey will testify on performance monitoring and preventive maintenance programs that Entergy has implemented to meet NRC Part 50 requirements. He also will testify on industry and IPEC-specific operating experience involving transformers.

B. Entergy's Evidence

In their testimony, Entergy's experts explain the many reasons why a Part 54 AMP is not required for transformers. Specifically, they provide a comprehensive explanation of why transformers properly are classified as AMR-excluded components under Part 54, and show that NYS's contrary position contains numerous errors and contradictions that seem to stem from NYS's use imprecise use of key terms and concepts. They also explain how Entergy has implemented performance monitoring and preventive maintenance programs at IPEC that are fully consistent with industry guidance and appropriate to monitor and assess the continuing functionality of IPEC transformers. Key aspects of their testimony are summarized below.

1. Describing Transformer Operation Requires Reference to a Transformer's Internal Magnetic Field and Terminal Voltages and Currents

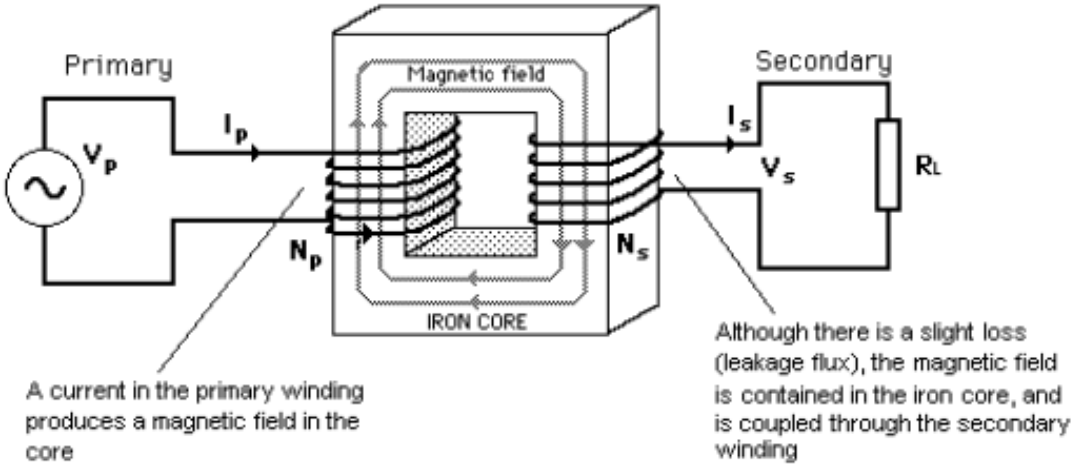
As Dr. Dobbs explains, describing the operation of a transformer necessarily requires reference to the (1) internal magnetic field and (2) terminal voltages and currents of the transformer in describing its operation.[105] A transformer is an electrical device that is used to convert alternating current ("AC") power at a certain voltage level to AC power at a different

[104] Entergy Test. at A13 (ENT000091); *Curriculum Vitae* of Thomas S. McCaffrey (ENT000095).

[105] Entergy Test. at A69 (*citing* Degeneff Report at 2; Degeneff Test. at 8).

voltage without changing the frequency, or which provides isolation to electrical circuits.[106] The intended function of a transformer is to step up voltage, to step down voltage, or to provide isolation between the input and output circuits.[107] As shown in Figure 1 below, in its simplest form, a transformer is formed by winding two coils of wire around some type of core, which usually is a material of high magnetic permeability (*e.g.*, iron or steel.)[108]

Figure 1. <u>Illustration of a Basic Transformer</u>



The winding used to input power to the transformer is called the primary winding, and the winding used to output power from the transformer is called the secondary winding.[109] An alternating current is used to excite the primary winding.[110] This current creates a magnetic field

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[106] *Id*. at A32, A42. Voltage, also referred to as electromotive force, is the measure of force that is created when unlike charges are separated. *Id.* at A52. It is the force that tries to drive the charges back together. *Id.* Current is simply the flow of charge when acted upon by an external force that is usually measured in volts. *Id.*

[107] *Id.* at A44.

[108] *Id.* at A43 & Fig. 1. In the figure above, V_P is the voltage applied to the primary coil, I_P is the primary coil current, V_S is the voltage created at the terminals of the secondary winding, and I_S is the current in the secondary winding.

[109] *Id.*

[110] *Id.*

in the core.[111] Because alternating current is used to drive the primary coil, the magnetic field produced in the core has a time-varying magnitude.[112] This time-varying magnetic field then induces a voltage in the secondary winding that is transferred to anything connected to that winding.[113] Whatever is connected to the secondary winding is usually referred to as the "load."[114]

The voltage at the output terminals of the transformer is determined by the input voltage of the source and how many turns of wire exist in the primary and secondary transformer windings. Similarly, the amount of current at the input terminals of the transformer is determined by the current drawn by the load and the number of turns of wire in the transformer windings.[115] The ratio of these turns is usually referred to as the "turns ratio" and determines whether the intended function of a transformer is to step up voltage, to step down voltage, or to provide isolation between the input and output circuits.[116] The input and output voltages and currents of a transformer change depending on the loading condition of the transformer.[117] These basic principles apply to all transformers, irrespective of how the transformer is constructed or the purpose for which it is used.[118]

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[111] *Id.*

[112] *Id.*

[113] *Id.*

[114] *Id.*

[115] *Id.*.

[116] *Id.* at A43, A44 & Tbl. 2.

[117] *Id.* at A45 & Tbl. 3. As used here, the term "load" refers to the amount of current being drawn from the secondary winding. *Id.* at A45. Increasing the load means that more current is being drawn from the secondary. Decreasing the load means that less current is being drawn from the secondary. *Id.*

[118] *Id.* at A46.

2. A Transformer's Internal Magnetic Field, Terminal Voltages and Currents, and Turns Ratio Are Properties of the Transformer

As Dr. Dobbs further explains, a property is a characteristic or trait of an object that is inherent to the object.[119] It is not possible to fully describe or understand an object without consideration of its properties.[120] The magnetic field, terminal voltages and currents, and the turns ratio are properties of a transformer because they are inherent to the description and operation of a transformer.[121] As is evident from NYS's own description of transformer operation, explaining how a transformer operates invariably requires consideration of those concepts and use of these terms.[122]

A transformer's internal magnetic field is what makes transformer operation possible.[123] The terminal voltages and currents create the internal magnetic field of a transformer.[124] The terminal voltages drive the terminal currents, which create the internal magnetic field.[125] Therefore, defining the magnetic field as a property requires that the associated terminal voltages and currents (which are tied the magnetic flux inside the transformer) be included as properties.[126] In addition, like virtually all electrical components, transformers are described by their terminal voltages and currents, *i.e.*, their terminal characteristics.[127] Further, because a transformer either

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[119] *Id.* at A47.

[120] *Id.*

[121] *Id.* at A53.

[122] *Id.* at A53, A69.

[123] *Id.* at A53.

[124] *Id.*

[125] *Id.*

[126] *Id.*

[127] *Id.*

transforms input voltage to some other voltage at the output or isolates voltage (both as a function of its turns ratio), the turns ratio of the transformer also is a property of the transformer.[128]

a. Contrary to NYS's Claim, A Transformer's Terminal Voltages and Currents Are Not Properties of the Electricity Passing Through the Transformer

A transformer's terminal voltages and currents are properties of the transformer—not of the electricity or power passing through it, as Dr. Degeneff claims.[129] As Dr. Dobbs explains, electricity is charge. It has no voltage or current unless it is acted on by some external force.[130] In electrical circuits the outside forces exist as loads and sources. A transformer is designed to act as both a load and a source and is designed to have specific voltages and currents at its terminals.[131] All terminal values depend on the terminal characteristics of the transformer, which themselves depend upon the magnetic characteristics of the transformer and the changing magnetic field.[132] Thus, the terminal voltages and currents and the magnetic field are properties of the transformer that change during operation.[133]

Dr. Dobbs further explains why NYS is incorrect in arguing that voltage and current are properties of the source of power being supplied to the transformer and of the load being served.[134] In short, voltage and current are not characteristics peculiar to power, whereas the terminal voltages and currents present in a transformer are peculiar to (and properties of) the transformer.[135]

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[128] *Id.*

[129] *Id.* at A73.

[130] *Id.* at A51-52, A73.

[131] *Id.* at A73.

[132] *Id.* at A78.

[133] *Id.*

[134] *Id*. at A74-75.

[135] *Id.* at A74.

b. Dr. Degeneff's Comparison of a Transformer to a Pipe Is Invalid

A major element of Dr. Degeneff's testimony is his analogy between a pipe (a passive component) and a transformer (an active component).[136] Specifically, he attempts to compare water flowing through a pipe of varying diameter (*i.e.*, a pipe nozzle) to voltage and current in a transformer, suggesting that the latter also is a passive component subject to AMR.[137] But as Dr. Dobbs convincingly shows, that analogy unravels under technical scrutiny. Indeed, it violates settled principles of fluid mechanics and electromagnetic field theory.[138]

Dr. Degeneff states that, although the properties (*e.g.*, pressure, flow) of fluids contained within piping may change, the properties of the pipe do not change as it performs its intended function.[139] But as Dr. Dobbs explains, according to accepted physical theory (*i.e.*, Bernoulli's equation), water pressure is created by the force (*e.g.*, gravity, a pump) that causes the water to flow in the pipe, and is transformed by a change in the diameter of the pipe—*not* by a property of the water itself.[140] Pressure and velocity thus are not inherent traits of water, and thus are not properly considered properties of water.[141] Indeed, this conclusion applies to any fluid.[142] Figure 10 in Entergy's testimony (reproduced below as Figure 2), summarizes the fundamental differences between a pipe nozzle and a transformer as it relates to determination of AMR classification under Part 54.

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136 *See* Degeneff Test. at 6:20-7:2, 13:5-13:10, 14:7-14:11, 18:19-19:17, 24:1-25:12 (NYS000003); Degeneff Report at 7, 10, 23-26, 29-30 (NYS000005).

137 *See*, *e.g.*, Degeneff Test. at 18:19-19:17 (NYS000003).

138 *See* Entergy Test. at A78 (ENT000091).

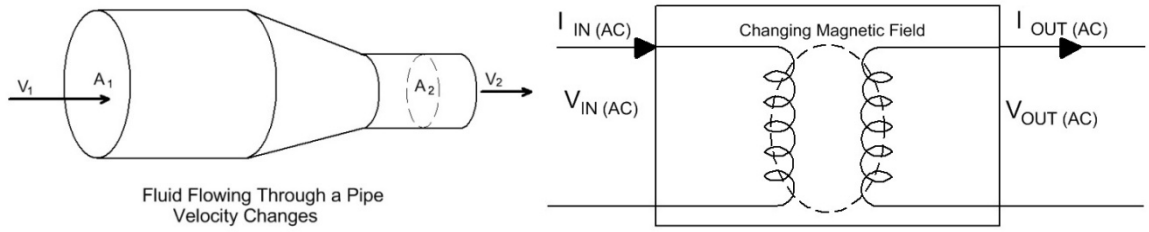
139 *See* Degeneff Test. at 19:2-19:6 (NYS000003); Degeneff Report at 7 (NYS000005).

140 Entergy Test. at A78 (ENT000091).

141 *Id.*

142 *Id.*

Figure 2. **Direct Comparison of Pipe Nozzle and Transformer**



PIPE NOZZLE	TRANSFORMER
The pipe properties do not change in any way when it performs its intended function.	The magnetic field of the transformer changes continuously when it performs its intended function.
The water that flows out at velocity V_2 is the same water that flowed in at velocity V_1 when the pipe performs its intended function.	The current that flows out when a transformer performs its intended function as I_{OUT} is new current that has been created by the magnetic field interacting with the secondary winding. I_{OUT} contains no part of the current $I_{IN.}$
The changes in the pressure and velocity of the fluid when the pipe performs its intended function are due to the forces exerted on the fluid by the pipe. If pressure and flow are deemed to be properties, then they must be properties of the pipe nozzle that changes them and not the fluid.	The terminal voltages and currents of the transformer when it performs its intended function are a direct result of transformer action. All terminal values depend on the terminal characteristics of the transformer, which themselves depend upon the magnetic characteristics of the transformer and the changing magnetic field. Thus, the terminal voltages and currents and the magnetic field are properties of the transformer that change during operation. It is the transformer that produces the change in voltage and current from the input to the output.
Regardless of any other function that piping might perform, all piping within the scope of 54.4 operates as a *pressure boundary*, a function that is specifically defined as passive by the 1995 License Renewal SOC (at 22,477) (NYS000016).	Transformers perform no function that is defined as passive by the 1995 License Renewal SOC. Instead, they transform voltage and current at the primary terminals to different voltage and current at the secondary terminals. This function is very similar to the functions performed by other electrical components without moving parts that are in the AMR-excluded list in § 54.21(a)(1)(i).

c. Dr. Degeneff's Comparison of a Transformer to "Two Cables Laid Parallel in a Raceway" Is Invalid

Dr. Degeneff claims that the equations describing the electrical performance of two parallel electrical cables "are exactly the same equations that describe the performance of a two

winding transformer with no iron core."[143] However, as Dr. Dobbs explains, although Maxwell's equations provide a basic description of all electromagnetic interactions, they do not substantiate the claim that two wires or cables in proximity to one another are equivalent to a transformer in form or operation.[144] The two components (parallel cables and transformers) are fundamentally different in design and operation (*i.e.*, a cable is not intended to provide voltage function like a transformer stepping or stepping down voltage, for example). Moreover, power plant cables are intentionally routed to minimize any such magnetic coupling between the cables.[145] In contrast, magnetic coupling between the primary and secondary windings in a transformer is maximized by design and transfers considerable power from the primary winding to the secondary winding.[146]

3. A Transformer's Internal Magnetic Field and Terminal Voltages and Currents Are Properties That Change as the Transformer Performs Its Intended Function

The internal magnetic field and the terminal voltages and currents of a transformer—which are properties of transformer—change as a transformer performs its intended function.[147] Transformers, therefore, meet the criterion in § 54.21(a)(1)(i) for exclusion from AMR. As discussed above, transformers are made with magnetic core materials, the magnetism of which can be changed by applying electric current to the primary winding.[148] A transformer's magnetism can be made to vary between very strong (full load) and very weak (no load).[149] In fact, a transformer is designed to change its magnetism, which clearly is a change in its properties and, in

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143 *See* Degeneff Test. at 18:12-18:15 (NYS000003); Degeneff Report at 7 (NYS000005).

144 *See* Entergy Test. at A77 (ENT000091).

145 *Id.*

146 *Id.*

147 *Id.*. at A54.

148 *Id.*

149 *Id.*

some cases, a change in state from being "On" to being "Off" (or vice versa).[150] The transformer cannot change the voltage and current at its output unless it also changes the strength of the magnetism in its core.[151] The change in magnetism that occurs in the transformer's core occurs automatically through external electric stimulus supplied by changes in the source and load.[152] These changes in the transformer's electromagnetic properties result directly from the transformer performing its intended function of supplying a load circuit with current at a specific voltage under varying conditions.[153] Therefore, it is a well-accepted principle of electromagnetic field theory that the properties of a transformer change as it performs its intended function.

4. Changes in a Transformer's Terminal Voltages and Currents Can be Directly Monitored During Transformer Operation, Such That Transformers Are Properly Excluded from AMR Under § 54.21(a)(1)(i)

Changes in the terminal voltages and currents of a transformer are readily monitorable while the transformer performs its intended function of providing voltage and current to a load.[154] Because the intended function of a transformer is to provide voltage and current to a load, and virtually all power plant loads vary in time, a power plant transformer can perform its intended function only with a change in properties.[155] This change in properties can be observed via directly measurable changes in the transformer terminal voltages and currents.[156]

Notably, these indisputable scientific facts formed the technical basis for the 1997 guidance provided by the NRC Staff to the industry, as discussed by the Commission in its recent

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150 *Id.*

151 *Id.*

152 *Id.*

153 *Id.*

154 *Id.* at A55.

155 *Id.*

156 *Id.*

Seabrook Order (CLI-12-05). In that guidance, the Staff concluded that transformers do not require AMR under 10 C.F.R. Part 54 because:

> Transformers perform their intended function through a change in state similar to switchgear, power supplies, battery chargers, and power inverters, which have been excluded in §54.21(a)(1)(i) from an aging management review. *Any degradation of the transformer's ability to perform its intended function is readily monitorable by a change in the electrical performance of the transformer and the associated circuits. . . .* Therefore, transformers are not subject to an aging management review.[157]

In accordance with the Staff's recommendation, the industry revised its principal license renewal guidance document, NEI 95-10,[158] to reflect the exclusion of transformers from AMR under §54.21(a)(1)(i).[159] Entergy followed the NRC-endorsed guidance in NEI 95-10 in its preparing its LRA and determining that transformers are not subject to AMR under Part 54.[160]

Furthermore, as described fully in Entergy's testimony, station operators continually monitor the in-service performance of large power transformers that are relied upon to perform the required functions identified in § 54.21(a)(1).[161] A failure in the ability of such transformers to perform those required functions will not go unnoticed or unaddressed under current programs.[162] For these reasons, the performance of transformers—which satisfy the definition of an "active" component and are thus generically excluded from an AMR—is assured through ongoing monitoring programs, including those programs implemented under the maintenance rule in 10 C.F.R. § 50.65.

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157 Grimes Letter, Attach. at 2 (ENT000097) (emphasis added).

158 NEI 95-10, "Industry Guideline for Implementing the Requirements of 10 CFR Part 54 – The License Renewal Rule," Rev. 6 (June 2005) (ENT000098).

159 Entergy Test. at A32 (ENT000091).

160 *See id.* at A38-40.

161 *Id.* at A116.

162 *Id.*

5. Contrary to NYS's Claims, Transformers Are More Similar to the AMR-Excluded Component Examples Listed in 10 C.F.R. § 54.21(a)(1)(i)

As Entergy's experts explain, the operative language in 10 C.F.R. § 54.21(a)(1)(i)—"without moving parts or without a change in configuration or properties"—must be read in conjunction with the component lists in that same regulation and the Commission's clarifying statements in the 1995 License Renewal SOC.[163] The failure to do so can lead to inconsistent and erroneous AMR component classifications of the type posited by NYS's expert and fully refuted in Entergy's testimony.[164]

The AMR-included list in § 54.21(a)(1)(i) contains such items as the reactor vessel, pressure boundaries, piping, component supports, valve bodies, penetrations, electrical cables, and electrical cabinets.[165] The intended functions performed by these structures and components are to maintain physical configuration and properties (*e.g.*, pressure boundary or structural integrity).[166] A common characteristic of these items is that each one's ability to perform its intended function is not directly verifiable by monitoring moving parts or a change in configuration or properties.[167] Instead, indirect measurements, tests, and observations are used to predict degradation of the item based on an analysis of this secondary information.[168] For example, the ability of a pipe to perform its intended function is monitored indirectly by measuring the thickness of the pipe's wall and inspecting it for signs of corrosion.[169]

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[163] *See id.* at A37, A96.

[164] *See*, *e.g.*, *id.* at A56,A95.

[165] *Id.* at A60.

[166] *Id.*

[167] *Id.*

[168] *Id.*

[169] *Id.*

In contrast, the list of AMR-excluded components includes such items as motors, diesel generators, pressure transmitters, pressure indicators, transistors, batteries, breakers, relays, switches, power inverters, battery chargers, and power supplies.[170] These items have properties or configurations that change or parts that move to perform the intended functions.[171] These changes can be directly observed or monitored.[172] The output fluid pressure of a pump, the output voltage and frequency of a diesel generator, the air pressure of a compressor, the output signal of a pressure indicator, the output voltage of a battery, the electrical output of a power supply, the position of a valve, and the status or condition of a relay all are readily monitored.[173]

As Dr. Dobbs explains, with regard to the electrical components listed in § 54.21(a)(1)(i), transformers are more similar to the AMR-excluded components (*e.g.*, transistors, batteries, power inverters, circuit boards, battery chargers, power supplies), in that the *terminal voltages and currents* directly indicate whether these components are performing their required functions.[174] From an AMR classification perspective, the construction details of these components are irrelevant.[175] The common characteristic of these electrical components is that each has terminal voltages and currents (*i.e.*, properties) that change as the component performs its required function, and which can be directly measured or observed.[176] The Commission's inclusion of transistors, power inverters, circuit boards, battery chargers, and power supplies in the 10 C.F.R. § 54.21(a)(1)(i) AMR-excluded list—without any details about their construction—indicates that

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170 *Id.*

171 *Id.*

172 *Id.*

173 *Id.*

174 *Id.*; *see also id.* at A76.

175 *Id.* at A61.

176 *See id.* at A60-61; *see also id.*, Fig. 2, at 43 (Comparison of Transformers to AMR-Included and AMR-Excluded Components).

terminal voltages and currents are correctly considered properties of these components.[177] Otherwise, there is no identifiable changing property or configuration to explain their explicit exclusion from AMR under Part 54.[178]

As Dr. Dobbs further explains, this is, in effect, a classic electrical engineering theory "black box" situation; *i.e.*, for each of the listed AMR-excluded electrical components, what matters is what is happening at the terminals, not inside the component itself.[179] Dr. Dobbs cogently illustrates this point by comparing a transformer to a transistor within the context of Part 54's AMR classification scheme.[180] He explains why the "change in resistivity" in a transistor is directly analogous to the change in the magnetic field inside a transformer.[181] In short, the changing magnetism in a transformer and the changing resistivity in a transistor are controlled from and visible at the terminals of their respective devices.[182]

Dr. Dobbs also refutes NYS's assertion that a transistor is distinguishable from a transformer because a transistor cannot perform its intended function without the application of a "control voltage" (*i.e.*, controlling a large amount of power using a small amount of power).[183] The presence of a control voltage is irrelevant to the Part 54 AMR classification of transistors, which are on the AMR-excluded list because their directly measurable properties (terminal voltage

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177 *Id.*

178 *Id.*

179 *Id.* at A62.

180 *See id.* at A62-64, A82-83.

181 *Id.* at A82.

182 *Id.* at A83.

183 *See id.* at A86.

and current)—like those of a transformer—change as transistors perform their intended function.[184]

In a related vein, Dr. Degeneff states: "Passive electrical devices, such as resistors, cables, connectors, capacitors, inductors, and transformers are not designed for or capable of power amplification, changing conductance, or otherwise changing the configuration or properties of the device based upon an external control signal."[185] But as Dr. Dobbs explains, an electrical device need not perform any of these functions based on an external control input or signal to be considered active under Part 54.[186] Indeed, circuit boards, batteries, battery chargers, and power supplies all are on the AMR-excluded list, yet none of these components necessarily performs any of the functions cited by Dr. Degeneff in his report.[187]

6. NYS's Interpretation of 10 C.F.R. § 54.21(a)(1)(i) Is Fundamentally Flawed, Disregards the Commission's 1995 License Renewal SOC, and Results in Erroneous AMR Classifications of Transformers

NYS alleges that transformers are "passive" components because they do not have moving parts and allegedly do not undergo a change in configuration or properties in performing their intended functions.[188] There is no regulatory or technical basis for NYS's position. The definition of "passive" adopted by Dr. Degeneff is not the definition provided by the Commission in the 1995 License Renewal SOC.[189] Further, Dr. Degeneff uses the terms "static" and "passive" interchangeably, even though the term "static" is not used in Part 54 or its regulatory history, or in

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184 *Id.*

185 Degeneff Report at 12-13 (NYS000005).

186 Entergy Test. at A86 (ENT000091).

187 *Id.*

188 *Id.* at A65.

189 *Id.*

any NRC guidance implementing Section 54.21.[190] Instead, Dr. Degeneff borrows definitions of static and passive from IEEE standards and electrical engineering texts that have no relevance or applicability to the license renewal-specific AMR classification of components under 10 C.F.R. § 54.21(a)(1)(i).[191]

In revising Part 54 in 1995, the Commission explained that "passive" components are those that perform their intended functions without moving parts or without a change in configuration or properties, *and* for which the aging degradation effects "are not readily monitorable."[192] The Commission specifically noted that "has reviewed several industry concepts of 'passive' structures and components and has determined that they do not accurately describe the structures and components that should be subject to an aging management review for license renewal."[193] It emphasized that its description of "passive" structures and components has been "incorporated into § 54.21(a)" and "should be used *only* in connection with the IPA review in the license renewal process."[194] Thus, NYS's use of the term "passive" is imprecise and contrary to the Commission's own definition of that term.[195]

Additionally, the list of components excluded from AMR includes several electrical components. Those components include transistors, power inverters, circuit boards, battery chargers, and power supplies.[196] As Dr. Dobbs explains, all of these items are excluded from an AMR because (1) they have terminal voltages and currents; (2) these terminal voltages and

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190 *Id.*

191 *Id.*

192 *Id.* at A56 (*quoting* 1995 License Renewal SOC at 22,477 (NYS000016)).

193 1995 License Renewal SOC, 60 Fed. Reg. at 22,477 (NYS000016).

194 *Id.* at A24, A65 (*quoting* 1995 License Renewal SOC at 22,477) (emphasis added); *see also id.* at A118 (ENT000091).

195 *Id.* at A65.

196 10 C.F.R. § 54.21(a)(1)(i).

currents are properties of the components that change as the components perform their required functions; and (3) changes in terminal voltages and currents are "readily monitorable" because they can be can be "directly measured or observed."[197]

Dr. Degeneff's flawed comparison of transformers to various electrical and non-electrical components listed in § 54.21(a)(1)(i) does not account for these critical facts.[198] With regard to electrical components, the premise that transistors are excluded from AMR because they are "active" solid state devices is unsupported.[199] He further posits, again without support, that because power inverters, battery chargers, power supplies, and circuit boards all have solid state devices in or on them, they too are "active" and excluded from AMR.[200] But as Dr. Dobbs explains, application of NYS's theory of "inherited exclusion" for the purposes of AMR classification would lead to misclassification of the electrical components specifically listed in § 54.21(a)(1)(i).[201] It is because transistors, power inverters, circuit boards, battery chargers, and power supplies have readily monitorable terminal voltages and currents that change as those components perform their intended functions that they are excluded from AMR.[202] The same is true of transformers.

In this regard, NYS's comparison between transformers and cables also is misplaced. Specifically, NYS cites the Commission's rejection of an industry group's (the Nuclear Utility Group on Equipment Qualification) 1994 request that electrical cables be excluded from the

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197 Entergy Test. at A57 (ENT000091).

198 *See, e.g.*, Entergy Test. at A94-95 (discussing the flawed methodology underlying the table, "Comparison of Various Structures and Components," which is appended to the Degeneff Report).

199 *Id.* at A95.

200 *Id.*

201 *Id. See also Hydro Res., Inc.*, LBP-06-1, 63 NRC 41, 57 (2006), *aff'd*, CLI-06-14, 63 NRC 510 (2006) (*citing United States v. Raynor*, 302 U.S. 540, 547 (1938)) (stating that it is a "canon of construction that, where possible, a regulation should be construed in a manner that avoids internal inconsistencies").

202 Entergy Test. at A95 (ENT000091).

AMR-included component list in 10 C.F.R. § 54.21(a)(1)(i) in support of this position.[203] The 1995 License Renewal SOC passage quoted by NYS, however, only reinforces the clear differences between transformers and cables and why they are classified differently under § 54.21(a)(1)(i). The Commission emphasized that cables are "properly categorized as 'passive' because they perform their intended function without moving parts or without a change in configuration or properties and the effects of aging degradation for these components are not readily monitorable."[204] As demonstrated in Entergy's testimony, the electromagnetic properties of a transformer change in a readily-monitorable way as its performs its intended function of transforming input voltage and current to some other form or value of voltage and current.[205]

Dr. Dobbs also explains why Dr. Degeneff's comparisons of transformers to AMR-included non-electrical components like pipes, heat exchangers, steam generators, reactor vessels, and containment structures are misguided.[206] The 1995 License Renewal SOC is explicit as to why those components are on the AMR-included list: they all perform the passive function of providing a pressure retaining boundary.[207] This fact alone is sufficient cause for their being included in the AMR-included list.

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[203] *See* NYS Statement of Position at 24-26 (NYS000002) (*citing* Letter from Malcolm Philips and William Horin, Nuclear Utility Group on Equipment Qualification, to John Hoyle, NRC, "Nuclear Power Plant License Renewal; Proposed Revision (59 Fed. Reg. 46574 (September 9, 1994)," at 2-4 (Dec. 8, 1994) (NYS000043); 1995 License Renewal SOC at 22,477-78 (NYS000016)).

[204] 1995 License Renewal SOC at 22,477 (NYS000016).

[205] Entergy Test. at A118 (ENT000091).

[206] *See id*. at A79.

[207] *Id.* (*quoting* 1995 License Renewal SOC at 22,477 (NYS000016)).

7. There is No Basis for NYS's Claim That Current IPEC Performance Monitoring Programs are Inadequate Such That a Part 54 AMP for Transformers is Necessary

a. NRC Regulations Require Reasonable Assurance of Component Functionality, Not Detection of "All" Aging Degradation Mechanisms

The license renewal rule requires "reasonable assurance" that SSCs are capable of performing their intended function during the period of extended operation—not detection of "all" aging degradation mechanisms in advance of failure as NYS incorrectly asserts. As Mr. Craig explains, although the intent of NRC regulations is to provide reasonable assurance that SSCs including transformers perform their intended function, they do not require applicants for initial or renewed operating licenses to prevent all transformer failures.[208] Indeed, the NRC's 10 C.F.R. Part 50 design requirements assume that transformer and other component failures may occur and, for that reason, include requirements for independence, redundancy and diversity as part of the NRC's defense-in-depth approach to providing reasonable assurance.[209]

Furthermore, the license renewal rule is intended to assure the identification and management of aging effects that are not addressed by Part 50 requirements and licensee programs.[210] In other words, the Commission chose to rely on ongoing licensee programs and the regulatory process to manage the effects of aging on structures and components that perform active intended functions, such as transformers. Accordingly, there is no basis for NYS's claim that an AMP must be implemented, as part of license renewal, to detect certain aging degradation of transformers. NYS provides no reason to conclude that a Part 54 AMP would be any more effective than IPEC programs and practices, which are fully consistent with industry (*e.g.*,

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[208] *Id.* at A107.

[209] *Id.*

[210] *See id.* at A36.

ANSI/IEEE, EPRI) guidance on transformer maintenance and testing. In fact, in approving 71 renewed operating licenses over the past 12 years, NRC has never concluded that a Part 54 AMP is necessary to replace or supplement licensee programs and practices as they relate to transformers.

In short, the effects of aging on the active intended functions of transformers are directly addressed through existing programs and requirements. In accordance with the maintenance rule (10 C.F.R. § 50.65) and other Part 50 provisions, Entergy has implemented preventive maintenance and performance monitoring programs for IPEC transformers.[211] Those programs are intended to ensure plant safety and reliability by identifying and correcting potential degradation issues, including age-related degradation, associated with electrical transformers.[212] NRC regulations require that that licensees' CLB programs and activities for managing the aging or reliability of components remain in effect during the period of extended operation.[213]

b. NYS's Criticisms of Entergy's Current IPEC Transformer Monitoring and Maintenance Programs Lack Merit and Relate to CLB Activities Governed by 10 C.F.R Part 50, Not By the NRC's Part 54 License Renewal Regulations

In its testimony and related exhibits, NYS focuses on large oil-filled transformers, which at IPEC, include the main transformers, station auxiliary transformers, unit auxiliary transformer and the Unit 3 GT autotransformer.[214] Mr. Rucker and Mr. McCaffrey explain that Entergy uses industry standard preventive and predictive maintenance techniques on its large oil-filled

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211 *See id.* at A108.

212 *Id.*

213 10 C.F.R. §§ 54.3(a), 54.29(a), 54.33(d); *see also* 1995 License Renewal SOC at 22,475 (NYS000016) ("Reasonable assurance that the function of important systems, structures, and components will be maintained throughout the renewal period, combined with the rule's stipulation that all aspects of a plant's CLB (e.g., technical specifications) and the NRC's regulatory process carry forward into the renewal period, are viewed as sufficient to conclude that the CLB (which represents an acceptable level of safety) will be maintained.").

214 *See* Degeneff Test. at 29:15-42:9 (NYS000003); Degeneff Report at 3, 14-22 (NYS000005); Exhs. NYS000017 to NYS000041; *see also* Entergy Test. at 108 (ENT000091).

transformers. Specific details on IPEC large power transformer inspection and maintenance practices are contained in Entergy Fleet Engineering Guide EN-EG-G-001, "Large Power Transformer Inspection Guidelines," Rev. 2 (ENT000121).

Entergy's experts further explain how these inspection and maintenance practices for IPEC large power transformers (1) address the specific aging degradation mechanisms and other concerns cited by Dr. Degeneff and NYS, and (2) are consistent with the methods recommended in NRC, EPRI, and IEEE documents cited by NYS.[215] Contrary to NYS's claim, Entergy does not rely only on "remote monitoring" of transformers.[216] For example, predictive and preventive maintenance techniques used on large oil-filled transformers include monitoring or assessment of the following: power factor; winding insulation resistance; capacitance; sweep frequency response analysis; leakage reactance; excitation current; transformer turns ratio; winding resistance; corona scan; hot collar (on applicable bushings); oil quality; oil dissolved gas analysis; furanic compound analysis in oil; thermography.[217] Entergy also performs visual inspections/cleaning of such transformers.[218] Mr. Rucker and Mr. McCaffrey note that the "invasive" inspections advocated by NYS are unnecessary and run directly counter to transformer inspection guidelines issued by EPRI.[219] Finally, they also explain that the IPEC main transformer failures that occurred in 2007 and 2010 (which NYS cites as evidence of the need for an AMP) were due to

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[215] *See id.* at A114 & Tbl. 4 (ENT000091).

[216] Degeneff Test. at 40:11-42:9 (NYS000003); Degeneff Report at 14 (NYS000005).

[217] Entergy Test. at A108 (ENT000091).

[218] Entergy Test. at A114; *see also* Entergy Fleet Engineering Guide EN-EG-G-001, Large Power Transformer Inspection Guidelines, Rev. 2 (ENT000121).

[219] Entergy Test. at A113 (ENT000091).

design/manufacturing defects in certain transformer bushings, not aging-related degradation of the transformers.[220]

It warrants emphasis that IPEC predictive maintenance results are monitored and trended to identify potential degradation of transformers.[221] Entergy, in fact, has used such results to develop the Indian Point Energy Center Large Power Transformer Life Cycle Management Plan (2011) (ENT000125), which provides reasonable assurance that the transformers operate satisfactorily until their planned replacement dates.[222] The plan is updated as necessary based on applicable operating experience and changing plant conditions to ensure that the IPEC large power transformer replacement and maintenance strategies continue to provide reasonable assurance that an in-service transformer failure due to aging degradation does not occur.[223]

Importantly, these programs and activities are part of the IP2 and IP3 CLB and subject to ongoing NRC oversight.[224] Because transformers are properly excluded from the AMR requirements of Part 54, any proposed augmentation or modification of these CLB programs is a matter that must be addressed under the Part 50 regulatory framework.[225] This proceeding is not the proper forum for challenging Entergy's CLB programs or seeking changes to the Commission's Part 50 regulations and associated regulatory processes.[226]

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220 *Id*. at A115.

221 *Id.* at [A108.

222 *Id.*

223 *Id.*

224 *Id.* at A117.

225 *See*, *e.g.*, *N. States Power Co.* (Prairie Island Nuclear Generating Plant, Units 1 and 2), CLI-10-27, __ NRC __, slip op. at 13 (Sept. 30, 2010) (noting that a petitioner's remedy relative to current operational concerns is to direct the Staff's attention to the supporting facts via a petition for enforcement action under 10 C.F.R. § 2.206).

226 10 C.F.R. § 2.335.

V. CONCLUSION

For the foregoing reasons, Entergy and the NRC Staff have correctly concluded that transformers are not subject to AMR and, therefore, do not require an aging management program under 10 C.F.R. Part 54. Accordingly, NYS-8 should be dismissed as lacking merit.

Respectfully submitted,

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Dated in Washington, D.C.
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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket Nos. 50-247-LR and
	)	50-286-LR
ENTERGY NUCLEAR OPERATIONS, INC.	)	
	)	
(Indian Point Nuclear Generating Units 2 and 3)	)	
	)	March 28, 2012

CERTIFICATE OF SERVICE

I certify that, on March 28, 2012, copies of Entergy's Statement of Position, Testimony, and associated exhibits on Contention NYS-8 (Electrical Transformers) were served electronically with the Electronic Information Exchange on the following recipients:

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