State of New York
Initial Statement of Position
Contention NYS-5

UNITED STATES
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

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 16, 2011

STATE OF NEW YORK'S INITIAL STATEMENT REGARDING THE ADEQUACY OF ENTERGY'S AGING MANAGEMENT PROGRAM FOR BURIED PIPES AND TANKS (CONTENTION NYS-5)

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INTRODUCTION

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 ("State") hereby submits its Initial Statement of Position on the State's admitted Contention 5 ("NYS-5") concerning buried piping. This Statement is supported by the testimony of Dr. David J. Duquette, Ph.D, and exhibits thereto. Dr. Duquette has submitted pre-filed testimony demonstrating that Entergy's Aging Management Program ("AMP") for buried and underground pipes and tanks is inadequate to manage the effects of aging of buried and underground pipes and tanks during the period of the proposed extended operation of Indian Point Units 2 and 3, including the pipes at Indian Point Unit 1 that are used by the Units 2 and 3.

SUMMARY OF ARGUMENT AND SUPPORTING EVIDENCE

As discussed in more detail below and in Dr. Duquette's accompanying testimony and expert report, the AMP for buried pipes is inadequate to manage aging of already deteriorating systems because: (1) Entergy does not know the current state of its buried and underground pipes; (2) the AMP contains ambiguous and insufficient commitments; (3) the AMP does not commit to any corrosion mitigation measures such as reactivating inoperative cathodic protection systems at Indian Point--despite recognition by virtually every authority on the subject that cathodic protection is the best way to prevent corrosion in soil conditions like those at Indian Point; and (4) Entergy has not addressed how it will manage aging of Unit 1's buried piping systems that are also utilized by Units 2 and 3.[1]

[1] Dr. Duquette explains in his testimony and report that Entergy defines underground pipes to

PROPOSED FINDINGS OF FACT

This Statement of Position along with its supporting evidence provides the bases for the Board to find the following facts regarding NYS-5:

1. Widespread corrosion in buried and underground pipes and tanks at nuclear power plants around the country have caused the NRC and the industry to seek better ways of preventing and mitigating corrosion.

2. Entergy submitted an AMP for buried pipes and tanks at Indian Point.

3. Entergy's AMP adheres to Section XI.M34 of a now-superseded version of NUREG 1801, the GALL Report, Revision One.

4. Section XI.M34 of the GALL Report, Revision One does not require cathodic protection.

5. NRC Staff has not requested that Entergy conform its AMP to NUREG 1801, Generic Aging Lessons Learned (GALL) Report, Revision Two.

6. Entergy's AMP for buried pipes contains virtually no enforceable provisions or specific commitments; any specific details Entergy has offered have come in the form of documents which will not become part of the license and are unenforceable.

7. Entergy's AMP is primarily an inspection program.

8. Entergy's AMP for buried pipes contains no acceptance criteria or other indication of what Entergy will do with the results of its inspections.

9. The GALL Report, Revision Two does require cathodic protection.

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include those that are, and are not, in direct contact with soil, and uses the term buried to refer to pipes which are in direct contact with soil. Dr. Duquette focuses his testimony on underground systems that are in direct contact with soil and so uses the term "buried."

10. Recent industry initiatives from the Nuclear Energy Institute, the Electric Power Research Institute, and individual utilities recognize cathodic protection as one of the best ways, if not the best way, to prevent corrosion in buried pipes.

11. Entergy took part in creating the NEI initiative and NEI expects that all utilities will implement a buried piping aging management plan in accordance with the intent of the initiative.

12. The majority of Indian Point's buried pipes are made of welded carbon steel, which are susceptible to corrosion.

13. Buried pipes are already corroding at Indian Point, sometimes causing radioactive water to leak into the groundwater and the Hudson River.

14. Notwithstanding this operating experience, Entergy has let nearly every installed cathodic protection system on buried pipes at Indian Point become inoperative.

15. Environmental conditions at Indian Point warrant the application of cathodic protection.

16. Entergy's AMP for buried pipes does not commit to any corrosion mitigation measures, for example, reactivating inoperative cathodic protection systems at Indian Point.

17. Entergy's AMP will not adequately manage aging buried pipes and tanks at Indian Point.

LEGAL STANDARDS

The NRC's license renewal regulations require Entergy to "demonstrate that … [t]he effects of aging on the intended function(s) will be adequately managed for the period of

extended operation."[2] 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).[3]

Therefore, those buried pipes, tanks, and transfer canals 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 that could result in potential offsite exposures, must be the subject of an AMP in license renewal.

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[2] 10 C.F.R. § 54.21.

[3] 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, Docket No. 50-293-LR (June 17, 2010) at 5-8.

The ultimate burden of proof in any adjudicatory proceeding remains with the applicant throughout the proceeding.[4]

Regulatory Commitments

Entergy has included certain information concerning its management of aging of buried pipes in its AMP, certain information in its list of regulatory commitments, certain information in its updated final safety analysis report ("UFSAR"), and certain information in statements made to the NRC via other means, including in corporate documents and responses to requests for additional information. As discussed below, the AMP contains the least in the way of specifics, but it is the most enforceable. Regulatory commitments and statements made in other formats are on the other end of the spectrum, as voluntary, unenforceable statements. As the NRC Inspector General has stated:

> One way NRC provides oversight of licensees is through the management of regulatory commitments (commitments), which are non-legally binding actions that the licensee agrees or volunteers to take. Licensees are responsible for creating, tracking, and handling all commitments made to NRC. Within NRC, the primary responsibility for managing commitments lies with Division of Operating Reactor Licensing (DORL) project managers in the Office of Nuclear Reactor Regulation (NRR).
> ***
> Commitments are neither legally binding nor obligations of a license; however, a commitment may be escalated into a legally binding obligation only if NRC staff deems that the commitment is essential for ensuring public health and safety.
> ***
> Licensees are responsible for creating, tracking, and handling all commitments made to NRC. The licensee is entirely responsible for tracking the commitments, and this includes any changes to the commitments and notification to NRC about

[4] *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).

such changes. NRC expects licensees to honor commitments in good faith. [5]

Thus, even the information Entergy has submitted as a commitment is merely a voluntary initiative, and many details Entergy has shared about what it intends to do to manage buried pipes come in the form of corporate documents, such as responses to requests for additional information ("RAIs"), which are not part of Entergy's AMP at all. Moreover, the NRC Inspector General recently audited the NRC's tracking of commitments and found that the NRC inconsistently implements the audits of licensee commitment management programs; that the definition and use of commitments is not consistently understood throughout the agency; and that NRC does not systematically track commitments because the agency does not have an adequate tool for tracking them.[6] The NRC Inspector General concluded that the NRC cannot completely ensure oversight of commitments.[7] If the NRC does not adequately track commitments, surely statements made in RAI responses or utility corporate documents are not adequately tracked. It is important to bear in mind this institutional backdrop when assessing the adequacy of the many varying forms of "commitments" Entergy has made in regard to management of aging of deteriorating buried pipes.

BURIED PIPING FAILURES RESULT IN LEAKS AT NUCLEAR POWER PLANTS AROUND THE COUNTRY

Numerous radioactive leaks from buried pipes at aging nuclear power facilities around the country have prompted the NRC and the industry to assess their capability of preventing and addressing such leaks. As the State noted in its Contention:

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[5] NRC Inspector General, Audit of NRC's Management of Licensee Commitments, OIG-A-17 (Sept. 19, 2011)(Exh. NYS000181).

[6] *Id*. at iii.

[7] *Id*.

• In August 2004, the owner of the Dresden Nuclear Power Plant in Illinois discovered an underground leak from the condensate storage tank piping. Tritium levels in onsite ground water monitoring wells were as high as 1,700,000 picocuries per liter.[8] A survey of neighboring private wells revealed tritium contamination in at least one well above background levels (approximately 1,000 picocuries per liter).[9]

• In December 2005, tritium was detected in a drinking water well at a home near the Braidwood Nuclear Plant in Illinois.[10] The "initial evaluation indicated that the tritium in the groundwater was a result of past leakage from a pipe which carries normally non-radioactive circulating water discharge to the Kankakee River, about five miles from the site.[11] Several millions [sic] gallons of water leaked from the discharge pipe in 1998 and 2000."[12]

• In March 2006, a leak was discovered at Palo Verde Nuclear Generating Station in Arizona.[13] An analysis of the ground water revealed tritium levels of 71,400 picocuries/Liter (pCi/L).[14] The Arizona Republic reported on March 4, 2006 that, "Arizona Public Service Co. discovered radioactive water near a maze of underground pipes at the Palo Verde Nuclear Generating Station…and tests confirmed that the water contains more than three times the acceptable amount of tritium."[15]

• In October 2007, high levels of tritium were detected in the groundwater under the Catawba Nuclear Power Station located in York, South Carolina.[16] At one groundwater monitoring well, the tritium measured 42,000 pCi/L.[17]

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[8] *See* NRC, Preliminary Listing of Events Involving Tritium Leaks (Mar. 28, 2006), ML060930382 (Exh. NYS000182).

[9] *Id*.

[10] *See* NRC Preliminary Notification of Event or Unusual Occurrence PNO-RIII-05-016A, "Potential Off-site Migration of Tritium Contamination (Update)" (Dec. 7, 2005), ML053410293 (Exh. NYS000183).

[11] *Id*.

[12] *Id*.

[13] *See* NRC Preliminary Notification of Event or Unusual Occurrence, PNO-IV-06-001, "Followup For Tritium Contamination Found In Water Onsite" (Mar. 17, 2006), ML060760584 (Exh. NYS000184).

[14] *Id*.

[15] *Radioactive Water Found at Palo Verde*, Ken Alltucker, The Arizona Republic (Mar. 4, 2006) (Exh. NYS000185).

[16] *See* NRC Preliminary Notification of Event or Unusual Occurrence, PNO-II-07-012, "Onsite Groundwater Tritium Contamination" (Oct. 11, 2007), ML073111396 (Exh. NYS000186).

[17] *Id*.

• That same week, high levels of tritium were discovered in the groundwater at the Quad Cities Nuclear Power Station located in Warrenville, Illinois. The tritium levels measure up to 800,000 picocuries per litre.[18] "Underground piping from the condensate water storage tank is being examined as a possible source."[19]

• Seven days later, on October 19, 2007, a leak was discovered in piping within the essential service water system that serviced both reactors at the Byron Nuclear Power Station located in Byron, Illinois.[20] The NRC then announced that it had begun a special inspection at the Byron Nuclear Power Station to review the circumstances surrounding the corrosion of piping in the equipment cooling water system and subsequent leak in one pipe.[21] As a result of the leakage, reactor operators shut both reactors down on Friday, Oct. 19, to repair the leak and inspect similar pipes.[22] The pipes carry water from the plant where it is used for cooling of essential safety equipment back to basins under fan-driven cooling towers.[23]

• Similar leaks have been detected at other nuclear power plants in New Jersey (Salem) and Connecticut (Haddam Neck/Connecticut Yankee) as well as the spent fuel pool at the Brookhaven National Laboratory on Long Island.[24]

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[18] *See* NRC Preliminary Notification of Event or Unusual Occurrence, PNO-III-08-011, "Tritium Leakage" (Oct. 11, 2007), ML072890262 (Exh. NYS000187).

[19] *Id*.

[20] *See* NRC Preliminary Notification of Event or Unusual Occurrence, PNO-III-07-012, "Both Units at Byron Shut Down Due to a Leak in Pipe" (Oct. 23, 2007), ML072960109 (Exh. NYS000188).

[21] *Id*.

[22] *Id*.

[23] *See* NRC Press Release, III-07-24, "NRC Begins Special Inspection at Byron Nuclear Station to Review Corrosion and Leakage of Equipment Cooling Water Pipe" (Oct. 23, 2007), ML072960643 (Exh. NYS000189).

[24] *See* NRC Office of Nuclear Reactor Regulation, "Spent Fuel Pool Leakage To Onsite Groundwater," NRC Information Notice 2004-05 (Mar. 3, 2004) (Salem, New Jersey, Nuclear Power Generating Station) (Exh. NYS000190); NRC Office of Nuclear Reactor Regulation, "Ground-Water Contamination Due to Undetected Leakage of Radioactive Water," NRC Information Notice 2006-13 (July 10, 2006) (discussing leaks at Haddam Neck/Connecticut Yankee and other nuclear power plants) (Exh. NYS000191); General Accounting Office, Information on the Tritium Leak and Contractor Dismissal at the Brookhaven National Laboratory (GAO/RCED-98-26) (Nov. 1997) (Exh. NYS000192).

On April 7, 2007, a visible steam plume vented up through the soil and pavement from an underground steam pipe that runs between Indian Point Unit 2 and Unit 3.[25] This breach was not reported to the NRC for approximately two weeks.[26] Tritium radionuclides were detected in the water molecules that vented from the pipe.[27] In addition, in the Fall of 2007, the NRC and Entergy confirmed that a leak developed in the concrete transfer canal between Unit 2 and its associated spent fuel pool. Water contaminated with radioactive nuclides leaked through the crack in the transfer canal.[28] As recently as 2009 a leak was detected in a carbon steel underground recirculating condensate storage line that resulted in a shutdown of the plant for seven days.[29] While no radioactive materials were nominally carried in the pipe that leaked, the function of the pipe is safety related and the pipes are now designated as high impact, medium corrosion risk, and high inspection priority.[30] The root cause analysis of the leak indicated that there was damage to the pipes' bituminous coating due to backfill.[31] The pipe was not cathodically protected (*see* discussion of cathodic protection, *infra*). Notably, an earlier assessment of the line indicated that the soil conditions, at the time of installation, did not

[25] *See* Greg Clary, *New Tritium Leak Found at Indian Point*, Poughkeepsie Journal News (Apr. 24, 2007) (Exh. NYS000193).

[26] *Id*.

[27] *Id*.

[28] *See* Email, Kathleen McMullin, Entergy, to Eugene Coby, *et al*., NRC, "IPEC status report for Sept. 6 2007," ML072970221(Exh. NYS000194).

[29] IPEC Report CR-IP2-2009-00666 (Exh. NYS000170). The majority of buried and underground pipes at Indian Point are welded carbon steel. *See* PCA Engineering, Corrosion/Cathodic Protection Field Survey and Assessment of Underground Structures at Indian Point Energy Center Unit Nos. 2 and 3 during October 2008 (IPEC00202131 *et. seq*) (Exh. NYS000178) ("PCA Report").

[30] *See* Testimony of David J. Duquette at 10.

[31] IPEC Report CR-IP2-2009-00666.

require active corrosion control.[32] As Dr. Duquette explains, "the failure of an inspection process and the assumption that the soil in contact with the pipe was non-corrosive, provides a cautionary tale about the condition of all of the buried piping at Indian Point."[33] According to Dr. Duquette, the determinations of soil resistivity and the ensuing recommendation were not sufficient to prevent the leak in the condensate storage tank return line (and incidentally, as discussed below, Entergy's proposed AMP, if implemented at the time, would not have prevented this corrosion either).[34]

RELEVANT NRC AND INDUSTRY GUIDANCE

Entergy's evolving AMP for buried pipes has taken shape against this backdrop as many changes in the industry are also taking place. There are currently at least three relevant industry initiatives, some of which Entergy had a hand in drafting, which represent the industry's expectations of what a sufficient AMP should contain. A summary of these relevant initiatives is below.

A. NRC Guidance

1. NUREG 1801: The GALL Report

The NRC has issued a NUREG document called the Generic Aging Lessons Learned (GALL) Report which offers an applicant guidance on AMPs.[35] This report was originally issued in 2001, was revised in 2005 ("GALL Report, Revision One") and updated again in

[32] IPEC Report CR-IP2-2009-00666 at 7 of 39.

[33] *See* Testimony of David J. Duquette at 10.

[34] *Id*.

[35] *See generally* NUREG 1801, Generic Aging Lessons Learned (GALL) Report (2001) (NYS Exh NYS00146A-NYS00146C) and NUREG 1801, Generic Aging Lessons Learned (GALL) Report (Dec. 2010 Final Report) (Exh. NYS00147A-NYS00147D).

December 2010 ("GALL Report, Revision Two").[36] The Commission has stated that "[a]n applicant may commit to implement an AMP that is consistent with the GALL Report and that will adequately manage aging. But such a commitment does not absolve the applicant from demonstrating, prior to issuance of a renewed license, that its AMP is indeed consistent with the GALL Report."[37] The Commission "do[es] not simply take the applicant at its word."[38] Moreover, where GALL is inadequate to address plant-specific conditions, compliance with GALL does not equate with compliance with the regulations; GALL is merely guidance.[39] Certainly, compliance with a superseded version of GALL, without meeting the requirements of the new GALL, cannot equate with compliance with the regulations.

a. GALL Report, Revision One, Section XI.M34

Entergy states that its AMP for buried pipes will be consistent with GALL, Revision One, Section XI.M34, Buried Piping and Tanks Inspection.[40] Like Entergy's AMP for buried pipes, Section XI.M34 contains very few details for a licensee to follow. In its entirety, Section XI.M34 requires an applicant to (a) take preventive measures to mitigate corrosion, and (b) conduct periodic inspections to manage the effects of corrosion on the pressure-retaining capacity of buried steel piping and tanks. Section XI.M34 calls for opportunistic inspections

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[36] *Id.*

[37] *Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc.* (Vermont Yankee Nuclear Power Station), CLI-10-17, Docket No. 50-271-LR (July 8, 2010) at 45.

[38] *Id.*

[39] *See Curators of University of Missouri*, CLI-95-1, 41 NRC 71, 98, 100 (1995)(it is well established that NUREGs and Regulatory Guides, by their very nature, serve merely as guidance and cannot prescribe requirements); *see also* Duke Energy Corp. (Catawba Nuclear Station, Units 1 and 2), CLI-04-29, 60 NRC 417, 424 (2004), *reconsid. denied*, CLI-04-37, 60 NRC 646 (2004) ("Guidance documents are, by nature, only advisory. They need not apply in all situations and do not themselves impose legal requirements on licensees.").

[40] LRA, section B.1.6.

only and relies on preventive measures such as coating, wrapping and periodic inspection for loss of material caused by corrosion of the external surface of buried steel piping and tanks. Section XI.M34 does not address further steps once "holidays" (in layman's terms, breaks) in coatings and wrappings have already been established; it only seeks to have the licensee address those holidays through a corrective action (that is, a coating holiday does not compel a change to the applicant's AMP, but rather simply an action to repair that holiday). Under Section XI.M34, opportunistic inspections are to be performed "in areas with the highest likelihood of corrosion problems, and in areas with a history of corrosion problems, within the areas made accessible to support the maintenance activity." Section XI.M34 offers no guidance on how to determine likelihood of corrosion problems except to rely on previous opportunistic inspections (*i.e.*, those performed by chance throughout the plant's operating life), and does not address management of buried pipes and tanks in areas not subject to opportunistic inspections. Section XI.M34 does not require cathodic protection. As reflected in the industry initiatives and the second revised GALL Report detailed below, the NRC and the industry have recognized that XI.M34's approach is insufficient to manage aging in buried pipes.

b. <u>GALL Report, Revision Two, Section XI.M41</u>

The GALL Report, Revision Two, Section XI.M41, Buried and Underground Piping and Tanks, on the other hand, requires cathodic protection, which is in line with current industry expectations. It states that:

> Depending on the material, preventive and mitigative techniques may include the material itself, external coatings for external corrosion control, the application of cathodic protection, and the quality of backfill utilized. Also, depending on the material, inspection activities may include electrochemical verification of the effectiveness of cathodic protection, non-destructive evaluation of pipe or tank wall thicknesses, hydrotesting of the pipe, and visual inspections of the pipe or tank from the exterior as permitted by opportunistic or directed excavations.

For steel pipes such as those present at Indian Point, it recommends preventive measures such as coatings, cathodic protection, and an assessment of backfill quality.[41] As to cathodic protection, the GALL Report, Revision Two goes on to say that

> Cathodic protection is in accordance with NACE SP0169-2007 or NACE RP0285-2002. The system should be operated so that the cathodic protection criteria and other considerations described in the standards are met at every location in the system. The duration of deviations from these criteria should not exceed 90 days. The system monitoring interval discussed in section 10.3 of NACE SP0169-2007 may not be extended beyond one year. The equipment used to implement cathodic protection need not be qualified in accordance with 10 CFR 50 Appendix B.[42]

As discussed below, Entergy has chosen not to comply with this version of GALL despite the fact that it mirrors current industry initiatives on buried and underground piping, and NRC Staff is arbitrarily not applying Revision Two to Indian Point.[43] Staff counsel stated in a teleconference that one reason for not applying current NRC guidance to Indian Point was that the SER was issued years ago. At the time of that statement, counsel for NRC Staff was no doubt aware that NRC Staff would shortly (within three months of the teleconference) be issuing a revised Indian Point safety evaluation report ("SER"), which was released in August of 2011. Staff should apply GALL Report, Revision Two to Indian Point.

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[41] GALL Report, Revision Two, Section XI.M41-2. GALL Report, Revision Two also defines the terms "buried" and "underground": "buried piping and tanks are in direct contact with soil or concrete (*e.g.*, a wall penetration). Underground piping and tanks are below grade but are contained within a tunnel or vault such that they are in contact with air and are located where access for inspection is restricted."

[42] *Id*., n.4.

[43] Entergy Nuclear Operations Indian Point Units 2 and 3, Transcript, Docket Nos. 50-247-LR and 50-286-LR, Teleconference (June 6, 2011) at 978:19-24 (NRC Counsel Sherwin Turk states that "the staff is not applying GALL Rev 2 to plants like Indian Point -- Indian Point, whose application came in so many years ago and for which the SER [Safety Evaluation Report] was completed already some time ago.").

2. NUREG 1800: The Standard Review Plan

The NRC has issued a NUREG document, NUREG 1800 or the Standard Review Plan, which "provides guidance to Nuclear Regulatory Commission staff reviewers in the Office of Nuclear Reactor Regulation" who perform safety reviews of applications to renew nuclear power plant licenses in accordance with Title 10 of the Code of Federal Regulations Part 54.[44] The Standard Review Plan references the GALL Report. The Standard Review Plan was issued in 2005, and reissued again in 2010 in conjunction with GALL Report, Revision Two.

Where, as here, NRC Staff has not directed Entergy to rely on GALL Report, Revision Two and Entergy has not indicated that it would follow GALL Report, Revision Two, it is presumed that both NRC Staff and Entergy rely on the 2005 original version of the Standard Review Plan. The 2005 version of the Standard Review Plan identifies the Buried Piping and Tanks Inspection Program:

> The program includes preventive measures to mitigate corrosion by protecting the external surface of buried piping and components, e.g., coating, wrapping, *and a* cathodic protection system. The program also includes surveillance and monitoring of the coating conductance versus time or current.[45]

The 2005 Standard Review Plan states that the program should be implemented prior to the period of extended operation ("PEO").[46] Thus, an NRC Staff reviewer would, consistent with the 2005 Standard Review Plan which operates in conjunction with GALL Report, Revision One, find a buried piping AMP that does not include cathodic protection as inconsistent with the Standard Review Plan.

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[44] NUREG 1800, Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants, Rev. 1 (Sept. 2005) (Exh. NYS000196).

[45] *Id*. (emphasis added)

[46] *Id*.

In December 2010, along with the second revised version of the GALL Report, NRC Staff released a Standard Review Plan for Review of License Renewal Applications for Nuclear Power Final Report that revised the section on the Buried Piping and Tanks Inspection Program to read:

> This comprehensive program is designed to manage the aging of the external surfaces of buried and underground piping and tanks. It addresses piping and tanks composed of any material, including metallic, polymeric, concrete, and cementitious materials. The program manages aging through preventive, mitigative, and inspection activities. It manages all applicable aging effects, such as loss of material, cracking, and changes in material properties.[47]

This section does not specifically reference cathodic protection. However, since neither NRC Staff nor Entergy are relying on the GALL Report, Revision Two, presumably this version of the Standard Review Plan does not apply to the Indian Point license renewal review, and the earlier version, requiring cathodic protection, does apply.

B. Industry Guidance

1. EPRI Report 1016456: Recommendations for an Effective Program to Control the Degradation of Buried Pipe

In December 2008, the Electric Power Research Company ("EPRI") released Recommendations for an Effective Program to Control the Degradation of Buried Pipe ("EPRI Report").[48] This report followed workshops EPRI held in May and October of 2007, which Entergy and over 40 other utilities attended, at which "the utility attendees unanimously recommended that EPRI sponsor the development of a recommendations document for buried

[47] NUREG 1800, Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants (2010 version) (Exh. NYS0000161).

[48] Recommendations for an Effective Program to Control the Degradation of Buried Pipe ("EPRI Report") (Exh. NYS000167).

pipe to help plant engineers prevent and mitigate degradation and leaks in buried pipes."[49] The EPRI Report focused on six elements:[50]

- Prioritization of buried pipe systems and locations to be inspected based on risk of failure (likelihood and consequence of failure),
- Performance of direct inspections to quantify the degree of degradation and damage,
- Evaluation of the fitness-for-service of degraded buried pipes,
- Selection of the appropriate repair technique where required, including both non-welded and welded repairs, and
- Preventive actions taken to reduce the risk (likelihood and consequence) of future leaks or failures.

The EPRI Report observes that a cathodic protection system "will fall into disrepair if not properly maintained, and will not protect the buried pipe."[51] EPRI recommends that where buried pipes are protected by a cathodic protection system, the cathodic protection system should be periodically inspected and tested to assess its continued adequacy. EPRI recommends that periodic checks verify satisfactory cathodic potential on the pipe and groundheads, and that impressed current protective facilities be inspected annually by a National Association of Corrosion Engineers (NACE) cathodic protection tester or equivalent.[52] EPRI cautions that foreign pipelines or stray currents can be the source of stray current corrosion, which can decrease cathodic protection effectiveness, and can make cathodic protection system assessments much more difficult.[53] EPRI recommends that a facility update its risk ranking to take into account changes in the facility's cathodic protection system, among

[49] EPRI Report at v.

[50] EPRI Report at vi.

[51] EPRI Report at 2-8 (section 2.4.1.2).

[52] *Id.*

[53] *Id*.

other things.[54]

The EPRI Report also recommends fitness-for-service ("FFS") assessments. This involves evaluation of the "current degraded condition as measured by [non-destructive examination] extrapolated to the condition at the next inspection. For wall thinning this means that a future corrosion allowance (FCA) needs to be subtracted from the current wall thickness reading to project the wall loss till [sic] the next inspection or time of repair or replacement."[55] The results of the FFS assessment "will indicate whether the defect (wall thinning, cracking, mechanical damage, occlusions) is acceptable until the next inspection, or whether a repair or replacement is necessary, and when the repair should be implemented."[56]

2. Nuclear Energy Institute Guidelines for the Management of Underground Piping and Tank Integrity and Buried Pipe Integrity Task Force

In 2010 the Nuclear Energy Institute ("NEI") also issued a report, entitled "Guideline for the Management of Underground Piping and Tank Integrity," also identified as NEI 09-14 (Rev. 1).[57] It reflects the work product resulting from the Buried Piping Integrity Initiative of the Nuclear Strategic Issues Advisory Committee (NSIAC), which is made up of the chief nuclear officers of all nuclear utilities in the country. This guideline describes the policy and practices that the industry commits to follow in managing underground piping and tanks. NEI 09-14 (Rev. 1) states that the specific inspections and examinations that are performed will be based on degradation observed or expected, the susceptibility of the pipe to leakage, the

[54] *Id.* at 2-19 (section 2.9).

[55] EPRI Report at 4-4 (section 4.3).

[56] *Id*.

[57] Guideline for the Management of Underground Piping and Tank Integrity", NEI 09-14 (Rev.1) (Exh. NYS000168).

consequences of the leak, and the location of the pipe.[58] The document further details the number of inspections that should be required, especially for those lines that carry Licensed Material. NEI expects every utility, including Entergy, to implement, "in accordance with the intent of the Initiative," an AMP for buried pipes.[59]

In April of 2011, the Buried Pipe Integrity Task Force, which is affiliated with NEI, issued a document entitled "Industry Guidance for the Development of Inspection Plans for Buried Piping." According to this document, depending on pipe length, two, or in some cases three "direct examinations of the highest susceptible locations, with acceptable results, may be sufficient to demonstrate reasonable assurance".[60] According to Dr. Duquette, the phraseology "highest susceptible locations" is critical since susceptibility of buried pipes to corrosion is determined by the characteristics of the soil/water combination at all locations at a given site. Accordingly, he testifies that it is paramount that soil conductivity, chemistry, drainage, and water retention are characterized to determine the best locations for direct measurements.[61]

In response to or in conjunction with these industry initiatives, Entergy made changes to its buried piping AMP after releasing its license renewal application ("LRA"). However, as discussed below, Entergy failed to meet the industry standard of care established by these initiatives.

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[58] *Id.*

[59] Letter, Alexander Marion (NEI) to Eric J. Leeds (NRC Office of Nuclear Reactor Regulation) dated November 3, 2010; Guideline for the Management of Underground Piping and Tank Integrity," NEI 09-14 (Rev.1) (Exh. NYS000176).

[60] Buried Pipe Integrity Task Force, "Industry Guidance for the Development of Inspection Plans for Buried Piping" (Apr. 2011) (Exh. NYS000169).

[61] Testimony of Dr. David J. Duquette (Exh. NYS000164 ("Duquette Testimony") at 14; Expert Report of David J. Duquette ((Exh. NYS000165) ("Duquette Report") at 8.

EXISTING CONDITIONS AT INDIAN POINT

NRC staff have candidly acknowledged that "[t]he buried pipe degradation conditions at … Indian Point …illustrate that Plants do not fully know what they have in the scope and condition of buried piping."[62] Entergy has admitted that "we have no existing technology that could determine the 'health' of our buried piping without the use of excavation. We need to get started on this…."[63] These acknowledgments from both Staff and Entergy support Dr. Duquette's testimony, which will be discussed in more detail below, concerning the lack of a sufficient understanding of current conditions at Indian Point, rendering the AMP inadequate. Dr. Duquette's testimony and expert report explain corrosion of buried pipes, and the environmental factors affecting corrosion.[64] Dr. Duquette's testimony focuses on the following two preventive measures that are industry standard for protecting buried systems from corrosion – coatings and cathodic protection.

A. Coatings

As Dr. Duquette explains, most steel and cast iron pipes that are intended for long service and are underground use some form of protection from corrosion by soils.[65] He states that usually some level of protection is afforded by the application of surface coatings.[66] These coatings range from simple painted surfaces with conventional or epoxy paints to the use of

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[62] Email, Harold Gray to Keith Hoffman and Robert Hardies, cc Richard Conte and Timothy Lupold, Subject line: FW: Buried piping - Proposed NRC Action (Apr. 23, 2010) ("Gray email") (Exh. NYS000196).

[63] Email, Burroni, Richard J. to Lee, Robert; Azevedo, Nelson F; Orlando, Caputo, Charles; Mayer, Donald M. (Aug. 12, 2008), RE: J Pollock review Friday-ISE R-7 Recommendation (Exh. NYS000197).

[64] *See generally* Duquette Report; Duquette Testimony.

[65] Duquette Report at 5; Duquette Testimony at 8.

[66] *Id*.

sacrificial coatings such as galvanizing.[67] In some cases enamels are used while in other cases bituminous coatings such as coal tar are utilized.[68] Other types of coatings include tape wraps that may range from paper to polymer based tapes.[69] In many cases, if wrapping is used, a second layer of coating may be applied over the wrapping.[70] In Dr. Duquette's opinion, even with coated pipes, there is always a concern about breaks in the coatings (holidays), either introduced during the coating process, installation of the pipes or damage induced after installation.[71] Dr. Duquette states that when breaks in the coating occur, the corrosion damage in some cases can be more severe than if there is no coating at all.[72] This is because with breaks in the coating, all of the corrosion damage may be concentrated in a single location so that a deep pit may perforate the pipe.[73] Dr. Duquette posits that another possibility is that the interface between the coating and the pipe surface may introduce an effective crevice, noting that crevice corrosion can be especially damaging because the electrolyte chemistry in a crevice tends to be much more aggressive than the bulk electrolyte.[74] Dr. Duquette observes that in order to prevent localized corrosion at holidays in the coating, cathodic protection is often used. Cathodic protection will be discussed in more detail below.

Coatings are particularly relevant at Indian Point. In February of 2009, Entergy discovered a leak on the return line to the condensate storage tank at Unit 2. Entergy

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[67] *Id*.

[68] Duquette Report at 5; Duquette Testimony at 9.

[69] *Id*.

[70] *Id*.

[71] *Id*.

[72] *Id*.

[73] *Id*.

[74] *Id*.

determined that the root case of the leak was "the installation specification … in effect at the time of plant construction. There is evidence that sections of the pipe coating were damaged by rocks that were present in the backfill for the CST lines."[75] That is, the owner of the plant at the time of construction covered buried components with soil containing rocks which damaged the protective coating on the components.[76] Entergy reportedly replaced a section of the pipe containing the leak, repaired nearby areas exhibiting shallow corrosion, and revised procedures for backfill to prevent this from happening again. Without doing a more robust examination of backfill used throughout the years, including during the period of construction and the prior owners' maintenance, Entergy cannot be assured that this problem is not occurring elsewhere in the buried piping systems at Units 1, 2, or 3.

B. Cathodic Protection

Dr. Duquette states that cathodic protection is often used to prevent localized corrosion at holidays in the coating of buried pipes. As Dr. Duquette explains, cathodic protection effectively lowers the potential of steel to a potential that is below that required to oxidize the steel.[77] In other words, the electrochemical couple between a sacrificial coating such as zinc and steel is such that the steel becomes the cathode while the zinc becomes the anode.[78] The zinc then corrodes in a "sacrificial" manner to protect the steel.[79] If the zinc coats the steel, the steel is said to be "galvanized."[80] In many cases zinc anodes can also be placed in the same

[75] CR-IP2-2009-00666 (Exh. NYS000170) at 22 of 39.

[76] *Id*.

[77] Duquette Report at 5; Duquette Testimony at 9-10.

[78] Duquette Report at 5; Duquette Testimony at 10.

[79] *Id*.

[80] *Id*.

electrolyte as the steel (in the case of Indian Point, in water saturated soil).[81] As long as there is electrical contact between the zinc and the steel, the zinc will preferentially corrode.[82] Dr. Duquette's testimony and expert report offer a more detailed description of cathodic protection.

Indian Point has a spotty history maintaining cathodic protection, despite its effectiveness. Prior to construction, a Pennsylvania-based engineering firm, A. V. Smith Engineering Company of Narberth, Pennsylvania, conducted a survey to determine the need for cathodic protection on Indian Point Unit 2.[83] The engineering firm determined that cathodic protection was not required on underground facilities in areas away from the river or the containment building liner, although a protective coating on pipes was recommended to eliminate any random localized corrosion attack.[84] Because the river water was determined to be "extremely corrosive," the following structures in the area near the river were placed under cathodic protection at the time of construction:

1. Circulating water lines,
2. Service water lines,
3. Bearing piles,
4. Sheet piling (earth and water side) and wing wall anchorage system, and
5. Metallic structures inside intake structure (traveling screens, bar racks, circulating water pump suction, service water pump suction).[85]

On February 26, 2009, Entergy's consultant PCA Engineering, Inc., released a corrosion and cathodic protection field survey and assessment of buried structures at Indian Point which it had

[81] Duquette Report at 5; Duquette Testimony at 10.

[82] *Id*.

[83] UFSAR, Unit 2, Revision 20, at 5.1.3.12. UFSAR, Unit 2, Revision 20 was submitted as part of Entergy's License Renewal Application.

[84] *Id*.

[85] *Id*.

conducted during October 2008.[86] PCA Engineering concluded that there was basically *no functional cathodic protection* anywhere at Indian Point.[87] PCA Engineering found that the impressed current cathodic protection system installed during construction for the intake structures and the circulating/service water piping had been removed or was out of service, with the exception of that for the intake structure sheet piling associated with Unit 2.[88] Soil resistivity measurements conducted by PCA at a limited number of locations indicated that the resistivity ranged from approximately 8,000 ohms/cm to approximately 63,000 ohm/cm.[89] Eight of the locations indicated resistivities in the 10,000 ohm/cm to 30,000 ohm/cm range.[90] Soils with resistivities in that range are considered to be mildly corrosive.[91] One location that measured a resistivity of approximately 8,000 ohm/cm is considered to be moderately corrosive.[92]

The report found that although construction specifications called for coal tar coatings or tape wrapped pipe (most of which is carbon steel), there is no record of whether the pipe coatings had been inspected for quality or coating holidays at the time of installation.[93] The report notes that "[a]ny breaks or holidays in the pipe coating … can lead to accelerated rates of corrosion in steel and ferrous materials, particularly if soil resistivity is low."[94] This is

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[86] PCA Report (Exh. NYS000178).

[87] *Id*.

[88] *Id*. at 3.

[89] *Id.*

[90] *Id.* at 14; Table II.

[91] Duquette Report at 21; Duquette Testimony at 23-24.

[92] Duquette Report at 21; Duquette Testimony at 24.

[93] PCA Report at 2.

[94] PCA Report at 6.

consistent with Dr. Duquette's testimony on the subject of coatings.[95] Entergy's consultant characterized soil resistivity at Indian Point as a range from "moderately corrosive" in some areas to less corrosive in others.[96]

PCA went on to report that cathodic protection of existing components can be expensive, and recommended a multi-phase plan: (1) install a mitigation bond to eliminate/minimize stray current to the city water piping at the location where it crosses the Algonquin gas pipeline to provide a low resistance path between the foreign structure and the protected structure, (2) provide a progressive evaluation of cathodic protection needs for high priority piping services on a zone basis, beginning with a deepwell anode system, the effectiveness of which can be compared to the application for additional piping zones; and (3) the implementation of an inspection program based on American Petroleum Institute 570 Piping Inspection Code to identify high priority zones, through excavation and inspection of existing pipe.[97]

Entergy adopted only one of its consultant's recommendations regarding cathodic protection, and cathodic protection at Indian Point remains inoperable but for one area of the city water line near the Algonquin pipeline.[98] These conditions form the backdrop for Entergy's AMP for buried and underground pipes.

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[95] Duquette Report at 4-5; Duquette Testimony at 8-9.

[96] PCA Report at 7, 14.

[97] PCA Report at 16-18.

[98] Letter, Fred Dacimo (Entergy) to U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, NL-11-074 (July 14, 2011) at Attachment 1; Supplemental Safety Evaluation Report ("NL-11-074") (Exh. NYS000152).

ENTERGY'S AGING MANAGEMENT PROGRAM FOR BURIED PIPES AND TANKS

Entergy's Commitments

The AMP Entergy offers in its LRA contains almost no detail concerning measures that it will take to manage the aging of buried pipes, saying only that:

> The Buried Piping and Tanks Inspection Program is a new program that includes (a) preventive measures to mitigate corrosion and (b) inspections to manage the effects of corrosion on the pressure-retaining capability of buried carbon steel, gray cast iron, and stainless steel components. Preventive measures are in accordance with standard industry practice for maintaining external coatings and wrappings. Buried components are inspected when excavated during maintenance. If trending within the corrective action program identifies susceptible locations, the areas with a history of corrosion problems are evaluated for the need for additional inspection, alternate coating, or replacement.[99]

As to inspections, it says only that:

> Prior to entering the period of extended operation, plant operating experience will be reviewed to verify that an inspection occurred within the past ten years. If an inspection did not occur, a focused inspection will be performed prior to the period of extended operation. A focused inspection will be performed within the first ten years of the period of extended operation, unless an opportunistic inspection occurs within this ten-year period.[100]

Without offering any detail, the section entitled "Buried Piping and Tanks Inspection" concludes by stating that:

> The Buried Piping and Tanks Inspection Program will be effective for managing aging effects since it will incorporate proven monitoring techniques, acceptance criteria, corrective actions, and administrative controls. The Buried Piping and Tanks Inspection Program assures the effects of aging will be managed such that applicable components will continue to perform their intended functions consistent with the current licensing basis through the period of extended operation.[101]

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[99] LRA, section B.1.6.

[100] *Id.*

[101] *Id.*

Thus, in its LRA, Entergy in essence says only "we will create a plan and it will effectively manage aging."

In June of 2009, NRC Staff posed questions to Entergy regarding its AMP for buried pipes following up on the February leak. On June 30, 2009, Entergy responded to these questions and amended its AMP to increase inspection frequency by introducing a risk assessment process similar to that proposed by EPRI.[102] The "risk assessment of in-scope buried piping and tanks … includes consideration of the impacts of buried piping or tank leakage and of conditions affecting the risk for corrosion."[103] The new commitment, which incorporates elements adopted by both NEI and EPRI, obligates Entergy to:

> Classify pipe segments and tanks as having a high, medium or low impact of leakage based on the safety class, the hazard posed by fluid contained in the piping and the impact of leakage on reliable plant operation. Determine corrosion risk through consideration of piping or tank material, soil resistivity, drainage, the presence of cathodic protection and the type of coating. Establish inspection priority and frequency for periodic inspections of the in-scope piping and tanks based on the results of the risk assessment. Perform inspections using inspection techniques with demonstrated effectiveness.

Id. This new commitment, which as stated above is only voluntary, and in any case contains no methodologies, ranking criteria, or other specific information concerning the new elements of the AMP, reiterates Entergy's intention to comply with section XI.M34 of the GALL Report, Revision One, indicating Entergy will not revive or install cathodic protection systems at Indian Point.[104] Entergy in its Underground Piping and Tanks Inspection and Monitoring Program, identified as EN-DC-343, recognizes NL-09-111 as the most current license renewal

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[102] Letter, Fred Dacimo (Entergy) to U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, NL-09-106 (July 27, 2009) (Exh. NYS000203).

[103] *Id*.

[104] *Id*. at Attachment 2, p.2 of 18.

commitment Entergy has made to date.[105] Recent RAIs have not resulted in amended commitments or license renewal application amendments.

Teleconferences between Entergy and NRC Staff and a Slight Commitment Revision

On July 22, and August 4 and 5, 2009, Entergy and NRC Staff held teleconferences concerning Entergy's response to an RAI concerning the Buried Piping and Tanks Inspection program.[106] Despite the admission of the State's Contention 5, the State was not notified of these teleconferences or invited to participate. NRC Staff had inquired about the word "qualified" in Entergy's statement in its July 27, 2009 letter indicating that it would "perform inspections using qualified inspection techniques with demonstrated effectiveness." During these calls, Entergy indicated that it would be updating its Buried Piping and Tanks Inspection Program to reflect operating experience. In response to NRC Staff's inquiry, Entergy sent a letter to the NRC amending its revised commitment to delete the word "qualified" from its commitment, which was revised to read "perform inspections using inspection techniques with demonstrated effectiveness."[107]

In February of 2011, NRC Staff expressed concern to Entergy that "the LRA and supplemental material did not contain enough specifics on the planned inspections for the staff to determine if the inspections would be adequate to manage the aging effect for all types/materials of in-scope buried pipes [and that] that the LRA and supplemental material did not contain enough specifics for the staff to understand the general condition of the backfill

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[105] Underground Piping and Tanks Inspection and Monitoring Program, EN-DC-343, Rev. 4, (Exh. NYS000172) ("EN-DC-343") at Section 8 (p. 19 of 23).

[106] *See* Email, Kimberly Green to Michael Stroud and Donna Tyner, Subject: Draft Telecon Summaries (Aug. 10, 2009), ML092220768 (Exh. NYS000198); Letter, Fred Dacimo to U.S. Nuclear Regulatory Commission, NL-09-111 (Aug. 9, 2009) ML092250374 ("NL-09-111") (Exh. NYS000171).

[107] NL-09-111 at Attachment 1.

used in the vicinity of buried in-scope piping," saying "[g]iven that cathodic protection has not been installed for all buried in-scope piping, the staff lacks sufficient information to conclude that the applicant's evaluation of soil corrosivity will provide reasonable assurance that in-scope buried piping will meet its intended license renewal function(s)."[108] NRC Staff also expressed concern that although Entergy said it was considering soil resistivity and drainage, it did not state that other important soil parameters would be included such as, pH, chlorides, redox potential, sulfates and sulfides; that Entergy did not state how often it would conduct testing of localized soil conditions, nor provide the specific locations relative to buried in-scope piping that is not cathodically protected; that Entergy did not state how it would integrate the various soil parameters into an assessment of corrosivity of the soil; and that Entergy did specify how localized soil data would be factored into increased inspections, including the increase in the number of committed inspections by material type and location.[109]

Entergy responded in March of 2011, providing (1) tables of the number of planned inspections for different components, (2) admitting that the city water line is the only cathodically protected line, and (3) stating that Entergy had done two excavations which indicated no backfill problems, among other things.[110] Entergy also stated that soil would be sampled prior to the period of extended operation to confirm that the soil conditions were not aggressive, and that these samples would form the basis for the number of inspections during the PEO. Entergy stated that the soil samples would be taken prior to the period of extended

[108] NRC Letter, "Request for Additional Information for the Review of the Indian Point Nuclear Generating Unit Numbers 2 and 3, License Renewal Application" (Feb. 10, 2011) (Exh. NYS000199).

[109] *Id*.

[110] Letter, Fred Dacimo (Entergy) to U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, NL-11-032 (Mar. 28, 2011) ("NL-11-032") (Exh. NYS000151).

operation and at least once every 10 years thereafter to confirm the initial sample results, and that if the soil resistivity is <20,000 ohm-cm and the soil scores higher than 10 points using American Water Works Association (AWWA) Standard C105 Appendix A, the number of inspections would be increased to ensure the piping can perform its design function during the PEO. Entergy stated that the additional inspections would be in locations with aggressive soil conditions.

Notably, Entergy did not make any alterations to its broadly-worded regulatory commitment after sharing these details, and NRC Staff did not inquire as to the documentation in which these details could be found or request that Entergy's AMP or regulatory commitments be amended to include these details.

In June of 2011, NRC Staff sought additional information from Entergy concerning its buried piping aging management plan.[111] In July of 2011, Entergy amended its commitment to replace the phrase "[p]erform inspections using inspection techniques with demonstrated effectiveness" with "[p]erform inspections using direct visual inspection."[112] Staff expressed its concern that the UFSAR supplement did not reflect the planned number and frequency of buried in-scope piping inspections and soil testing to be conducted during the thirty-year period starting ten years prior to the period of extended operation, and asked that Entergy update the UFSAR. In response to the RAI, Entergy summarized statements it had made in response to Staff's February RAI:

> Prior to entering the period of extended operation, plant operating experience will be reviewed and multiple inspections will be completed within the past ten years. Additional periodic inspections will be

[111] NRC Letter, "Request for Additional Information for the Review of the Indian Point Nuclear Generating Unit Numbers 2 and 3, License Renewal Application" (June 15, 2011) (Exh. NYS000200).

[112] NL-11-074, Attachment 2, p. 1 of 17.

performed within the first ten years of the period of extended operation.

IP2 will perform 20 direct visual inspections of buried piping during the 10 year period prior the PEO. IP2 will perform 14 direct visual inspections during each 10-year period of the PEO. Soil samples will be taken prior to the PEO and at least once every 10 years in the PEO. Soil will be tested at a minimum of two locations at least three feet below the surface near in-scope piping to determine representative soil conditions for each system. If test results indicate the soil is corrosive then the number of piping inspections will be increased to 20 during each 10-year period of the PEO.

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IP3 will perform 14 direct visual inspections of buried piping during the 10 year period prior the PEO. IP3 will perform 16 direct visual inspections during each 10-year period of the PEO. Soil samples will be taken prior to the PEO and at least once every 10 years into the PEO. Soil will be tested at a minimum of two locations at least three feet below the surface near in-scope piping to determine representative soil conditions for each system. If test results indicate the soil is corrosive then the number of piping inspections will be increased to 20 during each 10-year period of the PEO. [113]

However, this language does not appear in Entergy's most recent updated UFSAR,[114] and also does not appear in Entergy's regulatory commitments. Despite the fact that NRC Staff has included these inspection numbers in its August 2011 Supplemental Safety Evaluation Report (discussed in more detail below),[115] it does not appear that Entergy has committed to performing this number of inspections in any enforceable document. Nor has Entergy

[113] NL-11-074, Attachment 2, p. 3-4 of 17. Previous versions of this document referred to the Program as the "Buried" Piping and Tanks Inspection and Monitoring Program. *See, e.g.*, Buried Piping and Tanks Inspection and Monitoring Program, EN-DC-Rev 0, Exh. NYS000201.

[114] June 2011 Updated Safety Analysis Reports for Units 2 (Licensee's Version 22) and 3 (Licensee's version submitted October 13, 2009) (ML112364A226 and ML11236A228). As the cover pages identify, these versions are "the latest UFSAR revision submitted to the NRC."

[115] Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Safety Evaluation Report Related to the License Renewal of Indian Point Nuclear Generating Unit Nos. 2 and 3 Supplement 1 (Aug. 2011) ("Supplemental Safety Evaluation Report") (ML11201A031) at 3-2, 3-3.

explained how, apparently having done virtually no non-opportunistic inspections in the last 8 years, it will be able to meet its promise that "Prior to entering the period of extended operation, plant operating experience will be reviewed and multiple inspections will be completed within the past ten years."

Non-Binding Corporate Documents

Entergy has provided the State with related corporate documents which shed more light on steps Entergy may take to implement its AMP, but these documents are not binding commitments and are not formally part of Entergy's AMP. Nevertheless, they warrant discussion as they include details the Board might expect to find in the AMP itself.

EN-DC-343: Fleetwide Buried Piping and Tanks Inspection and Monitoring Program

On November 19, 2007, Entergy issued Nuclear Management Manual EN-DC-343 introducing a fleetwide "Buried Piping and Tanks Inspection and Monitoring Program" applicable to nearly all of its facilities across the nation.[116] EN-DC-343 incorporates many of the elements also present in EPRI Report 1016456 including prioritization of buried pipe systems and locations to be inspected based on risk of failure (taking into account the likelihood and consequence of failure), and the performance of direct inspections to quantify the degree of degradation and damage.[117] EN-DC-343 "provide[d] the requirements, for each site to develop its own site specific Buried Piping and Tanks Inspection and Monitoring Program Section …."[118]

EN-DC-343 "provides the requirements for each site to develop its own site specific

[116] Buried Piping and Tanks Inspection and Monitoring Program, EN-DC-343, Rev. 0 (Exh. NYS000201).

[117] EN-DC-343 (Exh. NYS000172).

[118] *Id.*

Underground Piping and Tanks (UPT) Inspection and Monitoring Program [and] provides a set of recommendations for Entergy nuclear power plants to use in implementing an effective program to detect and mitigate life-limiting degradation that may occur in underground piping systems and tanks."[119] It acknowledges that "[t]he risk of a failure caused by corrosion, directly or indirectly represents the most common hazard associated with underground piping and tanks."[120] It "consists of inspection and monitoring of selected operational underground piping and tanks for external corrosion" (emphasis in original) and indicates that the details of the risk ranking criteria, reasonable assurance guidance, recommendations for inspection, monitoring, and mitigation portion of this Program are contained in CEP-UPT-0100. According to the document, "[t]his procedure and CEP-UPT-0100 contain the required elements to help Program Owners prioritize inspections of underground segments, evaluate the inspection results, make fitness for service decisions, select a repair technique where required, and take preventive measures to reduce the likelihood and consequence of failure."[121]

The procedures and oversight section of EN-DC-343 refers to Entergy's document CEP-UPT-0100 as the requirement associated with the scope, risk ranking and examination techniques to be followed. In CEP-UPT-0100's risk ranking section, an assemblage of a set of as-built drawings is required. It is not clear if such a set actually exists or if it was or will be provided for review in the license renewal process.[122] The remainder of the document details the inspection and monitoring program into Risk Ranking, Inspections, Fitness for Service, Repairs, and Prevention, Mitigation and Long term Strategies.

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[119] *Id*.

[120] *Id*.

[121] EN-DC-343 at 4.

[122] Duquette Report at 13; Duquette Testimony at 20.

With regard to repairs, EN-DC-343 says only that "[c]ontingency planning should be in place for prompt implementation in case an underground segment fails to meet acceptance criteria."[123] As discussed below, Entergy has not provided its acceptance criteria, making it impossible to assess its AMP's effectiveness.

In terms of prevention of leaks, Entergy offers only that "[w]here the risk of failure is unacceptable, [unspecified] preventive measures and options to mitigate the possible leakage should be implemented."[124] EN-DC-343 calls for coating of newly installed piping, proper use of fill when excavating and re-burying components, and baseline inspections should be performed prior to piping installation. However, this is not an aging management program. These are simply best practices for any buried pipes, and do not indicate any efforts that will be taken to manage already-aging pipes such as those present at Indian Point. EN-DC-343 goes on to say that for plants with installed cathodic protection systems for underground (which includes buried) piping and tanks, Entergy should ensure that the proper operation of the systems is verified semi-annually. EN-DC-343 calls for cathodic protection affecting safety-related structures, systems, and components ("SSCs") to be repaired on a presumably expeditious schedule (as compared with the non-safety-related SSCs, which are to be repaired within only six months of detection of a problem). Entergy has made no regulatory commitment to implementing EN-DC-343 at Indian Point.

EN-DC-343 states that the fleetwide AMP will be consistent with NUREG-1801, Revision One, Section XI.M34 (Buried Piping and Tanks Inspection). NUREG-1801 XI.M34 explicitly does not require cathodic protection. Entergy does not commit to following NUREG-1801, Revision 2, section XI.M41 which does require cathodic protection.

[123] EN-DC-343 at 16.

[124] *Id.*

On December 11, 2008, Entergy issued a Corrective Action report to track the scheduling of future inspections "pending formal issue of the IPEC Buried Pipe Program document."[125] The Corrective Action report states that "in lieu of each of the Entergy sites issuing its own buried piping program document, it has been decided … that a fleet Central Engineering Program (CEP) Buried Piping Program Document will be generated."[126] EN-DC-343 has been revised four times since 2007, with its name changed in its most recent iteration to the *Underground* Piping and Tanks Inspection and Monitoring Program.[127] (emphasis added)

CEP-UPT-0100

In October of 2009, Entergy issued the Central Engineering Program document it referenced in its December 2008 Corrective Action report. The document, identified at the time as CEP-BPT-0100, has since been updated (now identified as CEP-UPT-0100). This Central Engineering Document "details the program requirements associated with the scope, risk ranking, and examination techniques" required by EN-DC-343, including the risk-based matrix into which Entergy will place segments of buried and underground tanks based on a non-quantified likelihood of failure (*i.e.*, low, medium, or high) versus the non-quantified consequences of failure (*i.e.*, none, low, medium, and high) which will then be used to determine inspection intervals.[128] CEP-UPT-0100 contains the specifics of how to classify a plant's pipes. For NYS-5, it is relevant to know only that Entergy considers any piping/tanks containing radioactive material as high risk and automatically ranked as a High Inspection

[125] CR-IP2-2008-04754 (Dec. 11, 2008) (Exh. NYS000202).

[126] *Id*.

[127] EN-DC-343. Entergy defines buried as piping coming into direct contact with soil, while underground pipes may be technically "under ground" but may not be in direct contact with soil (i.e., embedded in concrete or located in underground concrete vaults, tunnels, or guard pipes). *Id*. at 3.0[2], [25].

[128] EN-DC-343 at §§ 5.2[2] and 5.3[1].

Priority and that the plant owner is required to conduct further risk ranking of piping and tanks containing radioactive material using the methodology developed in Engineering Report ECH-EP-10-00001, "Radiological SSC Groundwater Initiative Risk Evaluation Criteria" to prioritize radioactive or contaminated piping and tanks in relation to each other.[129] Entergy is then to group pipes together depending on the specific features of the components for inspection. Furthermore, CEP-UPT-0100 explains how examinations should take the place of the grouped lines or segments of lines, and includes inspection methodologies for underground and buried pipes and tanks, specifically including direct examination options (internal pipeline inspection gauges ("pigs") and local pipe non-destructive examination ("NDE")) and indirect examination options including guided wave.[130] Entergy has not committed to comply with the recommendations of CEP-UPT-0100, its own internal guidance document, at IPEC.

CEP-UPT-0100 section 5.5, entitled "Evaluation of Inspection Data," states that "Acceptance criteria for any degradation of external coating, wrapping, and pipe wall or tank plate thickness shall be developed prior to performing opportunistic and scheduled inspections." (emphasis in original). It states that "[a]cceptance criteria are published in [unspecified] approved engineering documents" and that "[p]iping with measured wall thickness less than 1/16" will be repaired/replaced." It states also that "[a] condition report shall be initiated when measured wall thickness is found to be less than 87.5% of nominal thickness."[131] CEP-UPT-0100 offers no specific acceptance criteria, does not indicate what steps Entergy will take if problems are found, and contains no mandatory repair requirements.

In terms of preventive actions, CEP-UPT-0100 states that "existing [cathodic

[129] CEP-UPT-0100, Rev. 0 (Exh. NYS000173) ("CEP-UPT-0100") at 10.

[130] CEP-UPT-0100 at 14-15.

[131] CEP-UPT-0100 at 16.

protection] systems may be upgraded or a new [cathodic protection] system installed" (emphasis added), and requires that plants with installed cathodic protection systems verify proper operation of these systems, periodically test them, ensure the system is evaluated in accordance with EN-DC-343, put an individual in charge of the cathodic protection system, and verify that cathodic protection systems are corrected on a schedule commensurate with the safety significance of the system or component being protected.[132] Entergy has not implemented these actions at Indian Point despite knowing for years that its cathodic protection systems have fallen into disrepair, and has not committed to repairing them now.

SEP-UIP-IPEC: Underground Components Inspection Plan

Program Section No. SEP-UIP-IPEC, the Underground Components Inspection Plan, appears to be the only Indian Point-specific document Entergy produced in this line of buried and underground piping management manuals and programs. The document states that it "represents a specific commitment milestone in the NEI Industry Initiative." SEP-UIP-IPEC acknowledges that although many buried or underground pipes were once cathodically protected, such cathodic protection systems have lapsed, accelerating external corrosion where coatings have failed.[133]

SEP-UIP-IPEC notes that there are currently no industry guidelines for determining and achieving "Reasonable Assurance (RA) of Integrity" for inspected SSCs but that Entergy aims to achieve RA with a combination of a Fitness-for-Service engineering evaluation, indirect inspections, direct examinations, and remediation if necessary. Through this combination, Entergy believes a "high level of confidence that the structural and/or leakage integrity of the

[132] CEP-UPT-0100 at 16.

[133] Indian Point Units 2 & 3 Underground Components Inspection Plan, SEP-UIP-IPEC, Rev. 0 (Exh. NYS000174) ("SEP-UIP-IPEC") at 5.

underground SSCs will be maintained."[134]

SEP-UPT-0100 does not state that direct inspection locations should be focused on "highly susceptible factors" like those Dr. Duquette testifies are critical in determining direct inspection locations: soil conductivity, chemistry, drainage, and water retention. Thus, it is not clear if this document comports with the NEI initiative it purports to follow.

SEP-UIP-IPEC reiterates the risk ranking scheme laid out in EN-DC-343 and CEP-UPT-0100 and states that "[a]n effective cathodic protection system is essential to minimize underground piping corrosion." However, it observes that Indian Point's cathodic protection systems were "rarely maintained" and were in some cases abandoned, rendering the systems incapable of providing the needed corrosion protection. SEP-UIP-IPEC recommends that Entergy conduct an Area Potential and Earth Current Study to analyze and implement improvements to coatings and cathodic protection effectiveness.[135]

SEP-UIP-IPEC makes no mention of the PCA report which had found that cathodic protection was necessary but lacking at Indian Point. SEP-UIP-IPEC only establishes a goal of determining if available cathodic protection has been operated properly prior to performing inspections.[136] SEP-UIP-IPEC does not require the implementation of cathodic protection at all, and certainly not as a prerequisite for license renewal.

NRC Staff's Supplemental Safety Evaluation Report

In its revised SSER issued in August of 2011, the NRC staff found that "although the service water, containment isolation support, auxiliary feedwater, plant drains, fuel oil, security diesel propane, and fire protection systems are not cathodically protected, the applicant's

[134] SEP-UIP-IPEC at 9.

[135] SEP-UIP-IPEC at 14.

[136] SEP-UIP-IPEC at 15.

response is acceptable in that:

- The applicant is "risk informing" its piping inspection locations to select those with the greatest potential for leakage.

- The applicant is sampling the soil for corrosivity prior to and during the period of extended operation, using standard industry methodologies to determine soil corrosivity, and will be increasing the number of inspections if the soil is corrosive.

- Steel piping is coated.

- Recent inspections found that the backfill did not contain rocks or foreign material that would damage external coatings and the coatings were found to be in good condition. The staff noted that foreign material in backfill caused sufficient damage of the condensate storage tank return line coating such that the line corroded and leaked, and in other instances inspections found coating damage; however, the applicant's proposed number of inspections meet the current staff position for number of inspections."[137]

In its Supplemental Safety Evaluation Report, NRC Staff adopted Entergy's statements in response to Staff's RAIs, noting that:

> The applicant revised the number of planned inspections of buried piping within the scope of license renewal from 45 (a non-specific mix of direct and indirect inspections) in the 10-year period prior to the period of extended operation to 31 direct inspections of steel piping, 3 direct inspections of stainless steel piping, and 17 indirect inspections in the 10-year period prior to the period of extended operation. The applicant also revised the number of inspections to be conducted in the period of extended operation from a non-specific total in the first 10 years of the period of extended operation based on the results of inspections to be completed prior to the period of extended operation to 28 direct inspections of steel piping and two direct inspections of stainless steel piping in each 10-year period of the period of extended operation.[138]

Staff did not comment on the fact that Entergy made these statements only in an RAI response and not in its AMP or in a regulatory commitment. Given that these statements

[137] Supplemental Safety Evaluation Report (Aug. 2011) at section 3.0.3.1.2.

[138] *Id.*

from Entergy form the basis for the Staff signing off on Entergy's AMP even though it does not include cathodic protection, it is critical that Entergy commit itself to an enforceable position regarding the number of inspections of buried pipes and tanks it plans to undertake.

THE STATE OF NEW YORK'S CONTENTION 5

On November 30, 2007, the State submitted Contention 5, which the Board admitted on July 31, 2008, alleging that:

> The Aging Management Plan Contained In The License Renewal Application Violates 10 C.F.R. §§ 54.21 And 54.29(A) Because It Does Not Provide Adequate Inspection And Monitoring For Corrosion Or Leaks In All Buried Systems, Structures, And Components That May Convey Or Contain Radioactively-Contaminated Water Or Other Fluids And/Or May Be Important For Plant Safety.

Specifically, the State alleged that Entergy's buried piping AMP, contained in section B.1.6 of the LRA, contains no preventive measures, improperly relies on inadequate opportunistic inspections, and even those are of inadequate scope, and contains no requirement for the installation (or re-installation) of non-existent or inoperative cathodic protection systems.

Entergy's License Renewal Application states that its Buried Piping and Tanks Inspection Program is a "new program that includes (a) preventive measures to mitigate corrosion and (b) inspections to manage the effects of corrosion on the pressure-retaining capability of buried carbon steel, gray cast iron, and stainless steel components."[139] The LRA states that the program will be consistent with program attributes described in the GALL Report, Revision One, Section XI.M34. The GALL Report to which Entergy referred has now

[139] LRA, section B.1.6.

been superseded. Entergy has not committed, and NRC Staff have not requested that Entergy commit, to meeting the requirements of the GALL Report, Revision Two.

Section B.1.6 of the LRA indicates that the Buried Piping and Tanks Inspection Program applies to buried components in the following systems:

- Safety injection
- Service water
- Fire protection
- Fuel oil
- Security generator
- City water
- Plant drains
- Auxiliary feedwater[140]

The State's contention addresses all of these systems which do, or may, contain radioactive fluids.[141]

The Board's Admission of Contention 5

On July 31, 2008, the Board admitted the State's Contention 5

> to the extent that it pertains to the adequacy of Entergy's AMP for buried pipes, tanks, and transfer canals that contain radioactive fluid which meet 10 C.F.R. § 54.4(a) criteria. The questions to be addressed at hearing include, inter alia, whether, and to what extent, inspections of buried SSCs containing radioactive fluids, a leak prevention program, and monitoring to detect future excursions, are needed as part of Entergy's AMP for these components.[142]

The Board admitted discussion of proposed inspection and monitoring details to the extent they are "needed to demonstrate that the Applicant's AMP does or does not achieve the desired goal of providing assurance that the intended function of relevant SSCs discussed herein will be maintained for the license renewal period, and specifically, to detect, prevent, or mitigate the

[140] *See* LRA, section B.1.6.

[141] Memorandum and Order (Ruling on Petitions to Intervene and Requests for Hearing)(July 31, 2008) ("Contention Admissibility Order") at 34.

[142] Contention Admissibility Order at 34.

effects of future inadvertent radiological releases as they might affect the safety function of the buried SSCs and potentially impact public health."[143] The Board found that with regard to Indian Point Unit 1, Entergy had not provided details including: (1) definition of the relevant Indian Point Unit 1 components that fall under Section 54.21; (2) a demonstration that the Indian Point Units 2 and 3 AMP for buried pipes (contained in the LRA) pertains to Indian Point Unit 1 SSCs that are relied upon for the proposed extended operations; and (3) the extent of the proposed aging management activities that will be conducted on the Indian Point Unit 1 SSCs.[144]

Based on this, the Board concluded that "there remains a material dispute as to the existence and adequacy of the AMP for IP1-buried SSCs that are being used by IP2 and IP3 during the license renewal period, and that this dispute is subject to further litigation under this admitted contention."[145]

ARGUMENT

POINT I

ENTERGY DOES NOT KNOW THE EXISTING STATE OF BURIED COMPONENTS AT INDIAN POINT

Entergy's buried piping AMP depends on an assessment of pipe parameters -- for example, which pipes were coated prior to installation, with which kind of coating, and whether those coatings remain intact. EPRI has observed that "[b]uried pipes may be bare or they may have a variety of external coatings and internal linings."[146] Entergy's own consultant has

[143] *Id*. at 35.

[144] *Id*. at 35.

[145] *Id*.

[146] EPRI Report at 1-2.

admitted that it does not appear that proper oversight procedures were implemented when coatings were applied at the time of construction,[147] and Entergy personnel have stated that Entergy has no way of knowing the condition of Indian Point's pipes without excavation.[148] Photographs of corrosion's effect on one buried piping system at Indian Point appear at NYS-Exhibit NYS000170.[149]

As the Indian Point Unit 2 condensate storage tank line leak revealed, Entergy did not know that improper backfill had been used at the site during construction. Likewise, the State was not able to examine the engineering report on which the original plant owner's decision to limit the installation of cathodic protection to certain systems was based because Entergy objected to producing the report on grounds that, Entergy asserts, the UFSAR is part of the current licensing basis which is not subject to review in this proceeding.[150] Therefore, the grounds on which the decision was made whether or not to cathodically protect the buried pipes, and therefore whether or not environmental conditions have changed on the site, cannot be known. In fact, Entergy has produced virtually no documents from the period of Consolidated Edison's construction and operation of Indian Point Units 1 or 2 or New York Power Authority's construction and operation of Unit 3.[151] For that reason, coupled with

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[147] Entergy Operations, IPEC, Root Cause Analysis, CR-IP2-2009-00666, May 14, 2009 (section D, Safety Culture Evaluation)(Exh. NYS000179).

[148] Email, Burroni, Richard J (Entergy) to Lee, Robert C .; Azevedo, Nelson F; Orlando, Caputo, Charles; Mayer, Donald M (Aug. 12, 2008), RE: J Pollock review Friday-ISE R-7 Recommendation (Exh. NYS000197).

[149] It does not appear that Entergy produced this document in its entirety.

[150] *See* Declaration of Janice A. Dean, sworn to December 16, 2011 (Exh. NYS000205) and Letter, Paul Bessette, Esq. to Janice A. Dean, Re: Entergy Nuclear Operations, Inc. (Indian Point Nuclear Generating Units 2 and 3), Docket Nos. 50-247-LR and 50-286-LR (Nov. 17, 2009) (Exh. NYS00204).

[151] *See* Dean Decl., ¶ 5.

Entergy's consultant's statements concerning the lack of evidence of coating inspections, it is apparent that Entergy does not understand existing buried piping conditions absent a thorough inspection, essentially excavation, of virtually all relevant buried pipes at the Indian Point site. The adequacy of any AMP based on assumptions about existing conditions in the absence of this information is therefore impossible to assess, making additional pre-PEO inspections, and pre-hearing disclosure of the results, necessary before a genuine assessment of this Entergy AMP can be made.

Some examples of the ways in which existing conditions factor into Entergy's buried piping AMP include:

- CEP-UPT-0100 contemplates the assignment of buried piping inspection groups based on consideration of parameters including construction materials and coating of the pipe or tank and backfill, which requires not only access to specifications for what type of backfill or coating should have been used, but what backfill or coating was actually used. Alternatively, based on the data already collected on a limited amount of piping, Entergy can assume that all pipes were defectively coated and that all pipes were improperly backfilled, thus necessitating a 100% inspection of all in-scope buried pipes. Entergy's AMP does not call for inspection of all in-scope buried pipes.

- Entergy is not in possession of the soil analysis performed by the original plant owner at the time of construction, so Entergy cannot know the soil conditions which may have been impacting buried components over time. In addition, when a party has the burden of proof, the absence of evidence, without an investigation, is not evidence. It is up to Entergy to demonstrate that all buried pipes are exposed to the same soil conditions as when the pipes were installed and to determine what those soils are. Entergy's corporate documents state that it will conduct soil tests after its new license is granted, but Entergy already knows that soil on the site is corrosive, necessitating the installation of cathodic protection which Entergy has not committed to doing.

- Entergy personnel have also stated that "the coatings used on the buried components are similar such that it [sic] is expected to be able to credit opportunistic inspection results as representative of all buried components."[152] But Entergy has produced no information concerning the

[152] *Id.*

> coatings that were actually used on buried components and whether they were in fact the same on all buried components at the time of construction. In addition, in light of the findings that occurred in the Condition Report regarding leaks in the auxiliary steam supply – i.e. that the leaks occurred because of design defects in the coating[153] - this line of reasoning would lead to the conclusion that all pipes have defective coatings, not that all are coated but for the ones implicated in the leak.

NRC Staff have observed that the buried pipe degradation conditions at Indian Point indicate a lack of operator knowledge of the condition of buried piping.[154] Since many elements of Entergy's AMP depend on the conditions at the time of construction, which are not known, Entergy's AMP is based on nothing more than guesswork.

POINT II

ENTERGY HAS MADE INSUFFICIENT AND AMBIGUOUS COMMITMENTS

As stated above, there is no information in Entergy's AMP itself that would allow the State or the Board to determine whether Entergy will adequately manage buried pipes. Even the segment of Entergy's AMP that it wished to include in its list of regulatory commitments, which are voluntary unless elevated by Staff to a binding commitment, is vague and devoid of specific detail.

A. Entergy's AMP Lacks Sufficient Detail to Provide an Understanding of What It Intends to Do to Manage Aging Buried Pipes, and Its Commitments Are Not Aligned With Other Statements It Has Made

Entergy's corporate documents and RAI responses, which are not binding commitments, offer some details on what an effective buried piping AMP might look like at Indian Point, but these documents too are rife with ambiguity. For example, Entergy says its inspection intervals are determined by using inspection priority. For buried pipe sections with a high/high, high/medium, or medium/high impact-corrosion risk (which would include the piping systems

[153] CR-IP2-2009-00666 (Exh. NYS000170).

[154] Gray email, Exh. NYS000196.

within the scope of this contention, since Entergy has designated all radioactive fluid-containing piping systems "high priority"), inspections will be done at ten year intervals or as determined by inspection results.[155]

This would mean that radioactive fluid-containing buried piping systems at Unit 2, designated the highest-risk, would be inspected only twice during the PEO, or perhaps only once. But in its response to NRC's most recent RAI on buried pipes, Entergy stated it would perform at least 81 inspections: at Unit 2, 20 direct visual inspections of buried piping during the 10 year period prior the PEO and 14 direct visual inspections during each 10-year period of the PEO; at Unit 3, 14 direct visual inspections of buried piping during the 10 year period prior the PEO and 16 direct visual inspections during each 10-year period of the PEO.[156] It is not clear whether or how Entergy's response to the RAI correlates with the information in Entergy's corporate documents setting inspection priority and scheduling; it appears that Entergy has not "committed" to any specific number of inspections at all in any enforceable document. Entergy has committed only to classifying pipe segments and tanks as having a high, medium or low impact of leakage based on the safety class, the hazard posed by fluid contained in the piping and the impact of leakage on reliable plant operation; determining corrosion risk through consideration of piping or tank material, soil resistivity, drainage, the presence of cathodic protection and the type of coating; establishing inspection priority and frequency for periodic inspections of the in-scope piping and tanks based on the results of the risk assessment; and performing inspections using inspection techniques with demonstrated effectiveness.[157]

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[155] CEP-UPT-0100 at Table 9-1.

[156] NL-11-074, Attachment 2 at. 3-4 of 17

[157] NL-11-074, Attachment 2 at 1 of 17.

Moreover, certain elements of Entergy's EN-DC-343 require Entergy to have taken steps already, but Entergy has not disclosed that it has taken those steps. Entergy told the NRC Staff in its latest RAI response that it will conduct 34 pre-PEO inspections between Units 2 and 3, but it is also not clear how many inspections, if any, have already taken place that Entergy is counting against this requirement but that were not conducted to the standards to which Entergy's new program would dictate they should be conducted.[158] Curiously, since the commitments Entergy has made only become operable once a license has been granted, it will only be at the start of the PEO that Entergy would be obligated to conduct pre-PEO inspections, while of course any opportunity for it to have done so would have passed by then. Also, EN-DC-343 first requires Entergy (specifically, the Program Owner), to "develop a list of all systems containing buried piping and tanks, and to identify those sections of tanks that are buried, collecting physical drawings, piping/tank installation specifications, piping design tables and other data needed to support inspection activities."[159] EN-DC-343 requires the Program Owner to complete this list within three months after the issuance of the Procedure, which may have made such a list due as early as January of 2008, depending on what Entergy considers the date on which it "issued" the program. To date Entergy has disclosed no such list to intervenors, which may indicate no such assessment has been performed.

Moreover, Dr. Duquette has observed that Entergy has committed to implementing an inspection program for Indian Point Unit 2 in September, 2013 and at Indian Point Unit 3 in December, 2015, indicating that these are "new" programs. Both of these dates are well within the extended operating period and beyond the scope of this hearing. Dr. Duquette questions why it would take as long as 5 to 7 years after the publication of the EPRI guidelines for

[158] Duquette Report at 18; Duquette Testimony at 22.

[159] EN-DC-343 at section 5.4.

Entergy to begin an inspection program.[160]

B. Entergy's AMP Offers Virtually No Preventative Measures And Is Primarily An Inspection Program

As Dr. Duquette has explained in more detail in his report and testimony, Entergy's buried piping AMP contains no acceptance criteria and no indication of when Entergy will undertake repairs, or what those repairs would entail.[161] For that reason, Dr. Duquette is unable to assess the adequacy of Entergy's AMP as it relates to prevention of corrosion-related leaks and failures. As Dr. Duquette has observed, Entergy's AMP is primarily focused on inspections, and an inspection program, *per se*, is not adequate to ensure the safe operation of engineering systems. The acceptability of the results of the inspection program, including the criteria to be applied to continued operation, remediation, or replacement, should be specified.[162]

As with other issues, Entergy's corporate documents offer more detail on this prong though they are not binding or part of Entergy's license renewal application, and even EN-DC-343 is inadequate as to prevention of corrosion. With regard to repairs, EN-DC-343 says only that "[c]ontingency planning should be in place for prompt implementation in case an underground segment fails to meet acceptance criteria."[163] Entergy has offered no contingency plans or acceptance criteria in its AMP or otherwise. EN-DC-343 calls for newly installed piping to be coated, that proper use of fill should be used when excavating and re-burying components, and that baseline inspections should be performed prior to piping installation. However, this is not an aging management program. As Dr. Duquette has observed, these are

[160] Duquette Report at 23.

[161] Duquette Report at 14, 15; Duquette Testimony at 18, 19, 21, 26.

[162] *Id.*; see also Duquette Report at 23-24.

[163] EN-DC-343 at 16.

simply best practices for any underground pipes, and do not indicate any efforts that will be taken to manage already-aging pipes such as those present at Indian Point.[164]

NUREG-1801, Revision Two specifies not only an inspection program but also specifies preventive actions for buried pipes and tanks. For carbon steel components, NUREG-1801, Revision Two, Section XI.M41 specifies that buried piping should be coated and cathodically protected.[165] There are no cathodic protection systems currently in operation at Indian point for the protection of safety related buried piping, and there are apparently no plans to either re-commission the existing inoperative systems or to install new systems. But EN-DC-343, Entergy's fleetwide buried piping aging management plan, contemplates corrective action for improperly-operating cathodic protection systems.[166] Entergy recommends repair of cathodic protection systems on an expedited schedule for degradation affecting safety-related systems, structures, and components, and within six months of identification for degradation affecting non-safety-related systems, structures, and components.[167] But Entergy has known for years, if not decades, that its cathodic protection systems are inoperative at Indian Point and has not taken corrective action. Since Entergy is apparently already not complying with this element of either its own fleetwide piping program or industry initiatives, it is unclear which elements of its own program or industry guidance Entergy will follow at Indian Point. Entergy has not supplied any information for corrosion mitigation of the buried piping at Indian Point; that is, Entergy has identified an inspection schedule, but has not explained what it will do to

[164] *See generally* Duquette Report and Duquette Testimony.

[165] NUREG 1801, Revision Two, Section XI.M41.

[166] EN-DC-343 at section 5.9.

[167] Testimony of David J. Duquette at 17-18; EN-DC-343.

fix problems identified by the inspections.[168]

As Dr. Duquette has observed, with reference to Entergy's inspection program being a "new" program, Entergy published an inspection schedule of buried pipes in 2008.[169] That document stated that CST Inlet – 8" Line 1509 was inspected between October 1, 2008 and December 2008. However, Dr. Duquette observes, it is exactly in that line that a leak occurred in 2009.[170] From the information Entergy has provided, it is not clear to Dr. Duquette if all of the other inspections scheduled in LO-IP#LO-2008-00151 have been accomplished using a similar, and clearly inadequate, technique or what the results of those inspections were, despite those inspections being scheduled to take place three years ago.[171]

EN-DC-343 also lists a number of NDE methods but does not require their use or offer guidance for when they should be used.[172] In summary, neither the AMP to which Entergy has committed, nor any supplemental documents Entergy has provided, includes, among other things:

- Preventative measures,
- Guidance on what non-destructive testing methods should be used and when,
- Acceptance criteria, and
- Corrosion mitigation measures.

[168] Duquette Report at 2; Duquette Testimony at 21.

[169] Duquette Report at 23, citing LO-IP3LO-2008-00151 (Exh. NYS000180).

[170] Duquette Report at 23.

[171] Duquette Report at 23.

[172] EN-DC-343, section 5.12[2].

POINT III

ENTERGY'S BURIED PIPING AMP IS INADEQUATE BECAUSE IT DOES NOT REQUIRE CATHODIC PROTECTION, WHICH IS NECESSARY AT INDIAN POINT TO MANAGE AGING PIPES DUE TO RELEVANT ENVIRONMENTAL CONDITIONS

Entergy has failed to maintain its cathodic protection systems at Indian Point in spite of documented corrosion in buried piping systems. The majority of cathodic protection systems originally installed at the plants "have been removed or are out of service."[173] The Unit 2 USFAR indicated that cathodic protection had originally been recommended and installed for the following systems:

1. Circulating water lines,
2. Service water lines,
3. Bearing piles,
4. Sheet piling (earth and water side) and wing wall anchorage system, and
5. Metallic structures inside intake structure (traveling screens, bar racks, circulating water pump suction, service water pump suction).[174]

As discussed above, Entergy has acknowledged that of those originally cathodically-protected systems,[175] there is currently no functioning cathodic protection of circulating water lines, service water lines, bearing piles, or metallic structures inside intake structures.[176]

The condition of buried pipes at Indian Point illustrates the effect of this decision. In 1994, most of the Discharge Canal sheet piling system had to be replaced due to corrosion-

[173] PCA Report at 3 of 18.

[174] IP2 UFSAR Update, Revision 20, at 5.1.3.12.

[175] In at least one document, Entergy indicates that contrary to what the FSAR indicated, the reason cathodic protection systems did not work was "the lack of cathodic protection systems being installed." Entergy Corrective Action, CR-IP2-2005-03902 (Nov. 11, 2005) ("CR-IP2-2005-03902") (Exh. NYS000177) at p. 3.

[176] PCA Report at 3 of 18.

induced loss of material.[177] Entergy's consultant identified the apparent cause for the current inactive condition of the cathodic protection system (at the end of 2005) as "latent organization weakness in that the risk associated with the lack of a CP system was not clearly understood by personnel approving resource allocation to complete the modification process".[178] Basically, Entergy personnel underestimated the importance of cathodic protection. In 2005 Entergy's System Engineering Department issued a condition report, IP2-2005-03902, which indicated that INPO had completed an investigation of the cathodic protection systems at IPEC, and had concluded that "[t]he lack of a functioning cathodic protection system in severe environmental conditions leaves piping and structures susceptible to corrosion-induced failures."[179] But Entergy had been aware of the dysfunctional status of cathodic protection at Indian Point for years before that; at Unit 1, which is no longer operating but shares some buried pipes with Units 2 and 3, a 1989 survey indicated that the cathodic protection system had deteriorated and was no longer functional.[180] The system was upgraded in 1993/1994 and was found to be functional in 1994 but was no longer functional in 2002. At Unit 2, the 1989 survey indicated that the cathodic protection system designed to protect circulation water lines, service water lines, bearing piles and metallic structures inside the intake structure, was no longer operational. A modification was performed in 2001 to bring the system back into operation but failed shortly after re-start. It was concluded that the cathodic protection system has not been providing adequate protection since 1989.[181] At Unit 3 the entire cathodic protection system

[177] CR-IP2-2005-03902.

[178] IP2-2005-03902.

[179] *Id*.

[180] *Id*.

[181] *Id*.

was "temporarily" removed in the mid-1980s and was never re-installed.[182]

Entergy commissioned a study in October of 2008, which also showed that the majority of these systems had been removed or were out of service.[183] The PCA results indicated that virtually all of the structure to soil/water potential measurements performed on the piping were well below the recommended potential of -850 mv. vs. the copper/copper sulfate electrode.[184] Further, the circulating water piping was found to be electrically continuous to the plant copper grounding system.[185] This results in a galvanic couple between the copper and the steel piping that will result in accelerated corrosion of any exposed steel.[186] A stray current problem between the cathodically protected Algonquin pipeline and the unprotected city water piping system that services the plant was also identified.[187] Soil resistivity measurements conducted by PCA at limited locations indicated that the resistivity ranged from approximately 8000 ohms/cm to approximately 63,000 ohm/cm. Eight of the locations indicated resistivities in the 10,000 ohm/cm to 30,000 ohm/cm range.[188] Soils with resistivities in that range are considered to be mildly corrosive, and the one location that measured a resistivity of approximately 8,000 ohm/cm is considered to be moderately corrosive.[189]

Based on its survey, PCA recommended the installation of a mitigation bond, or sacrificial anodes, to protect the city water system from the stray current generated by the

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[182] *Id*.

[183] PCA Report.

[184] *Id.*

[185] *Id.*

[186] Duquette Report at 21.

[187] *Id*.

[188] PCA Report at 14; Table II.

[189] Duquette Report at 21; Duquette Testimony at 23-24.

Algonquin pipeline.[190] They also recommended the installation of a deepwell anode system for high priority piping services. Finally, they recommended establishing an inspection program based on API 570 (American Petroleum Institute Standard 570 – Inspection, Repair, Alteration, and Rerating of In-Service Piping Systems).[191] Entergy has indicated that it has cathodically protected its city water line, but it does not appear to have adopted any other of PCA's recommendations.[192] Instead, Entergy has chosen to follow the requirements of XI.M34 at Indian Point, which does not contemplate the use of cathodic protection as an aging management tool. This choice is apparently driven by Entergy's acknowledgement that there is very limited cathodic protection in place at Indian Point and by the conclusions of its cathodic protection consultant that:

> The installation of a cathodic protection system after plant construction can become difficult and generally expensive. This problem is exaggerated in the presence of subsurface rock as reported for this site.[193]

In its recent letter to the NRC, Entergy indicates that it will undertake soil testing and if the test results indicate the soil is corrosive, will increase the number of piping inspections to 20 during each 10-year period of the period of extended operation.[194] As stated above, Entergy's consultant PCA Engineering's 2008 report already indicates the presence of corrosive soils at Indian Point. Entergy recognizes that a more frequent inspection program is appropriate given Indian Point's soil conditions but has not committed to implementing it. Entergy seems to have disregarded entirely the conclusions of its consultants' 2008 report.

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[190] PCA Report at 16-18.

[191] *Id.*

[192] Supplemental Safety Evaluation Report at 3-3.

[193] PCA Report at 14.

[194] NL-11-074 (Exh. NYS000152).

Dr. Duquette has testified that implementing the recommendations of the PCA report would have brought IPEC into reasonable agreement with NUREG-1801 Section XI.M41 for buried and underground pipes, as well as with NEI and EPRI buried piping programs.[195] However, as has been noted, Entergy has aligned its buried piping AMP in its LRA with the out-of-date NUREG-1801 Section XI.M34. It is especially important to implement NUREG-1801 Section XI.M41 because Entergy has experienced both leaks and indications of coating damage at Indian Point.

Notwithstanding the historical application of cathodic protection, current conditions dictate that without cathodic protection of certain critical systems, the aging of buried pipes at Indian Point cannot be adequately managed. This is supported by Entergy's 2005 Condition Report which called for corrective action concerning inactive cathodic protection systems, by EPRI, by NEI, by NRC Staff in the most recent GALL Report, by Entergy's own EN-DC-343, and by best practices for corrosion prevention.

Staff, in its Supplemental Safety Evaluation Report, has approved of Entergy's AMP notwithstanding the fact that it does not require Entergy to take corrective action to fix out-of-service cathodic protection systems because (1) the applicant is risk informing its piping inspection locations to select those with the greatest potential for leakage; (2) the applicant is sampling the soil for corrosivity prior to and during the period of extended operation, using standard industry methodologies to determine soil corrosivity, and will be increasing the number of inspections if the soil is corrosive; and (3) recent limited inspections found that the backfill did not contain rocks or foreign material that would damage external coatings and the

[195] Duquette Report at 14.

coatings were found to be in good condition.[196] In the view of the State's expert Dr. Duquette, cathodic protection is required in addition to these measures.[197] Moreover, as illustrated above, the number of inspections Entergy "committed" to undertaking is not enforceable, as it is contained only in an RAI response and nowhere else. Staff fails to note this in its Supplemental Safety Evaluation Report, and has not required Entergy to incorporate the number of its inspections into its AMP.

POINT IV

ENTERGY HAS NOT CARRIED ITS BURDEN CONCERNING MANAGEMENT OF BURIED COMPONENTS AT INDIAN POINT UNIT ONE

The Board, in admitting Contention 5, stated that:

> In regards to IP1, Entergy referenced a generic statement contained in Section 1.2 of the LRA to the effect that IP1 SSCs that interface with the operation of IP2 and IP3 were considered in the scoping process and a commitment that their aging effects will be adequately managed for the period of extended operation. However, no other details were provided to (1) define the relevant IP1 components that fall under Section 54.21; (2) demonstrate that the IP2/IP3 AMP for buried pipes (contained in the LRA) pertains to IP1 SSCs that are relied upon for the proposed extended operations; and (3) delineate the extent of the proposed aging management activities that will be conducted on the IP1 SSCs. Based on this, the Board concludes that there remains a material dispute as to the existence and adequacy of the AMP for IP1-buried SSCs that are being used by IP2 and IP3 during the license renewal period, and that this dispute is subject to further litigation under this admitted contention.[198]

But Entergy has not provided a site-specific AMP at all, and has therefore not provided any information concerning the Indian Point Unit 1 components which it alleges fall under its AMP.

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[196] Supplemental Safety Evaluation Report at section 3.0.3.1.2.

[197] Duquette Report at 24; Duquette Testimony at 26.

[198] Contention Admissibility Order at 35.

There is apparently no "AMP for IP1-buried SSCs that are being used by IP2 and IP3 during the license renewal period," even though Entergy has known that since 1989 that the cathodic protection system at Unit 1 had deteriorated and was no longer functional.[199] Entergy has failed to carry its burden as to this prong of Contention 5.

CONCLUSION

In this proceeding, the State of New York and other intervenor parties have satisfied the standards contained in 10 C.F.R. § 2.309 governing contention admissibility – standards that NRC and Entergy have described as "strict by design." The State now submits this testimony to show that Entergy has not met its burden; that is, Entergy has not demonstrated that the effects of aging on the intended function(s) of buried pipes will be adequately managed for the period of extended operation. Dr. Duquette has testified that Entergy's AMP will not adequately manage aging of buried pipes since Entergy has not (1) taken steps including adopting the recommendations of the NEI and EPRI reports, including cathodic protection of buried pipes; (2) followed the dictates of NUREG-1801 Section XI.M41; (3) clearly identified acceptance criteria for corrosion damage to buried pipes; and (4) clearly stated the repair and remediation procedures to be followed if the corrosion damage lies outside of the acceptance criteria. Additionally, Entergy must (1) define the relevant Indian Point Unit 1 components that fall under Section 54.21; (2) demonstrate that the Indian Point Unit 1/Unit 2 AMP for buried pipes (contained in the LRA) pertains to Indian Point Unit 1 systems, structures, and components that are relied upon for the proposed extended operations; and (3) delineate the extent of the proposed aging management activities that will be conducted on the Indian Point Unit 1 systems, structures, and components.

[199] IP2-2005-03902.

For the above reasons Entergy's application to renew the operating licenses for Indian Point Unit 2 and Unit 3 should be denied.

Respectfully submitted,

Signed (electronically) by

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