

1 UNITED STATES

2 NUCLEAR REGULATORY COMMISSION

3 BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

4 -----X

5 In re: Docket Nos. 50-247-LR; 50-286-LR
6 License Renewal Application Submitted by ASLBP No. 07-858-03-LR-BD01
7 Entergy Nuclear Indian Point 2, LLC, DPR-26, DPR-64
8 Entergy Nuclear Indian Point 3, LLC, and
9 Entergy Nuclear Operations, Inc. December 16, 2011

10 -----X

11 PRE-FILED WRITTEN TESTIMONY OF

12 DR. DAVID J. DUQUETTE, Ph.D

13 REGARDING CONTENTION NYS-5

14 On behalf of the State of New York ("NYS" or "the State"),
15 the Office of the Attorney General hereby submits the following
16 testimony by Dr. David J. Duquette, Ph.D, regarding Contention
17 NYS-5.

18 Q. Please state your name and address.

19 A. David J. Duquette, Materials Engineering Consulting
20 Services, 4 North Lane, Loudonville, New York 12211.

21 Q. What is your educational background?

22 A. My educational and professional experience is detailed
23 in the attached curriculum vitae (CV)(Exhibit NYS000166); also

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 attached is a list of my publications, awards, and other
2 professional activities. I am a graduate of the United States
3 Coast Guard Academy and the Massachusetts Institute of
4 Technology. I performed my graduate work at the Corrosion
5 Laboratory at the Massachusetts Institute of Technology (MIT),
6 spent two years as a Research Associate at the Advanced
7 Materials Research and Development Laboratory at Pratt and
8 Whitney Aircraft prior to joining the faculty at Rensselaer
9 Polytechnic Institute.

10 Q. What is your professional experience, particularly as
11 it relates to corrosion prevention?

12 A. My research is primarily in the area of corrosion
13 science and engineering. I have supervised more than 50
14 graduate research dissertations in corrosion and related
15 sciences. I am the author or co-author of more than 230
16 publications and 20 book chapters. I present invited lectures
17 internationally 20 to 25 times per year. I just completed nine
18 years of service on the United States Nuclear Waste Technical
19 Review Board, having been appointed to the Board by President
20 Bush in 2002. I also maintain an active consulting practice,
21 primarily in the area of corrosion and mechanical failures. A
22 list of my publications is attached at Exhibit NYS000166.

23 Q. Can you cite specific examples of recognition by the

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 scientific community?

2 A. I have been elected a Fellow of three learned
3 societies, ASMI (formerly the American Society of Metals), NACE
4 (formerly known as the National Association of Corrosion
5 Engineers) and ECS (the Electrochemical Society). I have
6 received the Whitney Award of NACE for outstanding corrosion
7 research, an A. v. Humboldt Senior Scientist Award from the
8 German government, as well as other awards from the scientific
9 community.

10 Q. What materials have you reviewed in preparation for
11 your testimony?

12 A. Among the materials I have reviewed are Entergy's
13 buried and underground piping-related disclosures and NRC
14 documents and technical data as disclosed in this proceeding.

15 Q. I show you NYS Exhibits NYS00147A-NYS00147D,
16 NYS000151, NYS000152, NYS000154, NYS000160, and NYS000166
17 through NYS000203. Do you recognize these documents?

18 A. Yes. These are true and accurate copies of each of
19 the documents that I referred to, used and/or relied upon in
20 preparing my report and this testimony. In some cases, where
21 the document was extremely long and only a small portion is
22 relevant to my testimony, an excerpt of the document is
23 provided. If it is only an excerpt, that is noted on the first

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 page of the Exhibit.

2 Q. Did you review anything else in preparing your report
3 or this testimony?

4 A. Yes, I reviewed other documents Entergy produced in
5 this proceeding, including previous iterations of Entergy's
6 corporate documents, and concluded that they were not relevant
7 in preparing my report and this testimony. I reviewed lists of
8 the documents the State of New York, Entergy and NRC Staff
9 produced in this proceeding, using the descriptions provided on
10 the logs provided, and determined that there were none other
11 than the ones I attach as Exhibits that I needed to rely on.

12 Q. I show you what has been marked as Exhibit NYS000165.
13 Do you recognize that document?

14 A. Yes. It is a copy of the report that I prepared for
15 the State of New York in this proceeding. The report reflects
16 my analysis and opinions.

17 Q. What is the purpose of your testimony?

18 A. My testimony critiques Entergy's aging management
19 program (AMP) for buried and underground pipes and tanks.

20 Q. What is the difference between buried and underground
21 pipes?

22 A. Entergy indicates that underground pipes include those
23 that are, and are not, in direct contact with soil, and uses the

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 term buried to refer to pipes which are in direct contact with
2 soil. My report deals primarily with underground systems that
3 are in direct contact with soil so I use the term "buried".

4 Q. What, in general terms, does this report consist of?

5 A. This report contains a discussion of factors
6 influencing corrosion of buried pipes, how to prevent corrosion
7 using coatings and cathodic protection, briefly discusses
8 corroding and leaking pipes at Indian Point and other nuclear
9 power plants, and explains my understanding and critique of
10 Entergy's AMP for buried pipes.

11 Q. What is corrosion?

12 A. Corrosion of metals and alloys in underground piping
13 systems occurs when water comes into contact with the metal.
14 Corrosion rates of metals can be very slow in pure deaerated
15 water, but the presence of oxygen, which is admitted to the
16 water from air in most engineering cases, greatly increases the
17 corrosion rates. The corrosion reaction occurs because the
18 metal is oxidized by the oxygen with the production of hydroxyl
19 ions because of the combination of water and oxygen. The metal
20 is oxidized to a positive ion with the surrender of one or more
21 electrons. The site on which this reaction occurs is called the
22 anode. The electrons that are released from the anode
23 participate in the reduction of dissolved oxygen, to produce

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 hydroxide, on local sites called cathodes. In neutral solutions
2 $4 < \text{pH} < 10$, the positively charged metal ions combine with the
3 hydroxide, which has a negative charge, to form a nearly
4 insoluble compound. When the metal is iron, the metal hydroxide
5 that is formed is generically called "rust"- $\text{Fe}(\text{OH})_3$. In
6 general, if rust is deposited on the surface of an iron based
7 material, it will have a protective role, reducing the rate of
8 oxygen arrival to the metal surface and accordingly reducing the
9 general corrosion rate.

10 Q. What factors affect corrosion?

11 A. Factors that affect the corrosivity of water to iron
12 based surfaces include the aforementioned levels of oxygen, the
13 conductivity of the water, the specific ion concentration of the
14 water, and the pH of the water. The conductivity of the water
15 is important because the local anodic sites on a surface can
16 only react with equivalent cathodic sites. If water has a low
17 conductivity the distance between anodes and cathodes is
18 limited. In high conductivity solutions anodes and cathodes can
19 be widely spaced allowing more interaction between surface
20 sites.

21 Q. What types of pipes are affected by corrosion?

22 A. The vast majority of piping systems are constructed
23 from either low carbon steel (sometimes called mild steel), or

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 cast iron. Both of these materials are iron based. In near
2 neutral environments the specific structure of the steel or cast
3 iron does not have a strong effect on the corrosion behavior.
4 There are, of course many miles of pipe that are constructed of
5 stainless steel, copper alloys or, in rare cases titanium
6 alloys, as well as non-metallic materials such as HDPE or PVC.
7 However, those materials will show appreciable corrosion only
8 under rather severe conditions and accordingly I have not
9 devoted much time to these in my report, as I do not believe
10 them to be present, or present in high numbers, at Indian Point.
11 Steel and cast iron pipes can suffer from internal corrosion,
12 but my report focuses on a discussion of external corrosion of
13 pipes, specifically those in contact with soils: the factors
14 that affect external corrosion, and the steps that may be taken
15 to mitigate external corrosion of underground pipe.

16 Q. What factors affect external corrosion?

17 A. Soils can be considered to be a kind of poultice, or
18 sponge, when they are in contact with underground piping
19 systems. Accordingly they will hold water against a pipe
20 surface for extended periods of time even after the external
21 environment has changed from wet to dry. Thus, rain at the
22 surface of the ground will provide water to the soil, but the
23 soil may stay saturated with water for long periods after

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 precipitation ceases. Soils may also contain soluble species
2 such as nitrates, sulfates, chlorides, organic compounds, etc.
3 Each of these species, alone or in combination can dramatically
4 affect corrosion rates of buried metals. The effects may range
5 from simply increasing the conductivity of the soil or by
6 reducing the effectiveness of otherwise protective corrosion
7 products such as the effects of chlorides or the possibility of
8 adding weak acid that may either deleteriously affect the
9 protective properties of corrosion product films or may make
10 soluble corrosion products (for example, chlorides or the
11 addition of weak acids that may deleteriously affect the
12 protective properties of corrosion product films or may even
13 make soluble corrosion products). The ability of a soil to
14 retain water and the chemical make-up of soil are paramount in
15 affecting the corrosion behavior of buried metals such as the
16 iron based alloys used for piping systems.

17 Q. What steps can be taken to prevent corrosion?

18 A. Primarily, corrosion is prevented by applying coatings
19 to the piping systems, and by cathodically protecting the pipes.

20 Q. What types of coatings are you referring to?

21 A. Most steel and cast iron pipes that are intended for
22 long service and are buried use some form of protection from
23 corrosion by soils. Usually some level of protection is afforded

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 by the application of surface coatings. These coatings range
2 from simple painted surfaces, e.g., conventional or epoxy paints
3 to the use of sacrificial coatings such as galvanizing. In some
4 cases enamels are used while in other cases bituminous coatings
5 such as coal tar are utilized. Other types of coatings include
6 tape wraps that may range from paper to polymer based tapes. In
7 many cases, if wrapping is used, a second layer of coating may
8 be applied over the wrapping. Even with coated pipes, however,
9 there is always a concern about breaks in the coatings
10 (holidays), either introduced during the coating process,
11 installation of the pipes or damage induced after installation.
12 When breaks in the coating occur the corrosion damage, in some
13 cases, can be more severe than if there is no coating at
14 all. At breaks in the coating all of the corrosion damage may
15 be concentrated in a single location so that a deep pit may
16 perforate the pipe. Another possibility is that the interface
17 between the coating and the pipe surface may introduce an
18 effective crevice. Crevice corrosion can be especially damaging
19 because the electrolyte chemistry in a crevice tends to be much
20 more aggressive than the bulk electrolyte. In order to prevent
21 localized corrosion at holidays in the coatings, cathodic
22 protection is often used.

23 Q. What is cathodic protection?

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 A. Cathodic protection effectively lowers the
2 electrochemical potential of steel to a potential that is below
3 that required to oxidize the steel. Another way of expressing
4 that is in the electrochemical couple between a sacrificial
5 coating such as zinc and steel, the steel becomes the cathode
6 while the zinc becomes the anode. The zinc then corrodes in a
7 "sacrificial" manner to protect the steel. If the zinc coats
8 the steel the steel is said to be "galvanized". In many cases
9 the zinc anodes can also be placed in the same electrolyte as
10 the steel (in the case of IPEC, in water saturated soil). As
11 long as there is electrical contact between the zinc and the
12 steel the zinc will preferentially corrode. There are distinct
13 disadvantages to using zinc coatings or zinc anodes to protect
14 steel from corrosion. In the first instance (coatings) the
15 lifetime of zinc coatings is rather limited, and once the zinc
16 coating has corroded away the underlying steel is subject to
17 corrosion. In the second instance (replaceable anodes) the zinc
18 anodes also have a limited lifetime and must be monitored,
19 retrieved and replaced on a regular basis. For many buried
20 structures the maintenance period is on the order of a year.
21 From an operating plant point of view the most efficient method
22 for protecting buried structures from corrosion is an impressed
23 current system. When metals corrode the metal becomes a

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 positively charged ion with the release of one or more
2 electrons. It is those electrons that are available to reduce
3 some dissolved species in the environment. In near neutral
4 environments such as water in most soils, dissolved oxygen in
5 the aqueous environment is often the species reduced to produce
6 hydroxide. The hydroxide is then available to combine with the
7 positively charged ions produced by the corrosion reaction to
8 produce a sparingly soluble metal hydroxide, or hydrated metal
9 oxide; rust in the case of iron alloys. If electrons can be
10 provided to the metal surface from an external source, the metal
11 will not become oxidized (become positively charged), and
12 corrosion will effectively be reduced or stifled altogether.
13 The application of current in this manner is known as an
14 impressed current system and requires a DC power supply to
15 deliver electrons from an anode to the metal surface. The
16 anodes in this case are usually conducting but inert materials.
17 For example graphite is often used as an anode. From a
18 thermodynamic point of view the application of current to the
19 metal lowers the electrochemical potential of the metal to a
20 level where corrosion cannot occur. The method for measuring
21 the effectiveness of impressed cathodic protection systems,
22 especially for buried steel structures, is to measure the
23 potential of the steel vs. an electrode that has a standard

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 potential. The most commonly used standard electrode is a
2 copper/copper sulfate electrode that has a standard or reference
3 potential of +0.314 volts. For most impressed current systems
4 used to protect steel from corrosion, the measured potential
5 that will provide complete protection is considered to be -0.85
6 volts vs. the standard copper-copper sulfate electrode.

7 A potential disadvantage of impressed current systems for buried
8 structures is that the amount of current required to "polarize"
9 the steel to the protection potential criterion is proportional
10 to the surface area of the steel to be protected. For "bare"
11 pipes this can require a significant amount of power. However,
12 for pipes that are wrapped or coated, the cathodic protection
13 system need only protect the "holidays" and the power
14 requirements are greatly reduced. A further important
15 consideration is that the conductivity of the soil becomes very
16 important because of current-resistance losses in the soil.
17 Thus spacing of the anodes becomes an important aspect of any
18 impressed current cathodic protection system. Nevertheless,
19 design criteria are readily available for installation of anodes
20 if soil conductivities are known. The amount of current that is
21 required to control corrosion of buried steel structures,
22 especially pipelines, is generally controlled by applying
23 coatings to the steel. Accordingly the current is only required

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 to protect the areas exposed by the holidays in the coatings.
2 The holidays may be incorporated into the coatings during
3 application, or may be induced by damage or deterioration of the
4 coatings after emplacement of the structures.

5 Q. Turning back to aging management programs, has the
6 industry issued any guidance concerning aging management of
7 buried pipes that you are aware of?

8 A. Yes. Both the Nuclear Energy Institute (NEI) and the
9 Electric Power Research Institute (EPRI) have issued guidance
10 documents addressing utilities' approaches to managing aging of
11 buried pipes. I have reviewed NEI's Industry Guidance for the
12 Development of Inspection Plans for Buried Piping and Guideline
13 for the Management of Underground Piping and Tank Integrity,
14 also identified as NEI 09-14, and EPRI's Recommendations for an
15 Effective Program to Control the Degradation of Buried Pipe. I
16 discuss both in greater detail in my report. There may be
17 additional industry guidance documents in existence also but I
18 have not focused on those.

19 Q. What are the main points made in the NEI and EPRI
20 reports?

21 A. Primarily, NEI's Industry Guidance for the Development
22 of Inspection Plans for Buried Piping and Guideline for the
23 Management of Underground Piping and Tank Integrity, states

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 that the specific inspections and examinations that are
2 performed will be based on degradation observed or expected, the
3 susceptibility of the pipe to leakage, the consequences of the
4 leak, and the location of the pipe. The document further details
5 the number of inspections that should be required, especially
6 for those lines that carry Licensed Material.

7 The Buried Pipe Integrity Task Force, which is affiliated
8 with NEI, released a report which cites criteria for inspection
9 including that depending on pipe length, two, or in some cases
10 three "direct examinations of the highest susceptible locations,
11 with acceptable results, may be sufficient to demonstrate
12 reasonable assurance". The phraseology "highest susceptible
13 locations" is critical since susceptibility of buried pipes to
14 corrosion is determined by the characteristics of the soil/water
15 combination at all locations at a given site. Accordingly it is
16 paramount that, as a minimum, soil conductivity, chemistry,
17 drainage, and water retention are characterized to determine the
18 best locations for direct measurements.

19 The EPRI program contains six elements: (1) developing
20 a corporate program including training, implementing procedures,
21 documentation, and performance indicators; (2) prioritizing
22 buried pipe systems and locations to be inspected based on risk
23 of failure (including likelihood and consequence of failure);

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 (3) performing direct inspections to quantify the degree of
2 degradation and damage; (4) evaluating the fitness-for-service
3 of degraded buried pipes; (5) selecting the appropriate repair
4 technique where required, including both non-welded and welded
5 repairs; and (6) taking preventive actions to reduce the risk
6 (likelihood and consequence) of future leaks or failures. The
7 EPRI report recommends that specify not only periodic and
8 opportunistic inspections, but inspections based on local
9 conditions of the piping. Both the NEI and EPRI documents
10 recommend cathodic protection for critical piping systems.

11 Q. Do you believe an aging management program is
12 necessary to manage the aging of buried pipes at Indian Point?

13 A. Yes. The fact that Indian Point has already
14 experienced leaks, detailed in my report, indicates to me that
15 there are already corrosion problems at the facility and that
16 appropriate measures must be taken to prevent such piping
17 failures in the future.

18 Q. Has Entergy agreed that it needs an aging management
19 plan to address aging of buried pipes and tanks?

20 A. Yes. I also note that Entergy has endorsed the
21 EPRI report and I believe Entergy took part in drafting the NEI
22 initiative also.

23 Q. What is your understanding of what constitutes

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 Enterger's AMP?

2 A. As I understand it, Enterger's AMP is contained in its
3 License Renewal Application (LRA), section B.1.6, as well as
4 subsequent commitments and/or license renewal amendments. The
5 LRA at Section B.1.6 said only that Enterger would take
6 preventive measures to mitigate corrosion and perform
7 inspections to manage the effects of corrosion and provided for
8 only opportunistic inspections. The AMP states that the
9 inspection program will be consistent with program attributes
10 described in NUREG-1801, Section XI.M34, but offers no details.
11 This is a version of the GALL Report which has since been
12 superseded. Obviously, these bare statements are insufficient to
13 provide an understanding of what exactly Enterger would be doing
14 to manage aging of buried pipes.

15 Subsequently, Enterger revised its LRA to include a new
16 commitment, in which Enterger said it would:

17 include in the Buried Piping and Tanks Inspection
18 Program described in LRA Section B.1.6 a risk
19 assessment of in-scope buried piping and tanks
20 that includes consideration of the impacts of
21 buried piping or tank leakage and of conditions
22 affecting the risk for corrosion. Classify pipe
23 segments and tanks as having a high, medium, or
24 low impact of leakage on reliable plant
25 operation. Determine corrosion risk through
26 consideration of piping or tank material, soil
27 resistivity, drainage, the presence of cathodic
28 protection and the type of coating. Establish
29 inspection priority and frequency for periodic

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 inspections of the in-scope piping and tanks
2 based on the results of the risk assessment.
3 Perform inspections using inspection techniques
4 with demonstrated effectiveness.
5

6 This commitment was made in 2009 in a document identified
7 as NL-09-111, Attachment 2. No information is provided
8 concerning what factors Entergy will take into account in
9 performing a risk assessment or to classify its pipes, or how
10 frequently Entergy will inspect pipes according to their
11 priority, among other things. Moreover, Entergy makes no
12 commitment to taking any mitigative measures if problems are
13 found.

14 Q. Has Entergy provided other information that is related
15 to its AMP?

16 A. Yes. Entergy has produced a number of documents which
17 are not explicitly part of its LRA, AMP. These include CEP-UPT-
18 0100 "Underground Piping and Tanks Inspection and Monitoring",
19 issued 31 October 2011; EN-DC-343 (Rev. 4), "Underground Piping
20 and Tanks Inspection and Monitoring Program", an inclusion in
21 the IPEC Nuclear Management Manual, issued May 16, 2011; and
22 SEP-UIP-IPEC, "Indian Point 2 & 3 Underground Components
23 Inspection Plan" approved April 29, 2011. I do not understand
24 these to be part of Entergy's LRA but have addressed them in my
25 report.

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 Q. What, generally, is your conclusion about the adequacy
2 of Entergy's AMP for buried pipes and tanks?

3 A. There is nothing in the AMP at all to determine what
4 Entergy is committing to doing except a conceptual framework. It
5 is wholly deficient. Even if these other documents (which are
6 not part of the LRA) were adopted, Entergy still would not have
7 an adequate AMP, for numerous reasons.

8 Q. What are the specific reasons you believe Entergy's
9 AMP for buried pipes is deficient?

10 A. There are many reasons. First, Entergy's AMP, as
11 I described it above, contains very few actual commitments.
12 It is conceptual and aspirational in nature, stating only
13 that it will "will be effective for managing aging effects
14 since it will incorporate proven monitoring techniques,
15 acceptance criteria, corrective actions, and administrative
16 controls" without including those monitoring techniques,
17 acceptance criteria, corrective actions, or administrative
18 controls. Likewise, the newest revised commitment, in the
19 attachment to NL-11-090, states that Entergy will classify
20 pipe segments, determine corrosion risk through
21 consideration of piping or tank material, soil resistivity,
22 drainage, the presence of cathodic protection and the type
23 of coating, establish inspection priority and frequency for

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 periodic inspections of the in-scope piping and tanks based
2 on the results of the risk assessment, and perform
3 inspections using inspection techniques with demonstrated
4 effectiveness - but Entergy offers no pipe classification,
5 determination of corrosion risk, inspection priority or
6 frequency list, or specific inspection techniques it will
7 use. Without seeing the actual program, including
8 acceptance criteria and commitments to undertake repairs
9 that Entergy intends to adopt, it is not possible to
10 determine at this time whether the inspection program will
11 meet the requirements for an adequate AMP.

12 Q. Do the corporate documents Entergy provided shed
13 light on these missing details?

14 A. Yes, Entergy has offered more detail in corporate
15 documents it disclosed (of primary relevance EN-DC-343
16 (Rev. 4), CEP-UPT-0100, and SEP-UIP-IPEC), but these
17 internal documents are not included in the commitment from
18 Entergy or made a part of the LRA. They are presumably
19 subject to modification by Entergy without NRC approval and
20 would not be obligations imposed on Entergy by a renewed
21 license. The procedures and oversight section of EN-DC-343
22 refers to Entergy's document CEP-UPT-0100 as the
23 requirement associated with the scope, risk ranking and

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 examination techniques to be followed. In the risk ranking
2 section, an assemblage of a set of as-built drawings is
3 required. It is not clear if such a set actually exists or
4 if it was or will be provided for review in the LRA
5 licensing process.

6 Q. You said that even if Entergy's corporate
7 documents were adopted into the LRA, Entergy's AMP would
8 still fall short. What do you mean by that?

9 A. For example, the procedures and oversight section of
10 EN-DC-343 refers to Entergy's document CEP-UPT-0100 as the
11 requirement associated with the scope, risk ranking and
12 examination techniques to be followed. In the risk ranking
13 section, an assemblage of a set of as-built drawings is
14 required. It is not clear if such a set actually exists or if
15 it was or will be provided for review in the LRA licensing
16 process.

17 Additionally, EN-DC-343 calls for each plant to develop its
18 own site-specific Underground Piping and Tanks Inspection and
19 Monitoring Program. However, I have not been provided with an
20 Indian Point-specific Program, and have reviewed only Entergy's
21 fleetwide program. Nor am I aware that one exists. Thus, I
22 cannot assess what Indian Point's specific program will entail.

23 With regard to repairs, EN-DC-343 says only that

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 "Contingency planning should be in place for prompt
2 implementation in case an underground segment fails to meet
3 acceptance criteria." (EN-DC-343, Rev. 4 at 16.) But Entergy
4 has not provided its acceptance criteria, making it impossible
5 to assess its effectiveness.

6 EN-DC-343 calls for newly installed piping to be coated,
7 that proper use of fill should be used when excavating and re-
8 burying components, and that baseline inspections should be
9 performed prior to piping installation. However, this is not an
10 aging management program. These are simply best practices for
11 any underground pipes, and do not indicate any efforts that will
12 be taken to manage already-aging pipes such as those present at
13 Indian Point.

14 Q. What is the second reason you believe Entergy's AMP is
15 deficient?

16 A. Second, an inspection program, *per se*, is not adequate to
17 ensure the safe operation of engineering systems. The
18 acceptability of the results of the inspection program,
19 including the criteria to be applied to continued operation,
20 remediation, or replacement, should be specified. Entergy has
21 not identified when it will take mitigative measures if problems
22 are found, or what those mitigative measures will be. Also,
23 although Entergy says it will conduct many pre-period of

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 extended operation inspections, it is not clear how many
2 inspections, if any, have already taken place that Entergy is
3 counting against this requirement but that were not conducted to
4 the standards to which Entergy's new program would dictate they
5 should be conducted.

6 Q. Are there other reasons why you believe Entergy's AMP
7 is deficient?

8 A. Yes. Entergy has not committed to reinstalling
9 cathodic protection at Indian Point, despite NEI, EPRI,
10 Entergy's own corporate guidance documents and consultants'
11 reports, and NRC Staff in the new GALL Report revision stressing
12 the importance of cathodic protection. Apart from the industry-
13 wide focus on cathodic protection in general, Entergy's own
14 studies show that the soils at Indian Point are mildly to
15 moderately corrosive, warranting cathodic protection as an
16 objective matter. Entergy's consultant PCA Engineers, issued a
17 report called which assessed the status of cathodic protection
18 at Indian Point, and found a "latent organization weakness in
19 that the risk associated with the lack of a CP system was not
20 clearly understood by personnel approving resource allocation to
21 complete the modification process". PCA Engineers found that
22 nearly all cathodic protection systems at Indian Point were out
23 of service, and recommended reinstallation. Entergy did not

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 take PCA Engineers' recommendation and neither Entergy's AMP nor
2 its corporate documents even reference the PCA study.

3 This is another example of where Entergy's corporate
4 documents do not say the same thing as their AMP. EN-DC-343 says
5 that for plants with installed cathodic protection systems for
6 underground piping and tanks, Entergy should ensure that the
7 proper operation of the systems is verified semi-annually. EN-
8 DC-343 calls for cathodic protection degradation affecting
9 safety-related structures, systems, and components (SSCs) to be
10 repaired with "the Work Week T-process", which I presume to be
11 an expeditious schedule (as compared with the non-safety-related
12 SSCs, which are to be repaired within only six months of
13 detection of a problem). CEP-UPT-0100 states that "existing
14 [cathodic protection] systems may be upgraded or a new [cathodic
15 protection] system installed" and requires that plants with
16 installed cathodic protection systems verify proper operation of
17 these systems, periodically test them, ensure the system is
18 evaluated in accordance with EN-DC-343, put an individual in
19 charge of the cathodic protection system, and verify that
20 cathodic protection systems are corrected on a schedule
21 commensurate with the safety significance of the system or
22 component being protected. But Entergy knows there is
23 widespread cathodic protection system degradation of both safety

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 and non-safety-related SSCs at Indian Point, and has not
2 committed to repairing these systems. Given that Entergy has
3 chosen to follow an outdated version of NUREG 1801 specifically
4 because it does not require cathodic protection, it does not
5 appear that Entergy is proposing to implement EN-DC-343 or CEP-
6 UPT-0100 at Indian Point.

7 Q. Did PCA Engineers find the soils at Indian Point to be
8 corrosive?

9 A. Yes. Soil resistivity measurements conducted by PCA at
10 a limited number of locations indicated that the resistivity
11 ranged from approximately 8,000 ohms/cm to approximately 63,000
12 ohm/cm. Eight of the locations indicated resistivities in the
13 10,000 ohm/cm to 30,000 ohm/cm range. Soils with resistivities
14 in that range are considered to be mildly corrosive. One
15 location that measured a resistivity of approximately 8,000
16 ohm/cm is considered to be moderately corrosive.

17 Q. Are there other reasons you believe Entergy's AMP for
18 buried pipes is insufficient?

19 A. Yes. I find that Entergy has made a number of
20 inconsistent statements concerning what exactly it plans to do.
21 In addition to the above example about cathodic protection, for
22 example, Entergy says its inspection intervals are determined by
23 using inspection priority. For buried sections with a

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 high/high, high/medium, or medium/high impact-corrosion risk
2 (which would include the piping systems within the scope of this
3 contention, since Entergy has designated all radioactive fluid-
4 containing piping systems "high priority" in CEP-UPT-0100),
5 inspections are supposed to be done every ten years. As an
6 initial matter, such a long period between inspections is
7 questionable, especially for the highest risk piping systems.
8 But in its response to NRC's most recent RAI on buried pipes,
9 Entergy stated it would perform more than 80 inspections. It is
10 not clear how Entergy's response to the RAI squares with the
11 information in Entergy's corporate documents setting inspection
12 priority and scheduling every ten years. It bears repeating
13 here again that Entergy has not committed to either of these
14 inspection schedule, as neither appears in the AMP or in a
15 regulatory commitment, and that the only thing Entergy has
16 committed to in its AMP is creating an unspecified plan that
17 will manage aging.

18 Q. In your opinion, is Entergy's AMP for buried pipes and
19 tanks adequate to manage aging even though it does not require
20 cathodic protection?

21 A. No.

22 Q. Are you aware that NRC Staff, in its Supplemental
23 Safety Evaluation Report, found that the AMP was sufficient even

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 though it does not require cathodic protection?

2 A. Yes. I do not agree with that conclusion.

3 Q. What do you recommend Entergy do in order to create a
4 sufficient AMP for buried pipes?

5 A. I recommend that Entergy adopt the recommendations of
6 the NEI and EPRI reports, including cathodic protection of
7 buried pipes, follow the dictates of NUREG-1801, Revision 2,
8 Section XI.M41, clearly identify acceptance criteria for
9 corrosion damage to buried pipes, and clearly state the repair
10 and remediation procedures to be followed if the corrosion
11 damage lies outside of the acceptance criteria.

12 Q. Why do you believe cathodic protection is important at
13 Indian Point?

14 A. Plant conditions at IPEC indicate that the soil is
15 corrosive. As I discuss in my report, Entergy's inspections
16 indicate that in at least one location, piping degradation has
17 reduced pipe wall thickness by 85% (that is, to only 15%). IPEC
18 has experienced through-wall failures in the condensate storage
19 line, and Entergy's own consultants have issued a report
20 indicating that the soils are corrosive.

21 Q. Did you see any mention of Unit 1's buried piping
22 systems in the documents you reference above?

23 A. No.

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 Q. Have you now completed your initial testimony
2 regarding the contention?

3 A. Yes.

4 I have reviewed all the exhibits referenced herein. True
5 and accurate copies are attached.

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*

1 UNITED STATES

2 NUCLEAR REGULATORY COMMISSION

3 BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

4 -----X

5 In re: Docket Nos. 50-247-LR; 50-286-LR
6 License Renewal Application Submitted by ASLBP No. 07-858-03-LR-BD01
7 Entergy Nuclear Indian Point 2, LLC, DPR-26, DPR-64
8 Entergy Nuclear Indian Point 3, LLC, and
9 Entergy Nuclear Operations, Inc. December 16, 2011

10 -----X

11 DECLARATION OF DAVID J. DUQUETTE

12 I, David J. Duquette, do hereby declare under penalty of
13 perjury that my statements in the foregoing testimony and my
14 statement of professional qualifications are true and correct to
15 the best of my knowledge and belief.

Executed in Accord with 10 C.F.R. § 2.304(d)



David J. Duquette, Ph.D.
Materials Engineering Consulting Services
4 North Lane
Loudonville, New York 12211
Tel: 518 276 6490
Fax: 518 462 1206
Email: duqued@rpi.edu
December 16, 2011

*Pre-filed Written
Testimony of David J. Duquette
Contention NYS-5*