

In the Matter of: Entergy Nuclear Operations, Inc.
(Indian Point Nuclear Generating Units 2 and 3)

ASLBP #: 07-858-03-LR-BD01
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UNITED STATES

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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In re: Docket Nos. 50-247-LR; 50-286-LR
License Renewal Application Submitted by ASLBP No. 07-858-03-LR-BD01
Entergy Nuclear Indian Point 2, LLC, DPR-26, DPR-64
Entergy Nuclear Indian Point 3, LLC, and
Entergy Nuclear Operations, Inc. October 5, 2012

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PRE-FILED WRITTEN REBUTTAL TESTIMONY OF

DR. DAVID J. DUQUETTE

REGARDING CONTENTION NYS-5

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

Q. What documents did you review in preparation for this
rebuttal testimony?

A. I read Entergy's Statement of Position Regarding
Contention NYS-5 (Buried Piping and Tanks); the Testimony of
Entergy Witnesses Alan Cox, Ted Ivy, Nelson Acevedo, Robert Lee,
Stephen Biagiotti, and Jon Cavallo Concerning Contention NYS-5

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1 (Buried Piping and Tanks) and the exhibits thereto ("Entergy
2 Testimony"). I also read NRC Staff's Statement of Position on
3 Contention NYS-5 (Buried Pipes and Tanks) and the Testimony of
4 Kimberly J. Green and William C. Holston Concerning Contention
5 NYS-5 (Buried Pipes And Tanks) and the exhibits thereto ("NRC
6 Staff Testimony"). None of those documents have changed my
7 opinions related to the management of the buried pipelines at
8 IPEC.

9 Q. As an initial matter, Entergy states on page 6 of its
10 Statement of Position that you appear to have no prior
11 experience with respect to the aging management of buried piping
12 at a nuclear power plant. Is this correct?

13 A. No.

14 Q. Please describe your experience with respect to the
15 aging management of buried piping at a nuclear power plant.

16 A. My experience with corrosion issues at nuclear plants
17 includes consultation at Three Mile Island (TMI-1 and TMI-2),
18 Diablo Canyon, all of the pressurized water reactors and boiling
19 water reactors formerly operated by Commonwealth Edison (these
20 include Byron, LaSalle, Braidwood, Dresden, Quad Cities,
21 Clinton), and Seabrook. I have served on EPRI panels for
22 corrosion control in nuclear power systems, and I was funded by
23 EPRI for 5 years and by the Department of Energy for 11 years

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1 for corrosion research in nuclear systems. I have supervised
2 Ph.D. students performing research on nuclear systems for U.S.
3 Navy applications at the Knolls Atomic Power Laboratory. I have
4 also had personal tours of numerous reactors because of my
5 service on the Nuclear Waste Technical Review Board including
6 Dresden, Savannah River, Hanford, several French plants and
7 plants in England, Germany, Spain, and Argentina. In each of
8 those tours I discussed high level aspects of technical
9 management of the facilities, including aging and maintenance of
10 the infrastructures, in detail. As indicated below, I have also
11 had considerable experience in the management of corrosion of
12 underground piping systems.

13 A. Why was this information not included on the CV you
14 provided in your earlier testimony?

15 A. I provided my academic CV with my prior testimony,
16 which does not include these or other consulting engagements.
17 It is my opinion that my academic CV, without these engagements,
18 qualifies me as an expert in the matter of NYS-5 (Buried Pipes
19 and Tanks). However, I have also had considerable experience in
20 assessing corrosion of numerous structures including other
21 buried structures such as oil and natural gas lines, buried
22 tanks and other underground infrastructure. Any of these
23 experiences would have qualified me as an expert in the area of

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1 buried metallic components. There is nothing specifically
2 "nuclear" about the buried pipes at Indian Point.

3 Q. In response to your position that Entergy should
4 assume that pipes were defectively coated and that pipes were
5 improperly backfilled, Entergy emphasizes that the
6 specifications in place at the time of plant construction (that
7 is, in the 1960s, before Entergy owned the facility) contained
8 procedures for installing and inspecting coatings installed by
9 the piping manufacturer (Entergy Testimony, Q65-71). Have you
10 seen any evidence from Entergy's disclosures that indicate
11 whether those specifications were in fact met?

12 A. No. Entergy has provided the specifications, but in
13 the material I reviewed, I have not seen any indication that
14 they were met.

15 Q. Do you have reason to believe the specifications were
16 not met at the time of construction?

17 A. Yes. The corrosion problem Entergy identified in 2009
18 at the Indian Point Unit 2 condensate storage tank return line
19 was caused by improper backfill, which in turn resulted in a
20 coating failure. This is irrefutable evidence that the
21 specifications were not met 100% of the time at this site at the
22 time of construction.

23 Q. NRC's experts state that follow-up inspections in 2009

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1 on 28 feet of city water line and 8 feet of fire protection line
2 revealed no coating defects or potentially damaging backfill
3 (NRC Staff Testimony, A28). Does this alleviate your concern?

4 A. No. The admitted use of improper backfill leading to
5 corrosion of such severity that the pipe was compromised
6 suggests that there are other sites that may have been
7 inadequately or improperly assessed. Since at least one site
8 was either overlooked or improperly characterized, barring
9 complete inspection of all of the underground piping, there can
10 be no assurance that other areas have not been improperly
11 characterized. A sampling of 28 feet of city water line or of
12 only 8 feet of fire protection line hardly constitutes a
13 significant fraction of the entire underground piping system at
14 IPEC. There is no known method for assessing the depth of
15 localized corrosion at any other piping location at the site
16 based on these limited inspections. For example, given the
17 level of inspection and analysis that has been performed, there
18 is no way to know if there are sites where corrosion may have
19 penetrated though 90% of the pipe wall. To reiterate some of my
20 previous testimony, the use of a remote inspection technique,
21 guided wave technology, failed to detect the extent of corrosion
22 damage at the leak location at IPEC.

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1 Q. The NRC Staff takes the position that although the
2 Applicant's in-scope buried pipe plant-specific operating
3 experience has revealed locations where coatings have been
4 damaged, the current licensing basis functions of the affected
5 systems were maintained (NRC Staff Testimony, A30). Does this
6 alleviate your concern?

7 A. No. The fact that a failure has not yet occurred is
8 no indication that a failure will not occur in the renewed
9 licensing period. It has been stated that the function of the
10 buried piping system is to maintain a pressure barrier. Staff
11 Testimony at p. 25. However, I disagree with that opinion.
12 Leaking of radioactive fluids, in my opinion constitutes failure
13 of the system in a pipe, that, like all safety related pipes
14 carrying radioactive fluid, was not supposed to fail.
15 Accordingly, if a failure has already occurred, independent of
16 the root cause of that failure, absent a comprehensive
17 inspection, or protection of the system, there can be no
18 guarantee that future unpredictable failures will not occur in
19 other safety related piping.

20 Q. NRC Staff Testimony relies heavily on a document
21 called the Interim Staff Guidance, LR-ISG-2011-03, "Changes to
22 The Generic Aging Lessons Learned (GALL) Report Aging Management
23 Program XI.M41 'Buried and Underground Piping and Tanks' "

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1 (Exhibit NRC000019), or the "Draft ISG." You did not mention
2 this document in your testimony; was it available to you as you
3 were preparing your testimony?

4 A. No. This document was released in 2012 as I
5 understand it. I had not seen it before I read the Staff's
6 expert's testimony.

7 Q. Have you read the Draft ISG?

8 A. Yes.

9 Q. Does it change your testimony in any way?

10 A. Rather than changing my testimony, the Draft ISG
11 further provides strong support for the portion of my testimony
12 addressing the need for cathodic protection. The Draft ISG
13 makes clear that, contrary to NRC and Entergy's expert
14 testimony, failure to provide cathodic protection must be
15 justified, which has not been done by Entergy for Indian Point.
16 The Draft ISG states that "...an exception must be stated and
17 justified if the basis for not providing cathodic protection is
18 other than demonstrating that external corrosion control (i.e.
19 cathodic protection and coatings) is not required, or
20 demonstrating that installation, operation, or surveillance of a
21 cathodic protection system is not practical." Entergy has not
22 demonstrated that cathodic protection of IPEC's buried piping is
23 not required, nor have they provided evidence that installation,

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1 operation, or surveillance are not practical. In fact, it is my
2 opinion that proper operation and surveillance, much of which
3 can be done remotely, is far more practical than the requirement
4 to periodically excavate, inspect and repair meaningful sections
5 of buried piping.

6 The Draft ISG completely supports my prior testimony
7 concerning the importance of cathodic protection at this plant.
8 The Draft ISG requires a plant owner to take into consideration
9 factors including corrosivity of soil and backfill conditions in
10 assessing whether or not the absence of cathodic protection is
11 justified. As I noted in my initial testimony, at Indian Point,
12 we have corrosive soil and problematic backfill conditions.

13 Generally, I believe the Draft ISG supports nearly
14 everything I said NRC should require Entergy to do: (1) follow
15 the dictates of NUREG-1801, Section XI.M41, and (2) follow the
16 recommendations of NACE SP0169-2007.

17 Q. Do you have any other observations about the Draft
18 ISG?

19 A. Yes. I disagree with NRC Staff's experts' statements
20 in footnote 3 in which they said that the Staff evaluated the
21 Applicant's AMP against key elements of AMP XI.M41 and the Draft
22 ISG for AMP XI.M41 and concluded that Entergy's AMP is adequate
23 to manage the applicable aging effects to ensure that buried

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1 piping and tanks will perform their current licensing basis
2 functions. To reiterate, the Draft ISG requires the following:

- 3 • The failure to provide cathodic protection in
4 accordance with Table 2a must be justified in the LRA.
5
- 6 • An exception must be stated and justified if the basis
7 for not providing cathodic protection is other than
8 demonstrating that external corrosion control (i.e.,
9 cathodic protection and coatings) is not required or
10 demonstrating that installation, operation, or
11 surveillance of a cathodic protection system is not
12 practical.
13
- 14 • The applicant must demonstrate, through the submission
15 of a study, the impracticality of installing or
16 operating a cathodic protection system. This study
17 should be conducted by a competent person as defined
18 in NACE SP 0169-2007, Section 1.3, Introduction, who
19 is knowledgeable in the design, installation, and
20 operation of cathodic protection systems. The study
21 should be submitted with the LRA.
22
- 23 • The applicant must conduct a 20-year search of
24 operating experience for evidence of adverse
25 conditions as described in Section 4.f., Adverse
26 Indications, of Appendix A of this Draft ISG.
27

28 I have seen no evidence that Entergy has performed any of the
29 above. I have not seen any justification for the lack of
30 cathodic protection at Indian Point, and I have not seen any
31 study showing the impracticality of installing or operating a
32 cathodic protection system or that cathodic protection is not
33 necessary. Finally, I have seen no evidence of the 20 year
34 search of operating experience for evidence of adverse

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1 conditions, or for evidence that no adverse conditions exist at
2 IPEC.

3 Page one of the Draft ISG states that the ISG is based on
4 industry operating experience, but the NRC experts admit that
5 Entergy isn't required to meet the requirements of the revised
6 GALL report, or the Draft ISG, in footnote 3. It is poor
7 engineering practice, in my expert opinion, to be aware of
8 industry operating experience and resultant recommendations and
9 not incorporate them into current operating procedures. The
10 very nature of engineering practice is to take advantage of
11 observations and experience to improve operating procedures,
12 especially from a safety perspective.

13 The Draft ISG also states: "Given that the potential for
14 piping degradation increases with time, the inspection
15 quantities for some materials increase throughout the 30-year
16 period starting 10 years prior to entering the period of
17 extended operation." I have not seen any indication that
18 Entergy's AMP proposes to do this.

19 Finally, in a section entitled "Cathodic Protection Survey
20 Acceptance Criteria," on page 5, the Draft ISG states that

21 Based on staff findings during AMP audits, multiple
22 sites do not have an upper limit on cathodic
23 protection pipe-to-soil potential. If the cathodic
24 protection pipe-to-soil values are too high, coating
25 damage can occur. The staff deleted the general

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1 reference to the NACE standards for the acceptance
2 criteria and incorporated the NACE SP0169-2007
3 specific cathodic protection survey acceptance
4 criteria into the AMP.
5

6 The NACE SP0169-2007 specific cathodic protection survey
7 acceptance criteria were established in 2007. However, as I
8 noted in my initial testimony, Entergy has not and apparently
9 will not commit to following NACE guidelines. The NRC Staff
10 certainly were aware of NACE SP0169-2007 and incorporated it
11 into the ISG document as the basis for changes to the generic
12 aging lessons learned (GALL) report revision 2, Aging Management
13 Program XI.M41 "Buried and Underground Piping and Tanks." The
14 criteria should have been implemented at operating plants and
15 certainly incorporated into LRA's. Accordingly, there is no
16 excuse for the NRC to fail to require that Entergy meet those
17 guidelines now that the NRC Staff has incorporated them into its
18 Draft ISG.

19 Q. In light of your position that proper specifications
20 were not followed at Indian Point, what additional steps do you
21 believe Entergy should be taking that it has not committed to
22 take at Indian Point?

23 A. As I have stated, I believe that the NRC should
24 require Entergy to (1) follow the dictates of NUREG-1801,

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1 Section XI.M41, and (2) follow the recommendations of NACE
2 SP0169-2007.

3 Q. Do you agree with Entergy's experts' assertion that
4 cathodic protection is only warranted when coating has degraded
5 and when the metallic surface of the piping is exposed? (Entergy
6 Testimony Q61/A61).

7 A. No. Since any inspection program will only uncover a
8 small fraction of potential sites where coating damage has
9 occurred, there is no way to know where coating damage has
10 occurred that will expose sections of bare steel pipe. Without
11 knowing the extent of coating degradation or coating damage
12 there is no way to assess the efficacy of cathodic protection
13 after damage has been discovered. However, the judicious
14 installation, operation, and maintenance of a cathodic
15 protection system to the buried piping system will have the
16 effect of completely arresting any future corrosion damage.

17 Q. Do you have any other comments regarding cathodic
18 protection?

19 A. Entergy has experience with cathodic protection. At
20 one time the steel sections of the dock were cathodically
21 protected although it is not clear if that system is still in
22 operation. Entergy has also installed a limited cathodic
23 protection system in the vicinity of the city water lines

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1 (Entergy Testimony, A119(a)). It should not be a major exercise
2 to expand the existing cathodic protection system to the piping
3 under consideration in Contention NYS-5.

4 Q. NRC experts note that Entergy's aging management
5 program does not commit to meeting NACE standards, which call
6 for cathodic protection, but that Entergy has compensated for
7 this by requiring more frequent inspections. NRC Staff Testimony
8 A29. In your professional judgment, do an increased number of
9 inspections sufficiently make up for the absence of cathodic
10 protection in buried pipes and tanks?

11 A. No. An increased number of inspections will allow the
12 examination of more sites, but the total amount of piping that
13 will be excavated and inspected will still be much less than the
14 extent of the entire buried piping system. While the increased
15 number of inspections may statistically improve the possibility
16 of discovering coating and/or metal damage, the undetected areas
17 will still dominate the population. It is especially important
18 to note that the corrosiveness of the soil at IPEC is quite
19 variable near the surface, while little is known about the
20 quality of the soil at the depth of the piping. The incident at
21 Indian Point where backfill had damaged the coating on the
22 piping, resulting in corrosion of the pipe, is an example of the
23 difficulty in performing a three dimensional analysis of soil

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1 conditions at any buried piping site. Poor backfill, or other
2 aggressive conditions at the piping horizon can only be poorly
3 correlated with the chemical composition and corrosivity of soil
4 at the surface.

5 And regarding the increased number of inspections, it is
6 still not clear what the criteria will be for site selection,
7 where the inspections will be done, specifically how often they
8 will be done, and how quickly future inspections will take place
9 if a problem is found.

10 Q. NRC Staff's experts explain that the number of
11 inspections Entergy proposes is consistent with the Draft ISG.
12 NRC Staff Testimony A42. Do you agree with that statement?

13 A. No. One merely has to read the Draft ISG to come to
14 the conclusion that Entergy's inspections do not follow the
15 guidelines of the ISG or of NACE SP0169-2007, or AMP XI.M41.
16 Each of those documents cites the necessity of justification if
17 cathodic protection is not utilized. Increased frequency of
18 inspections does not replace the requirement for cathodic
19 protection, and certainly does not qualify as justification to
20 ignore the considerable benefits of cathodic protection.

21 Q. Entergy's experts explain that Entergy has gathered
22 "significant insights into the condition of IPEC buried pipes
23 and their coatings through direct visual examinations of

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1 excavated piping and indirect (e.g., APEC, guided-wave testing)
2 examinations performed to date." Entergy Testimony, A34. In
3 your opinion, is guided-wave testing a reliable inspection
4 method?

5 A. No, and neither NACE nor the NRC Staff think it is
6 either. Even the document on which the NRC Staff relies so
7 heavily, the Draft ISG, states that guided wave inspections do
8 not meet the intent of the paragraph requiring inspections.
9 Moreover, on this particular site, guided-wave technology was
10 not effective. Guided-wave technology was used on the
11 condensate storage return line immediately after a through-wall
12 failure, that was generated from external corrosion. The
13 technique indicated an 85% loss of wall thickness but did not
14 identify through-wall failure.

15 Q. Entergy's experts indicate that "available data do
16 not indicate that soil surrounding in-scope buried piping at
17 IPEC is corrosive." (Entergy Testimony, Q83/A83). Do you agree
18 with that statement?

19 A. No. Entergy's own consultant's report indicated that
20 soil on the IPEC site was mildly to moderately corrosive. I
21 discussed this report in my initial testimony. Corrosive is
22 corrosive; soil conditions either are or are not corrosive. To

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1 say that moderately corrosive soil is not corrosive is
2 inaccurate and misleading.

3 Q. Do you agree with the definition of "failure" offered
4 by Entergy and NRC Staff?

5 A. Absolutely not. Entergy offers an overly narrow
6 definition of a piping failure, and NRC Staff does not offer its
7 own definition but simply adopts Entergy's. Entergy defines the
8 function of a pipe as maintaining a pressure boundary. Entergy
9 Testimony at Answer 94. The function of piping and of tanks is
10 not only to maintain pressure, but to contain the fluids that
11 either flow or are stored in them. Piping systems that contain,
12 or can contain, potentially toxic materials, by definition, fail
13 if the toxic material is released to the environment. For
14 example, there are holding tanks at Hanford, Washington, that
15 contain highly radioactive liquids, that are currently leaking,
16 and the effluent will eventually reach the Columbia River
17 watershed. The State of Washington and the surrounding
18 population certainly consider the leaking of highly radioactive
19 liquids to be failure of the tanks.

20 In some cases small perforations on pipes such as corrosion
21 induced pits can even be considered a more serious failure of a
22 piping system than complete failure of the pressure boundary. A
23 simple consideration of Bernoulli's equations indicates that

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1 liquids under pressure will have an increased velocity if the
2 exit orifice in a pipe has a smaller diameter than the pipe
3 itself. This increase in velocity from the exit orifice (a pit
4 or local perforation) may actually result in fluids reaching the
5 surface more rapidly than if the pressure barrier is completely
6 compromised.

7 Q. Entergy indicates that the piping at issue in this
8 contention is a "relatively small subset of the piping managed"
9 by Entergy's aging management program. Entergy Statement of
10 Position at 22. Do you believe it is impractical, as Entergy
11 asserts, to excavate all in-scope buried piping?

12 A. Yes, I agree. However, there is no need to excavate
13 all of the buried piping. The application of a well designed,
14 properly operated, and adequately maintained cathodic protection
15 system will effectively arrest any corrosion that may now exist.
16 It will also prevent further corrosion from initiating, thus
17 effectively obviating the need for complete excavation of the
18 buried piping systems.

19 Q. Do you agree with the NRC Staff expert Mr. Holston's
20 assertion that "a leak (whether radioactive or non-radioactive)
21 from a piping system does not degrade the ability of a piping
22 system to perform its CLB pressure boundary function unless the
23 leak is very substantial."? (NRC Staff Testimony, A19)

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1 A. Mr. Holston is correct in that a leak does not
2 necessarily degrade the ability of a piping system to perform as
3 a pressure barrier. However, as I have stated, maintaining a
4 pressure barrier is only one function of a piping system. The
5 second, and perhaps more important function for piping systems
6 such as those at IPEC that are not under high pressure, is to
7 contain the fluid in the system. If the piping cannot perform
8 that function it has, *de facto*, failed.

9 Q. NRC Staff's expert Mr. Holston points out that Staff
10 guidance does not recommend a baseline inspection, baseline
11 piping wall conditions, or determination of corrosion rates, and
12 that such baseline and corrosion rate analyses are not necessary
13 to adequately manage leaks. NRC Staff Testimony A33. Do you
14 agree with those statements?

15 A. No. I don't understand Mr. Holston's opinion except
16 that he appears to believe that leaks are acceptable. It is my
17 opinion that a leak of a radioactive fluid presents a danger to
18 the population in the vicinity of the radioactive leak. I also
19 don't understand how Mr. Holston has arrived at the conclusion
20 that leaks can be "managed" without some consideration of the
21 conditions of the pipe wall conditions.

22 Q. Entergy's experts state that you did not take into
23 account "the specific program documents and procedures that are

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1 being used to implement" the aging management program when you
2 stated that the program was conceptual and aspirational in
3 nature. Entergy Testimony Q88/A88. What is your response to
4 that?

5 A. Entergy's experts are not correct. I did take these
6 program documents and procedures into account, and I generally
7 support the details within them - my problem stems from the fact
8 that Entergy's proposed aging management program contains
9 virtually none of the details found within these documents.
10 Accordingly, any "requirements" contained within the proposed
11 program that are not incorporated into the plant's license or
12 UFSAR are unenforceable by the NRC and can be changed at any
13 time without NRC notice, as the NRC's expert Mr. Holston has
14 admitted in A.47 of his testimony. The details found in these
15 programs need to be incorporated into the aging management
16 program to which Entergy is committed, and then into the
17 operating license itself. Of even greater concern is that even
18 these expanded, albeit unenforceable, plans by Entergy ignore
19 implementation of AMP XI.41, the issuance of the ISG and the
20 NACE basis for the ISG. The ISG is based on industry
21 experience, perhaps the most important consideration in good
22 engineering practice and yet Entergy is disregarding it.

23 Q. Entergy's experts have also asserted that you

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1 misunderstand the applicable program documentation as to the
2 timing of inspections, and indicate that Entergy will perform 20
3 visual inspections for IP2 and 14 direct visual inspections for
4 IP3 before the period of extended operation, and 14 direct
5 visual inspections for IP2 and 16 direct visual inspections for
6 IP3 during each 10-year interval of the period of extended
7 operation. Does this explanation satisfy you?

8 A. No. Entergy's experts have not addressed the "where
9 and when." They have not explained the specific criteria for
10 site selection, where the inspections will take place, or when
11 they will take place (for example, will they do all 14
12 inspections of IP2 in year five? year nine? start with year 1?).
13 This remains an open issue for me because in the past, Entergy
14 claims that they had performed a presumably careful inspection
15 of part of the CST line (according to their criteria), and the
16 line failed in a place other than that which was inspected. The
17 "where and when" is critical here to understanding the efficacy
18 of the proposed aging management plan. Entergy's experts do not
19 indicate in their testimony why these numbers were chosen. I
20 agree that, if NRC does not require compliance with AMP XI.M41
21 and the ISG, more frequent inspections will be needed, but how
22 many more and at what intervals? Entergy's experts have not
23 answered these questions such that my position on this issue has

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1 been resolved. The very nature of a "spot" inspection program
2 that can only be limited to specific sites is, by its very
3 nature, flawed, as witnessed by the lack of ability to predict
4 the corrosion failure of the CST line.

5 Q. Have you now completed your rebuttal testimony
6 regarding Contention NYS-5?

7 A. Yes. However, I retain the ability to offer further
8 testimony if new information is provided.

9 I have reviewed all the exhibits referenced herein. True
10 and accurate copies of documents not attached to my initial
11 testimony are attached here.

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1 UNITED STATES

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9 Entergy Nuclear Operations, Inc. October 5, 2012

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)



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