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. October 5, 2012
10	x
11	PRE-FILED WRITTEN REBUTTAL TESTIMONY OF
12	DR. DAVID J. DUQUETTE
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	rebuttal testimony by Dr. David J. Duquette, Ph.D., regarding
17	Contention NYS-5.
18	Q. What documents did you review in preparation for this
19	rebuttal testimony?
20	A. I read Entergy's Statement of Position Regarding
21	Contention NYS-5 (Buried Piping and Tanks); the Testimony of
22	Entergy Witnesses Alan Cox, Ted Ivy, Nelson Acevedo, Robert Lee,
23	Stephen Biagiotti, and Jon Cavallo Concerning Contention NYS-5
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	Rebuttal Testimony of David J. Duquette Contention NYS-5

(Buried Piping and Tanks) and the exhibits thereto ("Entergy 1 2 Testimony"). I also read NRC Staff's Statement of Position on 3 Contention NYS-5 (Buried Pipes and Tanks) and the Testimony of Kimberly J. Green and William C. Holston Concerning Contention 4 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?

A. No.

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Q. Please describe your experience with respect to theaging management of buried piping at a nuclear power plant.

16 My experience with corrosion issues at nuclear plants Α. 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, Clinton), and Seabrook. I have served on EPRI panels for 21 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 Rebuttal Testimony of David J. Duquette

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for corrosion research in nuclear systems. I have supervised 1 2 Ph.D. students performing research on nuclear systems for U.S. Navy applications at the Knolls Atomic Power Laboratory. I have 3 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 the infrastructures, in detail. As indicated below, I have also 10 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 you14 provided in your earlier testimony?

15 I provided my academic CV with my prior testimony, Α. 16 which does not include these or other consulting engagements. It is my opinion that my academic CV, without these engagements, 17 qualifies me as an expert in the matter of NYS-5 (Buried Pipes 18 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 Rebuttal Testimony of David J. Duquette Contention NYS-5

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

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In response to your position that Entergy should 3 Ο. assume that pipes were defectively coated and that pipes were 4 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?

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

> Q. NRC's experts state that follow-up inspections in 2009 Rebuttal Testimony of David J. Duquette Contention NYS-5

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

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4 Α. The admitted use of improper backfill leading to No. 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 only 8 feet of fire protection line hardly constitutes a 12 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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Q. The NRC Staff takes the position that although the Applicant's in-scope buried pipe plant-specific operating experience has revealed locations where coatings have been damaged, the current licensing basis functions of the affected systems were maintained (NRC Staff Testimony, A30). Does this alleviate your concern?

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7 Α. The fact that a failure has not yet occurred is No. 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. Leaking of radioactive fluids, in my opinion constitutes failure 12 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 quarantee that future unpredictable failures will not occur in 19 other safety related piping.

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

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(Exhibit NRC000019), or the "Draft ISG." You did not mention 1 2 this document in your testimony; was it available to you as you were preparing your testimony? 3 This document was released in 2012 as I 4 Α. No. 5 understand it. I had not seen it before I read the Staff's 6 expert's testimony. 7 Have you read the Draft ISG? Ο. Α. Yes. 8 9 Q. Does it change your testimony in any way? 10 Α. Rather than changing my testimony, the Draft ISG 11 further provides strong support for the portion of my testimony addressing the need for cathodic protection. 12 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 other than demonstrating that external corrosion control (i.e. 18 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, Rebuttal Testimony of David J. Duquette Contention NYS-5

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

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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 Draft18 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 *Rebuttal Testimony of David J. Duquette Contention NYS-5*

1	piping and tanks will perform their current licensing basis
2	functions. To reiterate, the Draft ISG requires the following:
3 4 5	• The failure to provide cathodic protection in accordance with Table 2a must be justified in the LRA.
6 7 9 10 11 12 13	 An exception must be stated and justified if the basis for not providing cathodic protection is other than demonstrating that external corrosion control (i.e., cathodic protection and coatings) is not required or demonstrating that installation, operation, or surveillance of a cathodic protection system is not practical.
14 15 16 17 18 19 20 21 22	 The applicant must demonstrate, through the submission of a study, the impracticality of installing or operating a cathodic protection system. This study should be conducted by a competent person as defined in NACE SP 0169-2007, Section 1.3, Introduction, who is knowledgeable in the design, installation, and operation of cathodic protection systems. The study should be submitted with the LRA.
23 24 25 26 27	 The applicant must conduct a 20-year search of operating experience for evidence of adverse conditions as described in Section 4.f., Adverse Indications, of Appendix A of this Draft ISG.
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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conditions, or for evidence that no adverse conditions exist at
 IPEC.

Page one of the Draft ISG states that the ISG is based on 3 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, especially from a safety perspective. 12

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

19 Finally, in a section entitled "Cathodic Protection Survey20 Acceptance Criteria," on page 5, the Draft ISG states that

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

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

6 The NACE SP0169-2007 specific cathodic protection survey acceptance criteria were established in 2007. However, as I 7 8 noted in my initial testimony, Entergy has not and apparently will not commit to following NACE guidelines. The NRC Staff 9 10 certainly were aware of NACE SP0169-2007 and incorporated it into the ISG document as the basis for changes to the generic 11 aging lessons learned (GALL) report revision 2, Aging Management 12 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?

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

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

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

7 Since any inspection program will only uncover a Α. No. 8 small fraction of potential sites where coating damage has 9 occurred, there is no way to know where coating damage has occurred that will expose sections of bare steel pipe. Without 10 knowing the extent of coating degradation or coating damage 11 there is no way to assess the efficacy of cathodic protection 12 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.

Q. Do you have any other comments regarding cathodicprotection?

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 Rebuttal Testimony of David J. Duquette

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

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

11 An increased number of inspections will allow the Α. No. 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 to note that the corrosiveness of the soil at IPEC is quite 18 variable near the surface, while little is known about the 19 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 piping, resulting in corrosion of the pipe, is an example of the 22 23 difficulty in performing a three dimensional analysis of soil Rebuttal Testimony of David J. Duquette

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

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

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

13 Α. No. One merely has to read the Draft ISG to come to 14 the conclusion that Entergy's inspections do not follow the 15 quidelines 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.

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

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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?

No, and neither NACE nor the NRC Staff think it is 5 Α. 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 condensate storage return line immediately after a through-wall 11 12 failure, that was generated from external corrosion. The technique indicated an 85% loss of wall thickness but did not 13 14 identify through-wall failure.

Q. Entergy's experts indicate that "available data do not indicate that soil surrounding in-scope buried piping at IPEC is corrosive." (Entergy Testimony, Q83/A83). Do you agree 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 24 *Rebuttal Testimony* 26 *David J. Duquette*

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

Q. Do you agree with the definition of "failure" offered4 by Entergy and NRC Staff?

5 Α. 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, or can contain, potentially toxic materials, by definition, fail 12 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 population certainly consider the leaking of highly radioactive 18 liquids to be failure of the tanks. 19

In some cases small perforations on pipes such as corrosion induced pits can even be considered a more serious failure of a piping system than complete failure of the pressure boundary. A simple consideration of Bernoulli's equations indicates that *Rebuttal Testimony of David J. Duquette*

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

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

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

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

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1 Α. Mr. Holston is correct in that a leak does not 2 necessarily degrade the ability of a piping system to perform as a pressure barrier. However, as I have stated, maintaining a 3 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?

A. No. I don't understand Mr. Holston's opinion except that he appears to believe that leaks are acceptable. I also don't understand how Mr. Holston has arrived at the conclusion that leaks can be "managed" without some consideration of the conditions of the pipe wall conditions.

Q. Entergy's experts state that you did not take into account "the specific program documents and procedures that are being used to implement" the aging management program when you stated that the program was conceptual and aspirational in

> Rebuttal Testimony of David J. Duquette Contention NYS-5

1 nature. Entergy Testimony Q88/A88. What is your response to
2 that?

3 Entergy's experts are not correct. I did take these Α. 4 program documents and procedures into account, and I generally 5 support the details within them - my problem stems from the fact 6 that Entergy's proposed aging management program contains 7 virtually none of the details found within these documents. 8 Accordingly, any "requirements" contained within the proposed 9 program that are not incorporated into the plant's license or 10 UFSAR are unenforceable by the NRC and can be changed at any 11 time without NRC notice, as the NRC's expert Mr. Holston has admitted in A.47 of his testimony. The details found in these 12 13 programs need to be incorporated into the aging management 14 program to which Entergy is committed, and then into the 15 operating license itself. Of even greater concern is that even 16 these expanded, albeit unenforceable, plans by Entergy ignore implementation of AMP XI.41, the issuance of the ISG and the 17 18 NACE basis for the ISG. The ISG is based on industry 19 experience, perhaps the most important consideration in good 20 engineering practice and yet Entergy is disregarding it.

Q. Entergy's experts have also asserted that you misunderstand the applicable program documentation as to the timing of inspections, and indicate that Entergy will perform 20 *Rebuttal Testimony of David J. Duquette Contention NYS-5*

visual inspections for IP2 and 14 direct visual inspections for
IP3 before the period of extended operation, and 14 direct
visual inspections for IP2 and 16 direct visual inspections for
IP3 during each 10-year interval of the period of extended
operation. Does this explanation satisfy you?

No. Entergy's experts have not addressed the "where б Α. 7 and when." They have not explained the specific criteria for 8 site selection, where the inspections will take place, or when 9 they will take place (for example, will they do all 14 10 inspections of IP2 in year five? year nine? start with year 1?). 11 This remains an open issue for me because in the past, Entergy claims that they had performed a presumably careful inspection 12 13 of part of the CST line (according to their criteria), and the 14 line failed in a place other than that which was inspected. The 15 "where and when" is critical here to understanding the efficacy 16 of the proposed aging management plan. Entergy's experts do not 17 indicate in their testimony why these numbers were chosen. Ι agree that, if NRC does not require compliance with AMP XI.M41 18 19 and the ISG, more frequent inspections will be needed, but how 20 many more and at what intervals? Entergy's experts have not 21 answered these questions such that my position on this issue has The very nature of a "spot" inspection program 22 been resolved. 23 that can only be limited to specific sites is, by its very Rebuttal Testimony of David J. Duquette

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nature, flawed, as witnessed by the lack of ability to predict
 the corrosion failure of the CST line.

Q. Have you now completed your rebuttal testimony4 regarding Contention NYS-5?

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5 A. Yes. However, I retain the ability to offer further6 testimony if new information is provided.

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

> Rebuttal Testimony of David J. Duquette Contention NYS-5

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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 $10 C E P = 8 - 2 - 304 (d)$
	S.J. Dray matter
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	Loudonville, New York 12211
	Tel: 518 276 6490 Fax: 518 462 1206
	Email: duqued@rpi.edu October 5, 2012
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