

**UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION**

**BEFORE THE ATOMIC SAFETY AND LICENSING BOARD**

In the Matter of	)	Docket Nos. 50-247-LR and
	)	50-286-LR
ENTERGY NUCLEAR OPERATIONS, INC.	)	
	)	
(Indian Point Nuclear Generating Units 2 and 3)	)	May 3, 2013
	)	

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**ENTERGY'S REPLY TO RIVERKEEPER'S FINDINGS OF FACT AND  
CONCLUSIONS OF LAW FOR CONTENTION RK-TC-2 (FLOW-ACCELERATED  
CORROSION)**

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## TABLE OF CONTENTS

	<b>Page</b>
I. REPLY TO RIVERKEEPER’S FACTUAL FINDINGS AND LEGAL CONCLUSIONS.....	3
A. Issues Not in Dispute .....	3
B. Riverkeeper’s Challenges to the Qualifications of Entergy’s Expert Witnesses Are Unsupported.....	4
C. The Record Supports Entergy’s and the Staff’s Positions on the Nature and Significance of FAC.....	6
1. Entergy’s Existing FAC Program Is Based on Widely Accepted, Standard Technical Principles.....	6
2. Riverkeeper’s Late-Filed Exhibits Do Not Show Unexpected Variations in Wall Thicknesses in IPEC Plant Components .....	9
3. Entergy Testimony, Corroborated by Substantial Documentary Evidence, Show that there Is No Unaddressed, Localized, Non-Linear Wall Thinning at IPEC .....	12
D. The Record Shows that Entergy’s FAC Program is Consistent With the GALL Report .....	16
1. Entergy’s Use of CHECWORKS as a Best-Estimate Code Is Consistent with the GALL Report and Staff Guidance .....	16
2. Riverkeeper’s Newly-Developed Claims Regarding Alleged Insufficient Details on the FAC Program Are Contrary to the Record.....	18
E. The Record Shows that CHECWORKS Is Performing Its Intended Screening Function at IPEC.....	23
1. Riverkeeper’s Various Generic Criticisms of CHECWORKS Are Unsupported by the Record .....	23
2. The Record Shows that CHECWORKS Provides Useful Information for the FAC Program .....	25
F. The Record Shows that Entergy Appropriately Uses Multiple Tools to Select FAC Program Inspection Locations, Consistent with Standard Industry Practice .....	29
1. Consistent with NRC-Endorsed Guidance, Entergy Uses Multiple, Complementary Tools to Select FAC Program Inspection Locations.....	29
2. There Is No Basis in the Record to Challenge the Adequacy of the SNM Rankings Process.....	33
G. The Record Shows that Riverkeeper’s Remaining Challenges to the FAC Program Lack Merit.....	34

## TABLE OF CONTENTS

	<b>Page</b>
1. Riverkeeper’s Claim that Entergy Has Failed to Address Potential FAC in Steam Generator Components Is Outside the Scope of the Contention and Unsupported in the Record.....	34
2. Riverkeeper Mischaracterizes the Record Evidence Regarding the BRT-CICERO Program.....	35
3. Riverkeeper Mischaracterizes the Record of FAC-Related Operating Experience at IPEC.....	36
4. Riverkeeper Mischaracterizes the Record of FAC-Related Operating Experience throughout the Industry.....	37
5. Riverkeeper’s Remaining Challenges Presume the Inadequacy of the FAC Program.....	39
II. REPLY TO NRC STAFF’S FACTUAL FINDINGS AND LEGAL CONCLUSIONS.....	39
III. CONCLUSION.....	40

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Pursuant to the Atomic Safety and Licensing Board (“Board”) February 28, 2013 Order,<sup>1</sup> Entergy Nuclear Operations, Inc. (“Entergy”) submits its Reply to Riverkeeper’s Proposed Findings of Fact and Conclusions of Law on Riverkeeper, Inc. (“Riverkeeper”) Contention TC-2 (“RK-TC-2”) concerning flow-accelerated corrosion (“FAC”). Entergy, the U.S. Nuclear Regulatory Commission (“NRC” or “Commission”) Staff, and Riverkeeper filed proposed findings of fact and conclusions of law on March 22, 2013.<sup>2</sup> As discussed below, Riverkeeper’s proposed findings of fact and conclusions of law are contrary to the evidentiary record in this proceeding. In its proposed findings, Riverkeeper makes numerous broad assertions that lack evidentiary support and fails to acknowledge directly contrary testimony and other evidence.

Entergy’s and the NRC Staff’s proposed findings of fact and conclusions of law demonstrate that Entergy has carried its burden of proof. Entergy has demonstrated that it has

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<sup>1</sup> Licensing Board Order (Granting Parties Joint Motion for Alteration of Filing Schedule) at 1 (Feb. 28, 2013) (unpublished).

<sup>2</sup> Entergy’s Proposed Findings of Fact and Conclusions of Law for Contention RK-TC-2 (Flow-Accelerated Corrosion) (Mar. 22, 2013) (“Entergy Proposed Findings”); NRC Staff’s Proposed Findings of Fact and Conclusions of Law Part 9: Contention RK-TC-2 (Flow Accelerated Corrosion) (Mar. 22, 2013) (“NRC Staff Proposed Findings”); Riverkeeper Post-Hearing Proposed Findings of Fact and Conclusions of Law Regarding Contention RK-TC-2 – Flow Accelerated Corrosion (Mar. 22, 2013) (“Riverkeeper Proposed Findings”).

taken, or will take, actions necessary to provide reasonable assurance that the effects of aging due to FAC will be adequately managed for in-scope structures, systems, and components during the period of extended operation. Nothing in Riverkeeper's Proposed Findings contradicts this fundamental legal conclusion. The Board should therefore resolve RK-TC-2 in favor of Entergy.

As discussed throughout Section I of this reply in the context of the key issues in dispute, Riverkeeper relies almost exclusively on the opinions of Dr. Hopenfeld and his unique and incorrect interpretation of various NRC, industry, and Entergy documents. In general, Riverkeeper asserts that the FAC program, which is an existing program at all plants in the United States, is fundamentally flawed and cannot be fixed.<sup>3</sup> Riverkeeper challenges the most basic definitions and principles that underpin the FAC program, not only in the United States but in other countries as well.<sup>4</sup> Thus, Riverkeeper's claims go well beyond issues related to license renewal for Indian Point Nuclear Generating Units 2 and 3 ("IP2" and "IP3," collectively "Indian Point" or "IPEC").

In making such sweeping claims, Riverkeeper's proposed findings are often inconsistent with the record, as they present unsupported and exaggerated assertions, make claims that are directly contradicted by the record, and disregard substantial contrary information that undermines its position.<sup>5</sup> Riverkeeper also continues to pursue claims that Dr. Hopenfeld conceded at hearing were incorrect or unfounded, or that he was not prepared to discuss.<sup>6</sup> In contrast, Entergy and the NRC Staff rely on the testimony of seven expert witnesses, including

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<sup>3</sup> See, e.g., Riverkeeper Proposed Findings at 33 (¶ 60) ("the assumption underlying the CHECWORKS model about the definition of FAC is a fundamental flaw").

<sup>4</sup> See, e.g., *infra*, ¶¶ 7-12.

<sup>5</sup> See, e.g., *infra*, ¶ 15.

<sup>6</sup> See, e.g., Riverkeeper Proposed Findings at 20 (¶ 23) (disregarding the documentary evidence that supports Entergy's expert testimony on variations in initial component wall thicknesses); *id.* at 64 (¶ 159) (disregarding Dr. Hopenfeld's concession that he was not prepared to discuss the susceptible non-modeled ("SNM") process).

many individuals with extensive experience developing, implementing and evaluating FAC programs, and on substantial documentary evidence that Riverkeeper frequently overlooks. Entergy has not attempted, in this response, to catalogue and correct every individual instance of such mischaracterizations of the record, but has focused on the instances that are most relevant to the resolution of RK-TC-2.

**I. REPLY TO RIVERKEEPER’S FACTUAL FINDINGS AND LEGAL CONCLUSIONS**

**A. Issues Not in Dispute**

1. While the parties disagree on some issues relevant to this contention, there are several key issues are not in dispute.

2. First, Riverkeeper has abandoned a claim that was a key element of its contention and the focus of its litigation efforts for years: the allegation that Entergy had “lost” certain FAC program and CHECWORKS data.<sup>7</sup> Riverkeeper does not mention this issue in its proposed findings.<sup>8</sup> Thus, it is undisputed that the data used in the IPEC CHECWORKS models are available in the most recent Steam Feedwater Analysis (“SFA”) Model Reports filed as exhibits in this proceeding, and that no necessary data has been lost. It is also undisputed that a former

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<sup>7</sup> See, e.g., Written Testimony of Dr. Joram Hopenfeld Regarding Riverkeeper Contention Riverkeeper Contention TC-2 - Flow Accelerated Corrosion at 9:3-6 (Dec. 22, 2011) (RIV000003); Report of Dr. Joram Hopenfeld in Support of Riverkeeper Contention RK-TC-2 – Flow Accelerated Corrosion at 20 (Sept. 7, 2012) (“Hopenfeld Report”) (RIVR00005); Prefiled Rebuttal Testimony of Dr. Joram Hopenfeld Regarding Riverkeeper Contention TC-2- Flow Accelerated Corrosion at 38:14-26 (June 29, 2012) (RIV000108). This claim of lost documentation was a foundation for Riverkeeper’s opposition to Entergy’s 2010 motion for summary disposition on this contention. See Riverkeeper Opposition to Entergy’s Motion for Summary Disposition of Riverkeeper Technical Contention 2 (Flow-Accelerated Corrosion) at 8 (Aug. 16, 2010), available at ADAMS Accession No. ML102371214 (seeking to distinguish the Board’s decision in *Entergy Nuclear Vt. Yankee* (Vermont Yankee Nuclear Power Station), LBP-08-25, 68 NRC 763 (2008) on this basis). It was also the driver for Riverkeeper’s 2010 motion to compel and 2012 motion in limine. See Riverkeeper, Inc. Motion to Compel Disclosure of Documents Relevant to Riverkeeper Contention TC-2 (Aug. 3, 2010), available at ADAMS Accession No. ML102250183; Riverkeeper, Inc. Motion in Limine to Exclude Portions of Pre-Filed Testimony and Statement Of Position Regarding RK-TC-2 (Flow Accelerated Corrosion) (Apr. 30, 2012) (“Riverkeeper Motion in Limine”), available at ADAMS Accession No. ML12122A222.

<sup>8</sup> Instead, Riverkeeper acknowledges that Entergy made available “[s]everal decades-worth of graphical CHECWORKS data.” Riverkeeper Proposed Findings at 37 (¶ 73).

key alleged distinction between the FAC Programs at IPEC and Vermont Yankee—that the Vermont Yankee plant had data going back approximately twenty years available for the intervenor to review, but IPEC does not—has no basis.<sup>9</sup>

3. Riverkeeper also acknowledges that the FAC program set forth in the NUREG-1801, Generic Aging Lessons Learned Report (“GALL Report”) is an acceptable method of showing compliance with the license renewal regulations in 10 C.F.R. Part 54. Riverkeeper states that “[a]n AMP that is consistent with the GALL Report is acceptable to show compliance with NRC’s regulatory standard in 10 C.F.R. § 54.21(a)(3).”<sup>10</sup> Entergy and the NRC Staff agree.<sup>11</sup>

4. The GALL Report, in turn, endorses the recommendations in NSAC-202L-R3<sup>12</sup> as the basis for an acceptable FAC program.<sup>13</sup> Given Riverkeeper’s acceptance of the GALL Report, Riverkeeper acknowledges that an applicant’s use of a FAC Program that is consistent with NSAC-202L-R3 constitutes reasonable assurance that the effects of aging due to FAC will be adequately managed.<sup>14</sup>

**B. Riverkeeper’s Challenges to the Qualifications of Entergy’s Expert Witnesses Are Unsupported**

5. As an initial matter, Riverkeeper continues to challenge the credibility and expertise of Entergy’s witnesses, but such challenges are unsupported by the record. First, in an

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<sup>9</sup> See Hopenfeld Report at 20 (RIVR00005); see also *Vt. Yankee*, LBP-08-25, 68 NRC at 894.

<sup>10</sup> Riverkeeper Proposed Findings at 8.

<sup>11</sup> See Entergy Proposed Findings at 29 (¶¶ 61-62); NRC Staff’s Proposed Findings and Conclusions of Law Part 1: Overview and Regulatory Standards at 21-22 (¶¶ 1.32-1.33) (Mar. 22, 2013).

<sup>12</sup> EPRI, NSAC-202L-R3, Recommendations for an Effective Flow-Accelerated Corrosion Program (May 2006) (“NSAC-202L-R3”) (RIV000012).

<sup>13</sup> See Entergy Proposed Findings at 9-10 (¶ 16); NRC Staff Proposed Findings at 20 (¶ 9.56).

<sup>14</sup> See *AmerGen Energy Co., LLC* (Oyster Creek Nuclear Generating Station), CLI-08-23, 68 NRC 461, 468 (2008).

unsuccessful effort to undercut the credibility of Entergy's expert witnesses, Riverkeeper continues to claim that Dr. Horowitz and Mr. Aleksick have financial interests in the promotion and use of CHECWORKS that biases their testimony.<sup>15</sup> Riverkeeper's allegations, however, are unsupported by the record. As Entergy has explained, allegations of witness bias require substantial evidentiary support, which is patently lacking here.<sup>16</sup>

6. Riverkeeper also attacks Entergy witnesses Mr. Mew, Mr. Cox, and Mr. Azevedo for lack of expertise in certain purportedly relevant technical topics, as "would be demonstrated by technical publications" in those fields.<sup>17</sup> As demonstrated in their *curriculum vitae*, however, these experts have worked directly on FAC and license renewal issues from a practical perspective for many years.<sup>18</sup> The focus of their experience is not theoretical and academic, but direct, specific, and practical. Riverkeeper's implied argument that only "technical publications" can establish expertise is legally unfounded.<sup>19</sup> And in comparison, it is far from clear that Dr. Hopenfeld has any practical experience in the management of FAC at any plant, or any directly-

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<sup>15</sup> See Riverkeeper Proposed Findings at 15 (¶¶ 9-10).

<sup>16</sup> See Entergy Proposed Findings at 35 (¶ 73). In any event, it is clear that Dr. Hopenfeld has his own biases. See, e.g., Official Transcript of Proceedings, Indian Point Nuclear Generating Units 2 & 3 at 1731:12-18 (Oct. 16, 2012) (Hopenfeld) ("Oct. 16, 2012 Tr.") ("I do believe from what I've seen that basically the same problem exists in all of them [nuclear power plants]. But, you see, the thing is, to a large degree these people applying it as some kind of a -- mainly, it has been conceived for many years that it's primarily a cost problem, so it was kind of treated as a second cousin. It wasn't treated as a serious safety issue."). More generally, with respect to the comparative weight to be given to expert witness testimony, Entergy continues to maintain that Dr. Hopenfeld's testimony should be accorded relatively less weight than the testimony of the Entergy and NRC Staff experts. See Entergy Proposed Findings at 37-38 (¶ 80).

<sup>17</sup> Riverkeeper Proposed Findings at 14-15 (¶¶ 6-8); see also *id.* at 15 (¶ 10).

<sup>18</sup> See Entergy Proposed Findings at 32-33 (¶¶ 68-70).

<sup>19</sup> See *Duke Energy Corp.* (Catawba Nuclear Station, Units 1 & 2), CLI-04-21, 60 NRC 21, 27-28 (2004) ("A witness may qualify as an expert by knowledge, skill, experience, training, or education to testify if scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue.") (alteration in original omitted) (internal quotation marks omitted).



relevant technical publications on the subject of FAC, notwithstanding Riverkeeper's representation that he has "published numerous peer-reviewed papers in the area of corrosion."<sup>20</sup>

**C. The Record Supports Entergy's and the Staff's Positions on the Nature and Significance of FAC**

**1. Entergy's Existing FAC Program Is Based on Widely Accepted, Standard Technical Principles**

7. Riverkeeper argues that the FAC Program is inadequate because it is premised on an incorrect definition of FAC.<sup>21</sup> In Section II of its proposed findings, Riverkeeper disputes the NRC-endorsed standard industry technical definition of FAC as a chemical dissolution phenomenon (*i.e.*, FAC is corrosion, not erosion). It asserts that FAC should also include "physical removal of metal by mechanical forces."<sup>22</sup> According to Riverkeeper, Entergy's FAC Program at IPEC (and presumably all other FAC programs at nuclear power plants throughout the United States and in many other countries) are deficient because they fail to address these other degradation phenomena.<sup>23</sup> The record does not support Riverkeeper's position.

8. The foundational technical principles of the industry FAC program—including the definition of FAC—are based on a substantial body of research and operating experience in the United States and in many other countries.<sup>24</sup> In the most recent and prior versions of the

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<sup>20</sup> Riverkeeper Proposed Findings at 13 (¶ 3). Riverkeeper also substantially overstates Dr. Hopenfeld's qualifications. *See id.* ("Dr. Hopenfeld has had vast amounts of direct, hands-on experience with FAC and related issues."); *see also id.* (¶ 4) (asserting that Dr. Hopenfeld has particular expertise with the CHECWORKS computer code and that he "has firsthand knowledge about the background and development of the CHECWORKS model."). Riverkeeper has submitted no documentary evidence to corroborate Dr. Hopenfeld's assertions regarding particular expertise or firsthand knowledge. The overwhelming evidence shows that Entergy's and the NRC Staff's witness have far more familiarity and experience with the management of FAC and the use and development of the CHECWORKS code.

<sup>21</sup> *See id.* at 17 (¶ 17).

<sup>22</sup> *See id.* (citing Hopenfeld Report at 2 (RIVR00005); Official Transcript of Proceedings, Indian Point Nuclear Generating Units 2 & 3 at 1321:4-13, 1322:4-7 (Oct. 15, 2012) (Hopenfeld) ("Oct. 15, 2012 Tr.")).

<sup>23</sup> *See* Riverkeeper Proposed Findings at 17 (¶ 17), 33 (¶ 60).

<sup>24</sup> *See, e.g.*, Bindi Chexal, *et al.*, EPRI, Flow-Accelerated Corrosion in Power Plants (1998) ("Flow-Accelerated Corrosion in Power Plants") (ENT00036A-B).

GALL Report, the NRC Staff endorsed NSAC-202L as the basis for an acceptable FAC program.<sup>25</sup> The guidance in NSAC-202L-R3, in turn, defines FAC in the standard manner as a chemical dissolution phenomenon.<sup>26</sup> The NRC Staff’s recent draft interim staff guidance (“Draft ISG”), discussed in more detail in Section I.D.1, below, proposes no changes to the standard definition of FAC.<sup>27</sup>

9. In addition, the standard authorities in the field all support Entergy’s position. For example, the definitive industry reference book, *Flow-Accelerated Corrosion in Power Plants*, uses the definition for FAC.<sup>28</sup> Électricité de France (“EDF”), which operates more than fifty nuclear power plants in France and the United Kingdom, similarly defines FAC as distinct from physical erosion phenomena.<sup>29</sup>

10. Relatedly, Riverkeeper asserts that chemical and mechanical wear can occur “simultaneously and synergistically,”<sup>30</sup> and therefore, because CHECWORKS is based on the principle that FAC is solely a chemical dissolution process, the model is “deficient for [the]

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<sup>25</sup> See, e.g., Entergy Proposed Findings at 9-10 (¶¶ 15-16) (citing NSAC-202L-R3 (RIV000012)); NRC Staff Proposed Findings at 18 (¶ 9.48), 19 (¶ 9.52).

<sup>26</sup> See, e.g., NSAC-202L-R3 at v, 1-2 (RIV000012);

<sup>27</sup> See Entergy Proposed Findings at 41 (¶ 89) (citing Letter from Brian E. Holian, Director, NRC, to Jason Remer, Nuclear Energy Institute, Draft License Renewal Interim Staff Guidance, LR-ISG-2012-01, Wall Thinning Due to Erosion Mechanisms, App. D at D-5 (July 5, 2012) (“Draft ISG”) (ENT000573) (defining erosion to include “cavitation, flashing, droplet impingement, or solid particle impingement,” and FAC as a “corrosion mechanism” which “in previous versions of the GALL Report and past NRC generic communications, . . . has been incorrectly called erosion-corrosion, which is misleading since erosion implies a mechanical process instead of chemical dissolution”). The NRC Staff very recently issued the final LR-ISG-2012-01. See Letter from John W. Lubinski, Director, NRC, to Jason Remer, Nuclear Energy Institute, Final License Renewal Interim Staff Guidance, LR-ISG-2012-01, Wall Thinning Due to Erosion Mechanisms, (Apr. 19, 2013), available at ADAMS Accession No. ML12349A386 (letter) and ML12352A057 (LR-ISG) (“Final ISG”).

<sup>28</sup> See *Flow-Accelerated Corrosion in Power Plants* at 2-1 to 2-8 (ENT00036A).

<sup>29</sup> Stephane Trevin and Marie-Pierre Moutrille, Optimization of EDF’s NPPs Maintenance Due to Flow Accelerated Corrosion and BRT-CICERO improvement by NDT Results Analysis at 1 (Apr. 2012) (“BRT-CICERO Paper”) (RIV000110) (identifying FAC and erosion as a separate and distinct forms of degradation). Dr. Hopenfeld admitted he had no basis to dispute this information in the BRT-CICERO paper. See Official Transcript of Proceedings, Indian Point Nuclear Generating Units 2 & 3 at 1819:6-1821:18 (Oct. 17, 2012) (Hopenfeld) (“Oct. 17, 2012 Tr.”).

<sup>30</sup> See Riverkeeper Proposed Findings at 17 (¶ 17).

purposes of detecting FAC . . . .”<sup>31</sup> In support, Riverkeeper cites to Dr. Hopenfeld’s review of a single paper by Dr. Digby Macdonald.<sup>32</sup> According to Dr. Hopenfeld, Dr. Macdonald’s paper suggests that in situations when “a certain critical velocity” is exceeded, there can be “very, very high turbulence” that can weaken the oxide layer and allow simultaneous FAC and physical erosion.<sup>33</sup> However, at hearing, Dr. Horowitz explained that Dr. Macdonald’s critical velocity does not occur under actual plant conditions.<sup>34</sup> Dr. Hopenfeld did not dispute this evidence.<sup>35</sup> Riverkeeper’s position that simultaneous corrosion and physical wear can occur in FAC-susceptible systems at IPEC is therefore unsupported.

11. In any event, Riverkeeper does not directly dispute Entergy’s testimony that the IPEC FAC program addresses such non-FAC mechanisms as part of the FAC Program, when operating experience reveals such mechanisms to be an issue.<sup>36</sup> In addition, the ultrasonic testing (“UT”) measurements used for FAC Program inspections detect degradation regardless of the cause.<sup>37</sup> Thus, Riverkeeper’s disputes over the proper definition of FAC are largely academic in that Entergy’s FAC Program addresses such other mechanisms when they are of concern.

12. Based on the weight of the evidence, Riverkeeper’s assertion that there is “academic opinion” (presumably referring to one paper by Dr. Macdonald) supporting Dr. Hopenfeld’s theory that the definition of FAC must be expanded to include physical wear

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<sup>31</sup> *Id.* at 33 (¶ 60).

<sup>32</sup> *See id.* at 17-18 (¶¶ 17-19) (citing Hopenfeld Report at 2 (RIVR00005); Oct. 15, 2012 Tr. at 1442:6-1444:6 (Hopenfeld), 1447:17-19 (Hopenfeld); Oct. 16, 2012 Tr. at 1517:18-20 (Hopenfeld); Digby D. Macdonald, The Point Defect Model for the Passive State, *J. of the Electrochemical Society*, Vol. 139, Issue No. 12 (Dec. 1992) (RIV000127).

<sup>33</sup> Oct. 15, 2012 Tr. at 1443:9-16, 23-25 (Hopenfeld).

<sup>34</sup> *See* Entergy Proposed Findings at 43 (¶ 92) (citing Oct. 15, 2012 Tr. at 1444:16-21 (Horowitz)).

<sup>35</sup> *See id.* (citing Oct. 15, 2012 Tr. at 1447:2-5 (Hopenfeld)).

<sup>36</sup> *See* Riverkeeper Proposed Findings at 17-21 (¶¶ 17-25). In this respect, Entergy’s practice is consistent with the Draft ISG. *See* Entergy Proposed Findings at 40-42 (¶¶ 86-90).

<sup>37</sup> *See* Entergy Proposed Findings at 40 (¶ 86).

mechanisms,<sup>38</sup> lacks adequate support. On the contrary, the considerable weight of authorities supports Entergy's position that the standard industry definition of FAC as a chemical dissolution process is appropriate for IPEC,<sup>39</sup> and that FAC and other wear mechanisms do not occur simultaneously under plant conditions.<sup>40</sup> In any event, Entergy's FAC program appropriately accounts for non-FAC wear mechanisms, through direct wall thickness measurements and through additional inspections when operating experience identifies such an issue.<sup>41</sup>

## **2. Riverkeeper's Late-Filed Exhibits Do Not Show Unexpected Variations in Wall Thicknesses in IPEC Plant Components**

13. To support its claim that there is a significant, non-FAC degradation mechanism at IPEC that is not adequately addressed by the FAC Program, Riverkeeper relies upon certain Entergy UT reports prepared as part of the IPEC FAC program, which Riverkeeper submitted as new exhibits immediately before and during the hearing.<sup>42</sup> According to Riverkeeper, exhibits RIV000130, RIV000132, RIV00133, and RIV000049, and "many other component measurements" purportedly reviewed by Dr. Hopenfeld show unexplained variations in wall thickness.<sup>43</sup> These wall thickness variations, according to Riverkeeper, show that FAC involves

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<sup>38</sup> Riverkeeper Proposed Findings at 21 (¶ 25).

<sup>39</sup> See Entergy Proposed Findings at 38-39 (¶¶ 82-84).

<sup>40</sup> See *id.* at 42-44 (¶¶ 91-93).

<sup>41</sup> See *id.* at 40-42 (¶¶ 86-89).

<sup>42</sup> See Riverkeeper, Inc. Motion for Leave to File Additional Exhibits Concerning Contention RK-TC-2 (Flow Accelerated Corrosion) (Oct. 11, 2012), available at ADAMS Accession No. ML12285A836; Entergy Ultrasonic Examination Report, IPEC00020853 (Apr. 3, 2003) ("Entergy 2003 UT Report") (RIV000130); Oct. 16, 2012 Tr. at 1768:4-22 (Brancato); Oct. 17, 2012 Tr. at 1787:21-1788:6 (Brancato); Excerpt of IP3, RO13 FAC Inspection Report (2005) ("IP3 RO13 FAC Inspection Report") (RIV000132); Excerpt of IP3, RO15 FAC Inspection Report (2009) ("IP3 RO15 FAC Inspection Report") (RIV000133); Oct. 16, 2012 Tr. at 1768:4-22 (Brancato); Oct. 17, 2012 Tr. at 1787:21-1788:6 (Brancato); Entergy Indian Point U3, FAC, 3RF13 Outage (2005) ("IP3 Outage Inspection Report") (RIV000049).

<sup>43</sup> See Riverkeeper Proposed Findings at 19-20 (¶¶ 21-22). The IP3 Outage Inspection Report (RIV000049) is not part of the record for this contention. As Riverkeeper notes, *after* the oral hearing on RK-TC-2, it filed an updated exhibit list that, for the first time, purported to designate RIV000049 as part of the record for this

mechanisms other than the chemical dissolution process.<sup>44</sup> Riverkeeper also claims that the same exhibits show that FAC is a localized, unpredictable phenomenon that, once initiated, can progress at a non-linear rate.<sup>45</sup> Riverkeeper's claims are, once again, unsupported by the record.

14. As Entergy's witnesses explained, in RIV000130, RIV000132, and RIV00133 the largest wall thickness variations were the result of the original component manufacture, not wear due to FAC or any other wear mechanism.<sup>46</sup> Therefore, there is no actual evidence of wear in the components Riverkeeper has identified in these exhibits.

15. To dispute Entergy's testimony on exhibits RIV000132, and RIV00133, Riverkeeper relies upon Dr. Hopenfeld's opinion that newly-installed plant components generally have uniform wall thickness.<sup>47</sup> Riverkeeper portrays this dispute as a "battle of the experts"—as simply Dr. Hopenfeld's word against Mr. Azevedo's and Mr. Aleksick's.<sup>48</sup> Not so. Mr. Azevedo's and Mr. Aleksick's opinions are supported by documentary evidence in the record. As Dr. Hopenfeld should understand and as explained in NSAC-202L-R3, variations in manufactured thicknesses in components such as the elbow and reducer shown in RIV000132 and RIV00133, respectively, are common and expected.<sup>49</sup> *Flow-Accelerated Corrosion in*

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contention. *See id.* at 7. Riverkeeper, however, never moved to submit this document as an exhibit for RK-TC-2. *See* Entergy Proposed Findings at 25 (¶ 50).

<sup>44</sup> *See* Riverkeeper Proposed Findings at 19-20 (¶¶ 21-22).

<sup>45</sup> *See id.* at 21-26 (¶¶ 26-38).

<sup>46</sup> *See* Entergy Proposed Findings at 49-51 (¶¶ 107-110).

<sup>47</sup> *See* Riverkeeper Proposed Findings at 20 (¶ 23), 24-25 (¶ 35).

<sup>48</sup> *See id.*

<sup>49</sup> *See* Entergy Proposed Findings at 51 n.305 (¶ 110) (citing NSAC-202L-R3 at 4-17 (RIV000012) (“[D]epending on the component type, the variation in thickness attributable to manufacturing variations should be separated from the FAC wear. . . . Elbows, tees, nozzles, reducers and expanders are examples of components in which there is significant variation in thickness due to the manufacturing process.”)). Entergy's procedures address this issue as well. *See* EN-CS-S-008-MULTI, Revision 0, “Pipe Wall Thinning Structural Evaluation” at 36 (Jan. 1, 2010) (ENT000065) (“Variations in the component wall from the manufacturing process can impact the wear rate calculations. This is most evident in reducers and in 90 degree wrought elbows.”).

*Power Plants* also explains that, “[v]ery often, the manufacturing process results in portions of the component being thicker or thinner than other portions.”<sup>50</sup> This fundamental concept is also clearly shown in RIV000133 itself, which shows two values for the nominal thicknesses of a reducer—one for the smaller end and one for the larger.<sup>51</sup> Thus, Entergy’s experts, documentary evidence, and simple logic,<sup>52</sup> make clear that components are often manufactured with varying wall thicknesses.

16. Similarly, neither Riverkeeper nor Dr. Hopenfeld dispute that the variations in UT thickness for the component shown in RIV000130 were due to component lamination during manufacturing—a well-understood circumstance that did not impact the structural integrity of the component.<sup>53</sup>

17. Riverkeeper asserts that Dr. Hopenfeld also reviewed unspecified “hundreds of pipe wall thickness measurements” of Indian Point components where there was allegedly evidence of non-FAC wall thinning, but it has presented no evidence to support that claim.<sup>54</sup> Entergy has fully addressed each example proffered by Riverkeeper and Dr. Hopenfeld in the record of this contention, and shown that Riverkeeper has identified no unexplained, unaddressed wall thickness variations in IPEC plant components.

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<sup>50</sup> Flow Accelerated Corrosion in Power Plants at 6-30 (ENT00036B); *see also id.* (“This is frequently observed in elbows, where the extrados is typically thinner than the intrados. Most reducers and nozzles intentionally have thickness variations along the length of the component.”).

<sup>51</sup> *See* IP3 RO15 FAC Inspection Report at 1 (RIV000133) (identifying the nominal thicknesses for the reducer as 0.594” and 0.337”).

<sup>52</sup> For example, the reducer shown in exhibit RIV000133 logically must be designed to have a greater wall thickness on the end connected to the larger pipe, where pressure and hoop stress would be greater. *See* Entergy Proposed Findings at 50-51 (¶ 110).

<sup>53</sup> *Compare* Entergy Proposed Findings at 49-50 (¶ 108) *with* Riverkeeper Proposed Findings at 19 (¶ 21) (failing to directly dispute these facts and instead referring vaguely to “so many other component measurements” that allegedly support Dr. Hopenfeld’s opinion).

<sup>54</sup> *See* Riverkeeper Proposed Findings at 19 (¶ 20); *see also id.* at 22 (¶ 29), 23 (¶ 32), 24 (¶ 33) (referring to unspecified “many other” UT examination reports).

**3. Entergy Testimony, Corroborated by Substantial Documentary Evidence, Show that there Is No Unaddressed, Localized, Non-Linear Wall Thinning at IPEC**

18. Relying on the same exhibits, Riverkeeper also claims that FAC is a localized, “inherently unpredictable” phenomenon that can progress at a non-linear rate.<sup>55</sup>

19. Riverkeeper portrays the question of whether FAC proceeds at a linear rate as Mr. Aleksick’s word against Dr. Hopenfeld’s.<sup>56</sup> But again, it is not. First, the principle of linearity in the rate of FAC is not Entergy’s invention—it is a standard principle in the field.<sup>57</sup> Furthermore, Mr. Aleksick is not the only Entergy expert who testified that FAC proceeds at a constant rate under constant operating conditions.<sup>58</sup> That testimony was supported not only by Dr. Horowitz’s, Mr. Aleksick’s, and Mr. Azevedo’s years of experience and observation, but by the laboratory data set forth in EPRI’s book on FAC.<sup>59</sup> The *Vermont Yankee* Board also concluded that FAC proceeds at a linear rate, based on the record of that proceeding.<sup>60</sup>

20. Thus, Riverkeeper’s claim that Entergy “failed to show any data to show that wear at Indian Point has been observed to be linear with time” is, at best, a mischaracterization of the record.<sup>61</sup> In fact, Dr. Hopenfeld is speculating based on an absence of such evidence from

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<sup>55</sup> See *id.* § II.B (citing Entergy 2003 UT Report (RIV000130); IP3 RO13 FAC Inspection Report (RIV000132); IP3 RO15 FAC Inspection Report (RIV000133); IP3 Outage Inspection Report (RIV000049)).

<sup>56</sup> See *id.* at 22 (¶ 30).

<sup>57</sup> See *Flow-Accelerated Corrosion in Power Plants* at 7-6, B-3 to B-4 (ENT00036B); *Vt. Yankee*, LBP-08-25, 68 NRC at 892.

<sup>58</sup> See Entergy Proposed Findings at 44 (¶ 96) (citing Testimony of Entergy Witnesses Ian D. Mew, Alan B. Cox, Nelson F. Azevedo, Jeffrey S. Horowitz, and Robert M. Aleksick Regarding Contention RK-TC-2 (Flow-Accelerated Corrosion) at 33 (A53) (Horowitz) (Oct. 12, 2012) (“Entergy Testimony”) (ENTR00029)); *id.* at 46 & n.279 (¶ 100) (citing testimony from Mr. Azevedo).

<sup>59</sup> See Entergy Testimony at 33 (A53) (ENTR00029) (citing *Flow-Accelerated Corrosion in Power Plants* at B-3 to B-4 (ENT00036B) (detailing the laboratory testing and field experience that demonstrate that the rate of FAC is constant)).

<sup>60</sup> See *Vt. Yankee*, LBP-08-25, 68 NRC at 892.

<sup>61</sup> Riverkeeper Proposed Findings at 22 (¶ 30).

certain exhibits.<sup>62</sup> The available information, however, including laboratory data and the observations of the engineers directly involved in the IPEC FAC Program, corroborates the fact that FAC proceeds at a linear rate under constant operating conditions.<sup>63</sup> Therefore, there is no reason to doubt the applicability of this standard principle to IPEC.<sup>64</sup>

21. Riverkeeper also mischaracterizes Entergy's testimony on this point, mixing issues and topics in the process.<sup>65</sup> While Riverkeeper portrays Mr. Aleksick's statement that "FAC might not be linear" under changing operating conditions as an admission that the rate of FAC is generally variable,<sup>66</sup> it is not. Entergy has consistently acknowledged that changing operating conditions can change the rate of FAC, and has explained how the IPEC FAC Program accounts for such changes by, among other things, updating the CHECWORKS model.<sup>67</sup>

22. Likewise, Mr. Aleksick's statements that "[o]ne portion of an elbow may wear more rapidly than another" and that component local geometry can influence wear rates are not concessions that the rate of FAC at a particular location is variable.<sup>68</sup> Riverkeeper fails to note the very next line of Mr. Aleksick's testimony, where he explained that, "at each location [within a component] under consistent conditions the wear rate will be linear at that point."<sup>69</sup> Thus,

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<sup>62</sup> See *id.* at 24 (¶ 34); Oct 15, 2012 Tr. at 1421:16-1422:2 (Hopenfeld) (stating that he has not "seen any data" to suggest that FAC progresses at a linear rate).

<sup>63</sup> See Entergy Proposed Findings at 44-45 (¶ 96).

<sup>64</sup> See Oct. 16 Tr. at 1578:10-18 (Azevedo); *id.* at 1766:18-23 (Aleksick); Oct. 17, 2012 Tr. at 1837:15-23 (Azevedo); *id.* at 1801:23-1802:5 (Horowitz).

<sup>65</sup> Without drawing clear distinctions, Riverkeeper appears to be using the term "non-linear" in at least three different ways: (1) the rate of FAC is allegedly variable with time, see Riverkeeper Proposed Findings at 22 (¶ 28); (2) FAC allegedly includes erosive mechanisms, see *id.* at 25 (¶¶ 35-36); and (3) the rate of FAC can be different at different locations within a component. See *id.* at 23-24 (¶¶ 33-34). The first two claims are incorrect. Entergy does not dispute the third.

<sup>66</sup> See *id.* at 23 (¶ 31).

<sup>67</sup> See Entergy Proposed Findings at 45 (¶ 97).

<sup>68</sup> See Riverkeeper Proposed Findings at 23 (¶ 31).

<sup>69</sup> Oct. 15 Tr. at 1423:22-1424:6 (Aleksick).



Riverkeeper is again confusing the point. Depending on a component's geometry, different portions of the same component may experience different wear rates.<sup>70</sup> That said, the wear rate at each point within a given component will remain constant.<sup>71</sup> For example, the inner curved portion of an elbow may wear at one rate while the outer curved portion wears at another. Both wear rates are constant under constant operating conditions, even though one portion may be wearing more rapidly.

23. With respect to RIV000049, which shows the results of UT thickness inspections of a non-modeled component, Riverkeeper asserts that this document provides an example of a component where “it was not possible to conclude that wear on the component was linear.”<sup>72</sup> Of course, the opposite can just as easily be said. The exhibit shows a single set of measurements taken at one outage—such information simply cannot establish whether or not the rate of wear is constant. In other words, any suggestion that RIV000049 presents evidence of component degradation at a non-linear rate is illogical.

24. Riverkeeper next asserts that by “comparing the corrosion rate of a straight section of pipe to the corrosion rate of a curved section of pipe, such as an elbow,” one can derive a ratio which can identify if component degradation is occurring due to FAC or FAC as well as erosion.<sup>73</sup> According to Riverkeeper, if the ratio of maximum to minimum pipe wall thickness exceeds 1.6, then FAC is not the only degradation mechanism at work.<sup>74</sup> Riverkeeper

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<sup>70</sup> *See id.*

<sup>71</sup> *See id.*

<sup>72</sup> Riverkeeper Proposed Findings at 24 (¶ 34). As explained in note 43 above, as a threshold matter, Entergy objects to the reliance on RIV000049 for any finding on this contention, as this document is not part of the record for RK-TC-2.

<sup>73</sup> *Id.* at 18-19 (¶ 20) (citing J. Wang and S. Shirazi, A CFD Based Correlation for Mass Transfer Coefficient in Elbows (2001) (RIV000131)).

<sup>74</sup> *See id.*

claims that such ratios at IPEC vary from 6 to 52.<sup>75</sup> Other than citing generally to the Wang and Shirazi Paper, however, neither Riverkeeper nor Dr. Hopenfeld have clearly justified or explained why the 1.6 value is an appropriate threshold for assessing FAC in Indian Point components. In any event, Dr. Hopenfeld's theory is based on the false assumption that newly-installed components have uniform wall thickness. Without the assumption of uniform initial wall thickness, the 1.6 ratio of maximum-to-minimum measured wall thickness is meaningless. As discussed above, the assumption of initial uniform wall thickness is not valid. For example, in RIV000133, the variation in *nominal* thickness between the larger and smaller ends of the reducer exceeds 1.6.<sup>76</sup> Likewise, RIV000132 and RIV000049 both show elbows which, as explained above, normally have significant variations in initial wall thicknesses. Moreover, as also explained above, components with complex geometries can wear at different (but constant) rates at different locations within the component. Given these facts, the metal loss ratio relied upon by Riverkeeper as the basis for its argument that some significant non-FAC degradation mechanism is at work at IPEC is irrelevant.

25. Finally, Riverkeeper refers to Dr. Hopenfeld's opinions on certain IPEC corrective action program reports and his opinions on certain FAC-related events at other stations to claim that these reports provide evidence of unaddressed "localized effects of FAC" or that FAC is "non-linear."<sup>77</sup> Nothing in the record on these topics supports or corroborates Riverkeeper's vague claims. On the contrary, these issues are addressed in Entergy's Proposed Findings, Sections IV.G.5 and IV.G.6, and again in sections I.G.3 and I.G.4, below.

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<sup>75</sup> See *id.* at 19 (¶ 20) (citing Dr. Hopenfeld's purported review of unspecified "hundreds" of wall thickness measurements).

<sup>76</sup> See IP3 RO15 FAC Inspection Report at 1 (RIV000133) (identifying the nominal thicknesses for the reducer as 0.594" and 0.337"). Likewise, RIV000132, which Mr. Aleksick and Mr. Azevedo testified depicts a brand new elbow, shows variations in initial component thicknesses that approach a ratio of 1.6.

<sup>77</sup> See Riverkeeper Proposed Findings at 25-26 (¶¶ 36-37).

26. In conclusion, although Riverkeeper portrays the linear rate of FAC and its line-level predictability as Entergy's mere presumptions,<sup>78</sup> Entergy in fact relies upon well-established principles that are supported by substantial industry research data and operating experience. Riverkeeper has presented no data to support its contrary hypothesis.

**D. The Record Shows that Entergy's FAC Program is Consistent With the GALL Report**

**1. Entergy's Use of CHECWORKS as a Best-Estimate Code Is Consistent with the GALL Report and Staff Guidance**

27. Riverkeeper asserts that Revision 2 of the GALL Report is the "current legally operative version of the guidance document."<sup>79</sup> Based on this erroneous argument, Riverkeeper continues to press Dr. Hopfenfeld's unsupported claim that CHECWORKS must be used as a bounding, rather than best estimate code. Specifically, Riverkeeper continues to focus on a new statement in the GALL Report, Revision 2, that CHECWORKS is appropriate "because in general the predicted wear rates and component thicknesses are conservative when compared to actual field measurements."<sup>80</sup> According to Riverkeeper, under GALL Revision 2, CHECWORKS must produce "conservative results," or else be recalibrated to do so.<sup>81</sup>

28. Entergy has shown that Riverkeeper's position is not correct as a technical or regulatory matter. CHECWORKS was intended to be used, and is used, as a best estimate code.<sup>82</sup> There is no evidence in the record of its use as a bounding code anywhere. The NRC

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<sup>78</sup> See *id.* at 26 (¶ 38).

<sup>79</sup> *Id.* at 10; see also *id.* at 48 (¶ 106). As explained below, this statement is incorrect. In any event, Entergy prepared its license renewal application ("LRA") for Indian Point in accordance with the GALL Report, Rev. 1. See Entergy Testimony at 21 (A35) (ENTR00029). The NRC Staff issued Revision 2 of the GALL Report in December 2010, several years after Entergy submitted its LRA. See Entergy Proposed Findings at 9 (¶¶ 15-16).

<sup>80</sup> Riverkeeper Proposed Findings at 51 (¶ 111) (quoting NUREG-1801, Rev. 2, Generic Aging Lessons Learned (GALL) Report at XI.M17-1 (2010) ("GALL Report, Rev. 2) (NYS00147D)).

<sup>81</sup> *Id.*

<sup>82</sup> See Entergy Proposed Findings at 73-75 (¶¶ 167-71).

Staff issued the Draft ISG, which clarifies the intent of the GALL Report, Revision 2 by removing this language because it had caused confusion.<sup>83</sup> The NRC Staff’s witnesses confirmed at the hearing that the Staff had no intent to mandate any wholesale change to the long-established industry FAC program or the use of CHECWORKS.<sup>84</sup> Riverkeeper’s claim, therefore, relies upon superseded text that the Staff no longer endorses. While Riverkeeper asserts that the Draft ISG is not final, effective, or binding,<sup>85</sup> that is beside the point for several reasons. The Staff has now issued the Final ISG,<sup>86</sup> and, in any event, no Staff guidance is binding.<sup>87</sup> Ultimately, there is no deficiency in the FAC Program at IPEC.<sup>88</sup>

29. Riverkeeper also argues that the Draft ISG leaves undisturbed the following text in the GALL Report: “It is recognized that CHECWORKS is not always conservative in predicting component thickness; therefore, when measurements show the predictions to be non-conservative, the model must be recalibrated using the latest field data.”<sup>89</sup> According to Dr. Hopensfeld, this text indicates that the use of CHECWORKS is acceptable “only if non-conservative results can be corrected by re-calibrating the model.”<sup>90</sup>

30. This interpretation ignores the contrary evidence in the record. As Entergy’s witnesses explained, the calibration process—commonly referred to as the PASS-2 analysis—compares CHECWORKS predictions to UT measurements, developing a line correction factor

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<sup>83</sup> See *id.* at 74-75 (¶¶ 170-71) (citing Draft ISG, App. D at D-7 (ENT000573)). The Final ISG now officially removes this language. See *supra* note 27.

<sup>84</sup> See *id.*

<sup>85</sup> See Riverkeeper Proposed Findings at 10-11, 52 (¶ 115).

<sup>86</sup> See *supra* note 27.

<sup>87</sup> See, e.g., *Int’l Uranium (USA) Corp.*, CLI-00-1, 51 NRC 9, 19 (2000).

<sup>88</sup> Indeed, even if the GALL Report, Revision 2 were “the operative version,” the Staff has found that the IPEC FAC Program is also consistent with GALL Revision 2. See Entergy Proposed Findings at 56 (¶ 122) (citing Oct. 17, 2012 Tr. at 1892:3-17 (Hiser)).

<sup>89</sup> Riverkeeper Proposed Findings at 53 (¶ 117) (quoting Draft ISG at D-7 (ENT000573)).

<sup>90</sup> *Id.*

(“LCF”), that will be used to allow more accurate future predictions of wear rates.<sup>91</sup> In this way, the calibration process is intended to provide a best estimate prediction (not a conservative estimate) of FAC wear rates.<sup>92</sup> This calibration using the latest field data is accomplished after every outage where FAC Program UT measurements are taken.<sup>93</sup> The NRC Staff’s witness, Dr. Hiser, concurred that the PASS-2 analysis specifically satisfies the GALL Report statement regarding calibration that Riverkeeper and Dr. Hopenfeld rely upon.<sup>94</sup> Without support from any other record evidence, Dr. Hopenfeld’s interpretation of the Staff’s own document cannot be credited.<sup>95</sup>

**2. Riverkeeper’s Newly-Developed Claims Regarding Alleged Insufficient Details on the FAC Program Are Contrary to the Record**

31. Continuing to shift its focus away from the claims that were originally central to its contention, in Section VII of its proposed findings, Riverkeeper now questions the sufficiency of the documentation demonstrating the IPEC FAC Program’s compliance with the GALL Report.<sup>96</sup> Riverkeeper claims that given the alleged lack of specificity in the GALL Report and the other deficiencies it has allegedly identified in the IPEC FAC Program, Entergy must, but has not, provided sufficient details about inspection scope, frequency, and component repair and replacement criteria, and all of the other AMP elements in the GALL Report.<sup>97</sup> Riverkeeper concludes that, ultimately, the FAC Program consists of “general platitudes” with “no

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<sup>91</sup> See Entergy Testimony at 58-59 (A85) (ENTR00029); NRC Staff Proposed Findings at 28-29 (¶¶ 9.82-9.84).

<sup>92</sup> See Entergy Testimony at 58-59 (A85) (ENTR00029).

<sup>93</sup> See *id.* at 63 (A91); Oct. 16, 2012 Tr. at 1745:17-22 (Aleksick) (noting that CHECWORKS predictions are adjusted “upwards or downwards to match field observations” and that “[e]very outage [Entergy] calibrate[s] and refine[s] a little bit more”).

<sup>94</sup> See Oct. 16 Tr. at 1676:3-19 (Hiser).

<sup>95</sup> In any event, the Final ISG now removes this sentence from the program description as well, so Riverkeeper’s argument is moot. See *supra* note 27.

<sup>96</sup> See Riverkeeper Proposed Findings at 74-75 (¶ 194).

<sup>97</sup> See *id.* at 74-76 (¶¶ 194-96).

specificity”<sup>98</sup> Given the substantial documentary evidence in the record, this claim is, at best, specious.

32. As a threshold matter, Entergy’s proposed findings fully explain that the available information in the record—including NSAC-202L-R3, the LRA, and the Entergy fleet-wide FAC program document, EN-DC-315<sup>99</sup>—is more than sufficient to demonstrate compliance with the GALL Report.<sup>100</sup> Riverkeeper has not identified any area where EN-DC-315 is inconsistent with the GALL-approved guidance in NSAC-202L-R3. And while Riverkeeper disparages EN-DC-315 (and NSAC-202L-R3) for allegedly not providing information specific to IPEC,<sup>101</sup> such claims simply fail to raise any deficiency. No guidance or rule suggests that Entergy should not be permitted to implement a uniform program across all of its plants. In addition, the *Vermont Yankee* Board also found the EN-DC-315 program to be adequate and consistent with the GALL Report.<sup>102</sup>

33. Beyond these fundamental FAC Program basis documents, Riverkeeper ignores the substantial additional information in the record documenting in detail the regular and extensive inspection and analysis activities that Entergy conducts as part of the FAC Program. This considerable volume of information is available because the FAC Program is an existing program that has been in place at IPEC for many years. Specifically, Entergy has submitted as part of the record for this contention:

- a. Other Entergy procedures used as part of the FAC Program, including EN-CS-S-008-MULTI, Revision 0, “Pipe Wall Thinning Structural Evaluation” (Jan. 1, 2010)

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<sup>98</sup> See *id.* at 79 (¶ 216).

<sup>99</sup> Entergy, EN-DC-315, Flow Accelerated Corrosion Program, Rev. 6, at 6 (Mar. 1, 2010) (“EN-DC-315”) (ENT000038).

<sup>100</sup> See Entergy Proposed Findings at 54-58 (¶¶ 116-27); NRC Staff Proposed Findings at 48 (¶¶ 9.173-9.175).

<sup>101</sup> See, e.g., Riverkeeper Proposed Findings at 72 (¶ 184).

<sup>102</sup> See *Vt. Yankee*, LBP-08-25, 68 NRC at 871.

- (ENT000065); EN-DC-126, Revision 4, “Engineering Calculation Process” (Jan. 31, 2011) (ENT000066), and EN-OE-100, Rev. 12, Operating Experience Program (Apr. 15, 2011) (ENT000055).
- b. The power uprate analysis reports for IP2 and IP3 (ENT000072 and ENT000073).<sup>103</sup>
  - c. Two recent examples of the FAC Program System Susceptibility Evaluation (“SSE”) Reports for IP2 and IP3, ENT000048 and ENT000049.<sup>104</sup> These reports provide a comprehensive list of all systems and components covered by the FAC Program at each IPEC unit, and are periodically updated to reflect and address applicable design and operational changes.<sup>105</sup> They also rank and classify the susceptible non-modeled (“SNM”) lines based on consequence of failure and susceptibility to FAC.<sup>106</sup>
  - d. The FAC Program inspection scope lists for numerous recent outages.<sup>107</sup>
  - e. The CHECWORKS SFA model reports for numerous recent outages at IP2 and IP3.<sup>108</sup> Each of these reports run into the hundreds of pages and the most recent SFA

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<sup>103</sup> See Indian Point Unit 2, CHECWORKS Power Uprate Analysis, Calc. No. 040711-02 (Mar. 23, 2005) (ENT000072); Indian Point Unit 3, CHECWORKS Power Uprate Analysis, Calc. No. 040711-01 (Mar. 23, 2005) (ENT000073). Although Riverkeeper criticizes Entergy for failing to account for changes in plant operating conditions, *see* Riverkeeper Proposed Findings at 42 (¶ 86), the record of this proceeding shows no discussion of these documents by Dr. Hopenfeld or Riverkeeper.

<sup>104</sup> See IP2 System Susceptibility Evaluation (SSE) Report No. 0700.104-02, Rev. 2 (Oct. 14, 2011) (ENT000048); IP3 System Susceptibility Evaluation (SSE) Report No. 0700.104-17, Rev. 2 (Oct. 14, 2011) (ENT000049).

<sup>105</sup> See Entergy Testimony at 39 (A61) (ENTR00029).

<sup>106</sup> See Entergy Proposed Findings at 61 (¶ 140).

<sup>107</sup> See Scope of Flow-Accelerated Corrosion Inspection Points for 3R14 Outage (Apr. 2, 2007) (ENT000060); Scope of Flow-Accelerated Corrosion Inspection Points for 3R16 Outage (Sept. 19, 2011) (ENT000061), Scope of Flow-Accelerated Corrosion Inspection Points for 3R16 Outage (Sept. 19, 2011) (ENT000062); Scope of Flow-Accelerated Corrosion Inspection Points for 3R12 and 3R13 Outages (Jan. 2004; Apr. 2005) (ENT000063); Scope of Flow-Accelerated Corrosion Inspection Points for 3R15 Outage (Mar. 2009) (ENT000064); Scope of Flow-Accelerated Corrosion Inspection Points for 2R19 Outage (Apr. 4, 2010) (ENT000057); Scope of Flow-Accelerated Corrosion Inspection Points for 2R18 Outage (June 2007) (ENT000058); Scope of Flow-Accelerated Corrosion Inspection Points for 2R17 Outage (Apr. 17, 2006) (ENT000059). Despite their various complaints of an alleged lack of information about the scope of FAC Program inspections at IPEC, the record of this proceeding also includes no discussion of these documents by Dr. Hopenfeld or Riverkeeper.

<sup>108</sup> See CHECWORKS SFA Model Calculations for IP2, No. 0705.101-01, Rev. 2 (July 7, 2010) (“IP2 SFA Report 0705.101-01”) (ENT000050); CHECWORKS SFA Model Calculations for IP3, No. 0705.100-01, Rev. 2 (Aug. 2, 2011) (ENT000051); CHECWORKS SFA Model Calculation for IP2, No. 050714b-01, Rev. 0 (July 2005) (ENT000074); CHECWORKS SFA Model Calculation for IP2, No. 050714b-01, Rev. 1 (Sept. 2006) (ENT000075); CHECWORKS SFA Model Calculation for IP2, No. 0705.101-01, Rev. A (Nov. 2008) (ENT000076); CHECWORKS SFA Model Calculation for IP2, No. 0705.101-01, Rev. 1 (Feb. 2010) (ENT000077); CHECWORKS SFA Model Calculations for IP3, No. 050714c-01, Rev. 0 (Oct. 2005) (ENT000078); CHECWORKS SFA Model Calculations for IP3, No. 0705.100-01, Rev. 0 (Nov. 2007) (ENT000079); CHECWORKS SFA Model Calculations for IP3, No. 0705.100-01, Rev. 1 (Feb. 2010) (ENT000080).

reports exceed 1000 pages.<sup>109</sup> Among other things, these reports document the assumptions and methodology used in the CHECWORKS models,<sup>110</sup> provide a specific evaluation of each modeled analysis line,<sup>111</sup> list the modeled piping that has been replaced at each unit,<sup>112</sup> and provide all of the UT data used to calibrate the CHECWORKS model.<sup>113</sup>

- f. Two recent examples of the FAC Program SNM Reports, ENT000052 and ENT000053.<sup>114</sup> These reports provide further information on the ranking and classification of SNM components.<sup>115</sup>

34. As for the specific items Riverkeeper raises in Section VII, Entergy has provided ample information on how the FAC Program inspection scope is determined for each outage.<sup>116</sup> The key program basis documents, including NSAC-202L-R3 and EN-DC-315, explain how inspection frequencies are determined.<sup>117</sup> As the NRC Staff witness Dr. Hiser explained, because of the nature of the FAC program, it is not necessary or advisable to specify inflexible inspection frequencies in such documents.<sup>118</sup> Instead, such information is provided on a component-by-component basis in the various documents Entergy prepares before and after each outage, including the documents referenced in the previous paragraph. The record does not

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<sup>109</sup> See, e.g., IP2 SFA Report 0705.101-01 (ENT000050).

<sup>110</sup> See *id.* at 5-24.

<sup>111</sup> See *id.*, App. D.

<sup>112</sup> See *id.*, App. E.

<sup>113</sup> See *id.*, App. F. Although Dr. Hopenfeld has repeatedly asserted that he reviewed the information in these reports, see Entergy Proposed Findings at 17 (¶ 31), 18 (¶ 33), 76 (¶ 174), at the hearing he admitted that he only focused on certain narrow sections of these documents (the Appendix J wear plots). See Oct. 16, 2012 Tr. at 1776:16-21 (Hopenfeld).

<sup>114</sup> See IP2 Susceptible Non-Modeled (SNM) Report No. 0700.104-03, Rev. 2 (Oct. 14, 2011) (ENT000052); IP3 Susceptible Non-Modeled (SNM) Report No. 0700.104-18, Rev. 2 (Oct. 14, 2011) (ENT000053).

<sup>115</sup> The record of this proceeding shows no discussion of these documents by Dr. Hopenfeld or Riverkeeper.

<sup>116</sup> See, e.g., Entergy Proposed Findings § IV.D.2.

<sup>117</sup> See *id.*

<sup>118</sup> See Oct. 15, 2012 Tr. at 1389:9-13 (Hiser).



reflect any criticisms of this information by Riverkeeper. And the program repair and replacement criteria are straightforward and well-established.<sup>119</sup>

35. Nor is there anything in the record—aside from Dr. Hopenfeld’s unsupported opinion—suggesting that the guidance on UT inspection grid sizes in NSAC-202L-R3 is unduly subjective or subject to cost considerations.<sup>120</sup> The grid sizes are specified in NSAC-202L-R3.<sup>121</sup> And Entergy’s witness Mr. Azevedo directly responded to Riverkeeper’s misinterpretation of that guidance, clarifying that cost is a consideration on the question of whether a component will be repaired, replaced, or inspected more frequently until it reaches the end of its allowable service life—not on the question of whether corrective action is necessary.<sup>122</sup>

36. And finally, Riverkeeper observes that there are no “license commitments or conditions” associated with the FAC Program.<sup>123</sup> The reason for this is simple: the FAC Program is an existing program that is already part of the IPEC current licensing basis (“CLB”) and is not being enhanced or otherwise changed specifically for license renewal, so there are no *new* commitments in the LRA regarding the FAC Program.<sup>124</sup>

37. In sum, the record of this proceeding provides more than sufficient information to show that Entergy’s FAC Program complies with GALL—which is the fundamental disputed

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<sup>119</sup> See Entergy Proposed Findings at 64 (¶ 146).

<sup>120</sup> See Riverkeeper Proposed Findings at 75 (¶ 196).

<sup>121</sup> See Entergy Proposed Findings at 51-52 (¶ 111).

<sup>122</sup> See Oct. 17, 2012 Tr. at 1860:21-1861:8 (Azevedo). Nor is there any real question of the accuracy of UT measurements. See Riverkeeper Proposed Findings at 75 (¶ 196). Mr. Azevedo’s statement that the uncertainty in UT thickness measurements is “not zero” is obvious and is not evidence of any deficiency in the FAC Program. See Oct. 16, 2012 Tr. at 1758:16-1759:4 (Azevedo).

<sup>123</sup> See Riverkeeper Proposed Findings at 72 (¶ 187).

<sup>124</sup> See Entergy Proposed Findings at 2 (¶ 2); NRC Staff Proposed Findings at 62 (¶ 9.228); Oct. 17 Tr. at 1824:4-8 (Hiser).

issue.<sup>125</sup> In fact, the record shows that Entergy is already implementing its FAC Program at IPEC in a robust manner. In addition to the information that is directly in the GALL Report, NSAC-202L-R3, the LRA, and EN-DC-315, Entergy has disclosed and included in the record many thousands of pages documenting its prior activities under the FAC Program—most of which Riverkeeper has ignored. In light of all of this information, Riverkeeper’s claim that Entergy’s FAC Program lacks documentation is unsustainable.

**E. The Record Shows that CHECWORKS Is Performing Its Intended Screening Function at IPEC**

**1. Riverkeeper’s Various Generic Criticisms of CHECWORKS Are Unsupported by the Record**

38. In Section IV.B of its proposed findings, Riverkeeper criticizes the CHECWORKS model for: (1) relying on the allegedly incorrect assumption that the rate of FAC is controlled by chemical dissolution;<sup>126</sup> (2) failing to acknowledge that FAC is a “local, non-linear phenomenon;”<sup>127</sup> and (3) failing to account for uncertainty in predictions based on chromium content.<sup>128</sup>

39. As a threshold matter, Riverkeeper’s claim that CHECWORKS is inherently problematic<sup>129</sup> is in serious tension with its acknowledgement that the GALL Report is adequate,<sup>130</sup> and the GALL Report’s endorsement of CHECWORKS.<sup>131</sup> The logical consequence of Riverkeeper’s argument—that the Board should find that CHECWORKS is

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<sup>125</sup> Riverkeeper, Inc.’s Request for Hearing and Petition to Intervene in the License Renewal Proceeding for the Indian Point Nuclear Power Plant, at 20 (Nov. 30, 2007), *available at* ADAMS Accession No. ML073410093.

<sup>126</sup> *See* Riverkeeper Proposed Findings at 33 (¶ 60).

<sup>127</sup> *See id.* at 33-34 (¶ 61)

<sup>128</sup> *See id.* at 34-35 (¶ 62).

<sup>129</sup> *See id.* § IV.B.

<sup>130</sup> *See id.* at 8, 75 (¶ 195).

<sup>131</sup> NUREG-1801, Rev. 1, Generic Aging Lessons Learned Report at XI M-61 (Sept. 2005) (“GALL Report, Rev. 1”) (NYS00146C); GALL Report, Rev. 2, at XI.M17-1 (NYS00147D).

inherently unusable at all plants, not just IPEC—is unjustified and extreme. Riverkeeper’s position is also directly contrary to the conclusions of the Board in the *Vermont Yankee* proceeding.<sup>132</sup>

40. The first two of these alleged deficiencies—that FAC involves mechanisms other than chemical dissolution and that FAC is localized and non-linear, even under constant operating conditions—have been addressed in Section I.C, above. In addition, Section IV.B of Riverkeeper’s findings further mischaracterizes the record on these topics by citing certain testimony from Mr. Aleksick stating that CHECWORKS provides only a single wear rate estimate for each component, suggesting that, in so doing, CHECWORKS fails to account for “geometrical effects on FAC.”<sup>133</sup> But this argument disregards Dr. Horowitz’s explanation that, although CHECWORKS provides a single, best-estimate of wear for each component, it predicts the maximum rate of thinning on each component based on local geometry (*i.e.*, the rate of wall thinning at the location of the component which is wearing the fastest).<sup>134</sup> The FAC Program also accounts for variations in wear within components through the UT measurement grid patterns specified in NSAC-202L-R3.<sup>135</sup>

41. As for the third allegation in Section IV.B, that CHECWORKS is inadequate because EDF relies more heavily on chromium measurements, Entergy has shown that the allegedly greater reliance on chromium measurements in the EDF approach, in comparison to the NSAC-202L-R3 approach, shows no deficiency in the NSAC-202L-R3 program endorsed in the

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<sup>132</sup> *Vt. Yankee*, LBP-08-25, 68 NRC at 889-893.

<sup>133</sup> Riverkeeper Proposed Findings at 34 (¶ 61).

<sup>134</sup> See Oct. 16, 2012 Tr. at 1654:24-1655:3 (Horowitz).

<sup>135</sup> See Oct. 15, 2012 Tr. at 1424:2-17 (Aleksick).

GALL Report.<sup>136</sup> Steels containing appreciable amounts of chromium, such as stainless steel, are immune to FAC.<sup>137</sup> Chromium content is also an input into the CHECWORKS model.<sup>138</sup> But if a component's chromium content is not known, then the program uses the most conservative value (*i.e.*, zero).<sup>139</sup> Any chromium in the actual component will only reduce its rate of FAC.<sup>140</sup> Thus, CHECWORKS addresses component chromium content in a conservative manner. In addition, any differences in wear rates due to chromium content are implicitly accounted for in the PASS-2 analysis, which calibrates the predicted wear rate based on actual data.

42. In summary, Riverkeeper's argument that CHECWORKS is inherently problematic is unsupported by the record, and it therefore lacks merit.

## **2. The Record Shows that CHECWORKS Provides Useful Information for the FAC Program**

43. In its proposed findings, Riverkeeper reiterates Dr. Hopenfeld's conclusion that, "[b]ased on his review and analysis . . . the [CHECWORKS] computer model as employed at Indian Point is highly inaccurate and produces results that demonstrate a complete lack of correlation between component wear predictions and actual wall thickness measurements."<sup>141</sup> In support, Riverkeeper cites certain qualitative judgments made by Dr. Hopenfeld, such as his conclusions that "most of the data" he reviewed exhibited a "wide scatter" and

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<sup>136</sup> See Entergy Proposed Findings at 94-95 (¶ 223). In addition, Dr. Hopenfeld's statement that "the equation underlying the BRT-CICERO model is better because it measures chromium" is incorrect. Riverkeeper Proposed Findings at 55 (¶ 126). The BRT-CICERO program does not "measure" chromium. Chromium content is an input to BRT-CICERO, just as it is in CHECWORKS.

<sup>137</sup> See Entergy Proposed Findings at 94 (¶ 223 n.573).

<sup>138</sup> See EPRI, CHECWORKS Steam/Feedwater Application Version 3.0 User Guide at 11-4 (2008) (ENT000070).

<sup>139</sup> See *id.*

<sup>140</sup> See Entergy Proposed Findings at 94 (¶ 223 n.573).

<sup>141</sup> Riverkeeper Proposed Findings at 38 (¶ 75).

“disagreement,”<sup>142</sup> and his vague claims that “many” CHECWORKS predictions “varied by at least a factor of two, and upwards of by [sic] a factor of 10, or higher.”<sup>143</sup> Riverkeeper concludes that CHECWORKS cannot be successfully calibrated at Indian Point and ultimately that benchmarking of the model is “impossible.”<sup>144</sup>

44. Riverkeeper, however, fails to dispute or even address Entergy’s quantitative assessment of CHECWORKS’ accuracy at Indian Point, which is that for five recent outages at each unit, an average of approximately 55% of the analysis lines across both plants are calibrated and the LCFs are in range approximately 70% of the time.<sup>145</sup> These results are typical of FAC Programs that Entergy’s experts have reviewed throughout their careers, and sufficient to show that CHECWORKS is serving its intended screening function of focusing the attention of the FAC engineer on lines that may be experiencing wear *and* on lines where the wear rate is not being accurately predicted.<sup>146</sup> Thus, CHECWORKS provides useful information to the FAC Program, regardless of whether a particular line is calibrated or not.<sup>147</sup>

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<sup>142</sup> See *id.* at 38-39 (¶ 76).

<sup>143</sup> *Id.* at 40 (¶ 79). As Entergy has explained, this claim is based on only a handful of data points. See Entergy Proposed Findings of Fact at 71-72 (¶ 164). This is not the only instance where Riverkeeper presents misleading interpretations of data. For example, it states that in a given refueling outage, “upwards of 38% of inspections are based on CHECWORKS predictions.” See *id.* at 35 (¶ 66) (citing Entergy Testimony, Figures 1 and 2 (ENTR00029)). But as Figures 1 and 2 show, 38.2% is the *largest* percentage of inspection locations selected through CHECWORKS during the ten recent outages illustrated in those figures, and the percentages actually varied between 8.3 and 38.2%. Similarly, Riverkeeper turns Dr. Hopenfeld’s observation that CHECWORKS predictions are “nonconservative” 40-60% of the time, *see, e.g.*, Hopenfeld Report at 15 (RIVR00005), into “CHECWORKS produces non-conservative results *upwards* of 60% of the time.” Riverkeeper Proposed Findings at 45 (¶ 92) (emphasis added). As Entergy’s witnesses have shown, however, CHECWORKS is designed and used as a best-estimate code, so it provides “conservative” and “non-conservative” predictions 50% of the time. See Entergy Proposed Findings at 74 (¶ 169).

<sup>144</sup> See Riverkeeper Proposed Findings at 42 (¶ 85).

<sup>145</sup> See Entergy Proposed Findings at 71 (¶ 162).

<sup>146</sup> See *id.*; *see also id.* at 66 (¶ 152).

<sup>147</sup> See *id.* at 67-68 (¶¶ 155-56).

45. In this respect, it is also important to emphasize that a primary reason why analysis lines are not calibrated is very low wear.<sup>148</sup> Entergy evaluates each modeled analysis line individually using the criteria in NSAC-202L-R3 to determine whether it is calibrated and what further actions are necessary.<sup>149</sup>

46. This individual, quantitative evaluation of CHECWORKS' results has long been a point of emphasis for Entergy.<sup>150</sup> Likewise, Entergy has long ago shown that uncalibrated lines provide useful information, and that a common cause of lack of calibration is low wear.<sup>151</sup> Riverkeeper has never refuted any of these facts. These un rebutted points undercut Riverkeeper's and Dr. Hopenfled's various criticisms of particular instances where CHECWORKS allegedly provided inaccurate information—and also undercut the vague and generalized charge of “complete” inaccuracy in the models.<sup>152</sup>

47. Apparently in response to Entergy's testimony, Riverkeeper states that Dr. Hopenfled's “notion” of what is calibrated or not is different from Entergy's.<sup>153</sup> Entergy, however, relies upon the NRC-endorsed industry standard definition of a calibrated line.<sup>154</sup> Riverkeeper, on the other hand, does not define or specify what Dr. Hopenfled's “notion” of calibration is, except to suggest that an “ideal correlation,”<sup>155</sup> or absolutely perfect agreement

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<sup>148</sup> See *id.* at 71 (¶ 162).

<sup>149</sup> See Entergy Proposed Findings at 68 (¶ 156); see also, e.g., IP2 SFA Report 0705.101-01, App. B (ENT000050).

<sup>150</sup> See, e.g., Entergy Testimony at 59-60 (A86) (ENTR00029).

<sup>151</sup> See, e.g., *id.* at 60 (A87).

<sup>152</sup> Riverkeeper Proposed Findings at 38 (¶ 75).

<sup>153</sup> See *id.* at 23 (¶ 56).

<sup>154</sup> See Entergy Proposed Findings at 68 & n.422 (¶ 156).

<sup>155</sup> Riverkeeper Proposed Findings at 39-40 (¶ 78).

between CHECWORKS' predictions and actual measurements (represented by an LCF of 1) would be acceptable.<sup>156</sup> Such a demand for absolute perfection is clearly unreasonable.<sup>157</sup>

48. For the foregoing reasons, Riverkeeper's discussion of the "implications" of the allegedly poor predictive accuracy of CHECWORKS is unsupported and incorrect.<sup>158</sup>

49. Likewise, Riverkeeper's portrayal of the FAC Program as relying solely on CHECWORKS to perform a limited number of inspections is incorrect.<sup>159</sup> As further explained in Section I.F.1, below, the use of CHECWORKS as one tool among many to develop a prioritized inspection program is fully consistent with the GALL Report and NSAC-202L-R3. Significantly, contrary to Riverkeeper's claims, Mr. Azevedo did not "concede" any deficiency in the FAC Program due to lack of perfection in CHECWORKS' predictions.<sup>160</sup> Instead, he refuted any implications of a deficiency—as shown on the very line of the transcript that immediately follows Riverkeeper's citation.<sup>161</sup>

50. In conclusion, Entergy has demonstrated that the CHECWORKS software adequately performs its intended screening and prioritization function to ensure that FAC Program inspections are focused on the higher-susceptibility locations. Riverkeeper's apparent

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<sup>156</sup> See *id.* at 41 (¶ 84).

<sup>157</sup> See *Vt. Yankee*, LBP-08-25, 68 NRC at 889 (holding that a similar demand for extensive benchmarking to produce improved results was "unreasonable and not defensible in light of the goal of CHECWORKS to merely identify locations for plant inspections").

<sup>158</sup> See Riverkeeper Proposed Findings at 43-45 (¶¶ 88-92).

<sup>159</sup> See *id.* at 43 (¶ 88).

<sup>160</sup> See *id.*

<sup>161</sup> See Oct. 16 Tr. at 1672:19-21 (Azevedo) ("If that was the only tool that we'd use, I would agree with that. But it [CHECWORKS] is not the only tool."). In any event, Entergy has already explained that the hypothetical postulated by Riverkeeper (that a component experiencing significant wear could go uninspected due to CHECWORKS under-predicting wear) is unfounded. See Entergy Proposed Findings at 68 (¶ 156).

demand for near-perfect results is unrealistic and has no basis, given CHECWORKS' purpose as one tool among many used to select inspection locations.<sup>162</sup>

**F. The Record Shows that Entergy Appropriately Uses Multiple Tools to Select FAC Program Inspection Locations, Consistent with Standard Industry Practice**

**1. Consistent with NRC-Endorsed Guidance, Entergy Uses Multiple, Complementary Tools to Select FAC Program Inspection Locations**

51. Riverkeeper argues that Entergy's FAC Program is inconsistent with the GALL Report, Revision 1, because the GALL Report allegedly "focuses" on the use of a quantitative code such as CHECWORKS.<sup>163</sup> According to Riverkeeper, Entergy's reliance on CHECWORKS for only "a portion" of the FAC Program is somehow inconsistent with GALL.<sup>164</sup>

52. Entergy has demonstrated, however, that the GALL Report endorses the comprehensive guidance in NSAC-202L-R3, which specifies the use of numerous inspection selection tools, of which CHECWORKS is one.<sup>165</sup> At the hearing, Dr. Hopenfeld himself acknowledged that neither the GALL Report nor NSAC-202L-R3 "clearly emphasize" that CHECWORKS should be the "main tool" in the FAC program.<sup>166</sup> The *Vermont Yankee* Board reached the same conclusion.<sup>167</sup> In light of this evidence, Dr. Hopenfeld's admission, and the contrary precedent on this issue, Riverkeeper's argument is baseless.

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<sup>162</sup> See *Vt. Yankee*, LBP-08-25, 68 NRC at 889.

<sup>163</sup> See Riverkeeper Proposed Findings at 48-49 (¶ 107).

<sup>164</sup> See *id.* at 49 (¶ 107).

<sup>165</sup> See Entergy Proposed Findings of Fact, § IV.D.2. As previously noted, Riverkeeper does not dispute the adequacy of the guidance in the GALL Report for the FAC Program.

<sup>166</sup> See *id.* at 79-80 (¶ 182-83) (citing Oct. 16, 2012 Tr. at 1598:13-1601:4 (Hopenfeld) ("There was no clear definition in NUREG-1801 [the GALL Report] that says CHECWORKS is the main tool. There is none in [NSAC-]202[L].")).

<sup>167</sup> See *Vt. Yankee*, LBP-08-25, 68 NRC at 892.



53. Beyond its argument regarding an alleged lack of consistency with the GALL Report, in Section V of its proposed findings, Riverkeeper presents its criticisms of the various individual tools that Entergy uses—along with CHECWORKS—to select FAC program inspection locations for each outage. Riverkeeper’s criticisms of Entergy’s reliance on trending,<sup>168</sup> operating experience,<sup>169</sup> other plant inspection programs,<sup>170</sup> and engineering judgment<sup>171</sup> present little that is new and that is not already addressed in Section IV.F of Entergy’s proposed findings.

54. Briefly, Riverkeeper repeats its premise that CHECWORKS is unreliable and serves no useful purpose.<sup>172</sup> That premise has already been addressed in Section I.E.2, above. Building on that unsupported premise, Riverkeeper then evaluates each inspection selection tool individually, as if it were the sole basis for the FAC Program, and finds fault because certain tools are allegedly not “entirely independent” of CHECWORKS, or because individual tools are “alone” insufficient.<sup>173</sup> But Entergy has demonstrated that the various tools specified in NSAC-202L-R3 are designed to be used in a complementary fashion, as part of a comprehensive aging management program.<sup>174</sup> No tool stands alone, or should be evaluated individually as Riverkeeper does.

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<sup>168</sup> See Riverkeeper Proposed Findings of Fact, § V.A.

<sup>169</sup> See *id.*, Section V.B.

<sup>170</sup> See *id.*, Section V.C.

<sup>171</sup> See *id.*, Section V.D.

<sup>172</sup> See, e.g., *id.* at 57-58 (¶ 134).

<sup>173</sup> See, e.g., *id.* at 57-58 (¶¶ 132-34, 137) (trending); see also *id.* at 59 (¶ 139) (operating experience), 60-61 (¶ 145) (“engineering judgment alone” is not sufficient). With respect to operating experience, Riverkeeper repeats Dr. Hopenfeld’s incorrect statement that industry and plant experience with pipe wall thinning “are types of information that feed into the CHECWORKS model.” See *id.* at 59 (¶ 139). Entergy’s witnesses explained in their written testimony that this statement is incorrect, because Entergy uses operating experience directly to select inspection locations. See Entergy Testimony at 72-73 (A98) (ENTR00029).

<sup>174</sup> See Entergy Proposed Findings at 82 (¶ 190).

55. With respect to trending, Riverkeeper’s primary additional criticisms are, first, that trending still relies on CHECWORKS for initial inspection selection, while CHECWORKS remains fundamentally flawed.<sup>175</sup> The alleged deficiencies in CHECWORKS have already been addressed in Section I.E, above. Second, Riverkeeper criticizes trending for relying on the principle of linearity in the rate of FAC under constant operating conditions.<sup>176</sup> That issue has also already been addressed in Section I.C.2, above.<sup>177</sup>

56. Riverkeeper also claims that Entergy’s use of a trending calculation, rather than CHECWORKS, to make reinspection determinations runs afoul of the GALL Report’s statement that inspection results should be “inputs” to a predictive code.<sup>178</sup> Here, Riverkeeper and Dr. Hopensfeld again misinterpret the GALL Report.<sup>179</sup> Entergy *does* input inspection results into CHECWORKS as part of the PASS-2 Analysis process, and this data is used by CHECWORKS to predict “the number of refueling or operating cycles remaining before the component reaches the minimum allowable wall thickness”<sup>180</sup> for previously-uninspected, modeled components, consistent with the guidance in the GALL Report.<sup>181</sup> Nothing in the GALL Report requires Entergy to use CHECWORKS to determine reinspection intervals for previously-inspected components.<sup>182</sup>

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<sup>175</sup> See, e.g., Riverkeeper Proposed Findings at 57 (¶¶ 132-33).

<sup>176</sup> See *id.* at 58 (¶¶ 136).

<sup>177</sup> See also Entergy Proposed Findings at 84 (¶ 194).

<sup>178</sup> See Riverkeeper Proposed Findings at 58 (¶ 135).

<sup>179</sup> In addition, the text Riverkeeper relies upon has been removed from the Staff’s guidance in the recently-issued Final ISG. See *supra* note 27.

<sup>180</sup> GALL Report, Rev. 1 at XI M-62 (NYS00146C).

<sup>181</sup> See Entergy Testimony at 57-59 (A84-85) (ENTR00029).

<sup>182</sup> See generally GALL Report, Rev. 1, at XI.M-61 to 62 (NYS00146C); GALL Report, Rev. 2 at XI M17-1 to M17-2 (NYS00147D).

57. With respect to other plant inspection programs, Riverkeeper criticizes Entergy for not providing enough information about how information from other programs is used to help select FAC Program inspection locations.<sup>183</sup> But Riverkeeper ignores Entergy's testimony on this issue, so this criticism lacks basis.<sup>184</sup> Entergy has explained how it uses information from other plant inspection programs to inform its FAC Program inspection scope.<sup>185</sup>

58. With respect to engineering judgment, Riverkeeper continues to criticize Entergy for not providing sufficient details on this tool, and for failing to meet Dr. Hopenfeld's own, unique criteria for the proper use of engineering judgment.<sup>186</sup> But Riverkeeper fails to address or refute the specific information that Entergy has provided, including its written testimony describing the qualification required of the FAC engineer and the self-assessment and peer review process,<sup>187</sup> and its written testimony responding to Dr. Hopenfeld's criteria for the exercise of engineering judgment.<sup>188</sup> Given this unchallenged evidence, the Board cannot credit Dr. Hopenfeld's claim that there is insufficient information about the use of engineering judgment.

59. In summary, Riverkeeper's critique of the individual tools used within the overall FAC Program as if they were each a stand-alone tool is inconsistent with the GALL Report and NSAC-202L-R3 and lacks merit.

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<sup>183</sup> See Riverkeeper Proposed Findings at 59-60 (¶¶ 141-42).

<sup>184</sup> See Entergy Testimony at 70-71 (A95) (ENTR00029).

<sup>185</sup> See Entergy Proposed Findings at 63 (¶ 144) ("For example, if an isolation valve is discovered to be leaking by (*i.e.*, not isolating the fluid on the high-pressure side of the pipe), then it would be appropriate to inspect the piping downstream of the leaking valve.").

<sup>186</sup> See Riverkeeper Proposed Findings at 61-63 (¶¶ 149, 152-54).

<sup>187</sup> See Entergy Testimony at 48 (A75) (ENTR00029).

<sup>188</sup> See *id.* at 74-76 (A100).

## 2. There Is No Basis in the Record to Challenge the Adequacy of the SNM Rankings Process

60. Entergy’s witnesses have explained that the SNM susceptibility rankings process, used only for piping that is not modeled in CHECWORKS, prioritizes those components based on operating conditions, consequence of failure, maintenance history, and industry experience.<sup>189</sup>

61. Dr. Hopenfeld’s written testimony, both direct and rebuttal, contained no specific challenges to the use of the SNM rankings process.<sup>190</sup> Indeed, at the hearing, Dr. Hopenfeld acknowledged that he was not prepared to discuss this topic.<sup>191</sup> Despite this concession, and Riverkeeper’s failure to develop the record on any specific criticism of the SNM rankings, Riverkeeper now, for the first time, alleges deficiencies in the use of this process.<sup>192</sup>

62. Specifically, Riverkeeper asserts, in conclusory fashion, that the SNM rankings process is “flawed.”<sup>193</sup> In support, it cites certain IPEC condition reports and other operating experience, claiming that the alleged “record of excessive wall thinning and component leaks” at IPEC suggests a deficiency in the SNM rankings tool.<sup>194</sup> As explained below in Section I.G.3, there is no such record.

63. For these reasons, Riverkeeper has failed to establish any deficiency in the SNM rankings process.

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<sup>189</sup> See Entergy Proposed Findings at 61 (¶ 139).

<sup>190</sup> See *id.* at 81-82 n.501 (¶ 189).

<sup>191</sup> See *id.* (citing Oct. 16, 2012 Tr. at 1501:6-12 (Hopenfeld) (stating that he did not come prepared to discuss SNM components in detail and that he “really [had not] put sufficient thought” into managing FAC of these components)).

<sup>192</sup> See Riverkeeper Proposed Findings at 64-65 (¶¶ 156-61).

<sup>193</sup> *Id.* at 64-65 (¶ 160).

<sup>194</sup> See *id.* at 65 (¶ 161)

**G. The Record Shows that Riverkeeper’s Remaining Challenges to the FAC Program Lack Merit**

**1. Riverkeeper’s Claim that Entergy Has Failed to Address Potential FAC in Steam Generator Components Is Outside the Scope of the Contention and Unsupported in the Record**

64. Riverkeeper alleges that there is unaddressed potential for FAC in steam generator components, particularly in the feed water distribution piping ring.<sup>195</sup> Specifically, Riverkeeper claims that “Entergy’s FAC program does not consider the effect of FAC on risk-significant FAC-susceptible components in the steam generators.”<sup>196</sup>

65. By simply stating that Entergy’s *FAC Program* “does not consider” steam generator components, Riverkeeper ignores Entergy’s undisputed responses that: (1) potential FAC in steam generator components is managed under a different AMP, the Steam Generator Integrity Program;<sup>197</sup> (2) Riverkeeper has presented no evidence of any deficiency in the Steam Generator Integrity Program,<sup>198</sup> and that (3) the original IPEC steam generators have been replaced, such that the new feedwater inlet rings and J-tubes are significantly less susceptible to FAC.<sup>199</sup> With respect to the latter, Dr. Hopenfeld acknowledged at the hearing that his “conclusion was based prior to the installation of the modification of the J-tubes.”<sup>200</sup>

66. Riverkeeper also presents no response to Entergy’s legal objection that any challenge to the Steam Generator Integrity Program is outside the scope of this contention.<sup>201</sup>

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<sup>195</sup> See *id.* at 31 (¶ 54), 66 (¶ 167).

<sup>196</sup> *Id.* at 31 (¶ 54).

<sup>197</sup> See Entergy Proposed Findings at 86 (¶ 198).

<sup>198</sup> See *id.*

<sup>199</sup> See *id.* at 86-87 (¶¶ 198-200).

<sup>200</sup> Oct. 16, 2012 Tr. at 1522:16-1523:12; see also Entergy Proposed Findings at 86 (¶ 198).

<sup>201</sup> See Entergy Proposed Findings at 86 (¶ 198).

67. In sum, Riverkeeper’s allegations of unaddressed FAC in steam generator components are outside the scope of RK-TC-2 and unsupported by the record.

**2. Riverkeeper Mischaracterizes the Record Evidence Regarding the BRT-CICERO Program**

68. In Section IV.H of its proposed findings, Riverkeeper continues to rely upon Dr. Hopenfled’s opinion that the BRT-CICERO program used by EDF is a superior alternative to CHECWORKS. Riverkeeper even pursues aspects of this issue where Dr. Hopenfled conceded at hearing that his original opinions were incorrect.

69. As a threshold matter, the question of what is the “best” FAC software is not a material issue for this proceeding under 10 C.F.R. § 2.309(f)(1)(iv).<sup>202</sup> As previously explained, the fundamental issue in dispute is whether the IPEC FAC Program’s use of CHECWORKS at uprated power levels complies with the GALL Report and thereby provides reasonable assurance that the effects of aging will be adequately managed.

70. Riverkeeper quotes Dr. Hopenfled’s opinion that data from the BRT-CICERO program shows “very narrow uncertainty” and “much less data scatter in wear predictions.”<sup>203</sup> This claim, however, was refuted at the hearing.<sup>204</sup>

71. Riverkeeper goes on to rely upon Dr. Hopenfled’s alleged mathematical review of the BRT-CICERO data in comparison to CHECWORKS data for IPEC.<sup>205</sup> But Dr. Hopenfled admitted that he only conducted a cursory visual review of the data in the one BRT-CICERO

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<sup>202</sup> See *id.* at 93 (¶ 219).

<sup>203</sup> Riverkeeper Proposed Findings at 54 (¶ 122); see also *id.* at 55 (¶ 123).

<sup>204</sup> See Entergy Proposed Findings at 92-95 (¶¶ 218-24). Briefly, the data presented in the BRT-CICERO Paper is not suitable for direct visual comparison to the PASS-2 analysis graphs in Entergy’s CHECWORKS reports, and the paper’s authors also excluded unspecified “wrong input data.” See *id.*

<sup>205</sup> See Riverkeeper Proposed Findings at 55 (¶¶ 123-24).

Paper.<sup>206</sup> Dr. Hopenfeld also admitted that he had no other source of information about the BRT-CICERO software, other than what he read in the BRT-CICERO Paper.<sup>207</sup> For these reasons, and because of the exclusion of unspecified data from the BRT-CICERO Paper, Dr. Hopenfeld's oral testimony about the 40% mathematical accuracy of BRT-CICERO lacks factual foundation.<sup>208</sup>

72. Finally, Riverkeeper speculates that the BRT-CICERO program “may consider all mechanisms,” rather than only FAC.<sup>209</sup> But the BRT-CICERO Paper itself shows that the BRT-CICERO software focuses on FAC, not non-FAC degradation mechanisms.<sup>210</sup> Dr. Hopenfeld even conceded at the hearing that there was no basis for his prior speculation that BRT-CICERO analyzed other, non-FAC mechanisms.<sup>211</sup> Thus, Riverkeeper's speculative argument that BRT-CICERO “may” address non-FAC mechanisms is unfounded.

73. In summary, there is no evidence in the record regarding the BRT-CICERO software used by EDF that suggests any deficiency in the IPEC FAC Program.

### **3. Riverkeeper Mischaracterizes the Record of FAC-Related Operating Experience at IPEC**

74. In Section IV.F of its proposed findings, Riverkeeper reiterates its prior arguments that Entergy's corrective action reports allegedly show numerous leaks and the

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<sup>206</sup> See Oct. 17, 2012 Tr. at 1812:2-3 (Hopenfeld). Moreover, as discussed during the hearing, because the plots contained in the BRT-CICERO Paper compare predicted *thickness* versus measured *thickness*, while CHECWORKS plots show predicted *wear* versus measured *wear*, Dr. Hopenfeld's reliance on a visual comparison of these graphs is ill-founded. See *id.* at 1810:2-15 (Hopenfeld); *id.* at 1811:21-1813:18 (Judge Wardwell, Hopenfeld).

<sup>207</sup> See *id.* at 1881:16-17 (Hopenfeld) (“I don't know anything about that program beyond what I read in that paper.”).

<sup>208</sup> See Riverkeeper Proposed Findings at 55 (¶¶ 123-24).

<sup>209</sup> See *id.* at 55 (¶ 126).

<sup>210</sup> See Entergy Proposed Findings at 94 (¶ 222) (citing BRT-CICERO Paper at 1 (RIV000110)).

<sup>211</sup> See Oct. 17, 2012 Tr. at 1819:6-1821:18 (Hopenfeld) (“I originally thought that one of those [variables] did deal with erosion because the way we were talking about it, but I may be wrong about that.”).

discovery of wall thinning allegedly below minimum acceptable values.<sup>212</sup> According to Riverkeeper, these events are “manifestations of the localized effects of FAC,”<sup>213</sup> show deficiencies in CHECWORKS,<sup>214</sup> and show deficiencies in the SNM process.<sup>215</sup>

75. Riverkeeper’s arguments on this topic are fully addressed in Section IV.G.5 of Entergy’s proposed findings.<sup>216</sup> Briefly, Entergy has shown that the IPEC FAC Program routinely identifies, documents, and corrects wall thinning in FAC-susceptible components before a loss of intended function.<sup>217</sup>

#### **4. Riverkeeper Mischaracterizes the Record of FAC-Related Operating Experience throughout the Industry**

76. Riverkeeper also reiterates its arguments that U.S. and worldwide operating experience allegedly show that FAC is a localized, non-linear phenomenon that poses serious safety risks.<sup>218</sup> Again, these arguments are fully addressed in Section IV.G.6 of Entergy’s proposed findings. Here again Riverkeeper largely relies on Dr. Hopenfeld’s uncorroborated opinions about events that have been addressed in great detail as lessons learned for the industry-wide FAC program.

77. Relatedly, Riverkeeper resurrects a claim from Dr. Hopenfeld’s direct testimony that, in 2005, a member of the Advisory Committee on Reactor Safeguards (“ACRS”) suggested

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<sup>212</sup> See Riverkeeper Proposed Findings at 46-47 (¶¶ 99-101).

<sup>213</sup> See *id.* at 25 (¶ 36).

<sup>214</sup> See *id.* at 47 (¶ 100).

<sup>215</sup> See *id.* at 65 (¶ 161).

<sup>216</sup> The only new claim is a mischaracterization of a statement by Entergy’s witness Mr. Azevedo. He testified that operating experience, in the form of measured wall thinning or identified leaks at IPEC or leaks at other facilities, is used to identify the presence of degradation mechanisms other than FAC. See Oct. 15 Tr. at 1440:2-4 (Azevedo). Riverkeeper incorrectly claims that this statement is a sweeping admission that “locations susceptible to wall thinning are identified when leaks occur.” Riverkeeper Proposed Findings at 47 (¶ 101).

<sup>217</sup> See Entergy Proposed Findings of Fact, § IV.G.5.

<sup>218</sup> See Riverkeeper Proposed Findings at 25-27 (¶¶ 37-40).



that he did not “really have too much confidence in CHECWORKS.”<sup>219</sup> Entergy’s witnesses, however, explained that Mr. Aleksick responded to the ACRS member’s question at that meeting, explaining that CHECWORKS is sufficiently accurate and precise to be useful as one factor among many used to select FAC program inspection locations.<sup>220</sup> The ACRS was satisfied.<sup>221</sup> Riverkeeper fails to acknowledge or dispute this evidence, so there is no reason to revisit this issue.

78. Riverkeeper also revives the long-refuted claim that NUREG/CR-6936, Probabilities of Failure and Uncertainty Estimate Information for Passive Components – A Literature Review (RIV000023)<sup>222</sup> shows that that “failures” due to FAC increased after CHECWORKS was introduced.<sup>223</sup> On the contrary, Entergy’s witnesses explained that the data set evaluated in NUREG/CR-6936 includes the late 1980s and the 1990s, before the major improvements in PWR water chemistry took place, and included worldwide operating experience from plants that did not use CHECWORKS.<sup>224</sup> Thus, these data do not represent information from plants using the modern U.S. FAC Program, as set forth in NSAC-202L-R3. In addition, the overall conclusion of NUREG/CR-6936 was that the FAC mitigation programs introduced after the 1985 Trojan event and the 1986 Surry event were effective.<sup>225</sup> Once again, Riverkeeper ignores this evidence and selectively cites only to Dr. Hopenfeld’s opinions.

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<sup>219</sup> *Id.* at 45 (¶ 95).

<sup>220</sup> *See* Entergy Testimony at 103-104 (A140) (ENTR00029).

<sup>221</sup> *See id.*

<sup>222</sup> NUREG/CR-6936, Probabilities of Failure and Uncertainty Estimate Information for Passive Components – A Literature Review (May 2007) (RIV000023).

<sup>223</sup> *See* Riverkeeper Proposed Findings at 45-46 (¶ 95).

<sup>224</sup> *See* Entergy Testimony at 92 (A127), 101-02 (A137) (ENTR00029).

<sup>225</sup> *See id.* at 102 (A137).

79. In conclusion, none of the industry operating experience cited by Riverkeeper shows any deficiency in the IPEC FAC Program.

**5. Riverkeeper’s Remaining Challenges Presume the Inadequacy of the FAC Program**

80. Section VI of Riverkeeper’s proposed findings reiterates prior claims regarding the alleged safety consequences of “improperly managed” FAC, including potential problems with degraded components under operational transients, design basis accidents, earthquake loads, station blackouts, anticipated transients without scram, and the alleged synergistic effects of FAC and metal fatigue. As Entergy has previously explained, all of these arguments presuppose a deficiency in the FAC program that Riverkeeper has not established.<sup>226</sup>

**II. REPLY TO NRC STAFF’S FACTUAL FINDINGS AND LEGAL CONCLUSIONS**

81. The NRC Staff correctly points out that Riverkeeper’s challenge to the use of CHECWORKS in the FAC Program is a challenge to the Indian Point CLB. In its proposed findings, the NRC Staff explains that the Staff reviewed and approved the use of CHECWORKS at uprated power levels at IPEC at the time of the 2004 and 2005 power uprates.<sup>227</sup> Thus, according to the Staff, Riverkeeper’s claim that CHECWORKS cannot be used at uprated power levels due to lack of calibration is a challenge to the IPEC CLB, and therefore impermissible in this license renewal proceeding.<sup>228</sup> Entergy agrees, for the reasons set forth in the Staff’s proposed findings.<sup>229</sup> The Board should, therefore, dismiss Riverkeeper’s challenges to CHECWORKS for this independent, additional reason.

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<sup>226</sup> See Entergy Proposed Findings § IV.G.7.

<sup>227</sup> See NRC Staff Proposed Findings at 54-57 (¶¶ 9.197-9.204).

<sup>228</sup> See *id.* (¶¶ 9.203-9.204), 62 (¶ 9.228).

<sup>229</sup> Therefore, based on the hearing record, the Board may dismiss the contention as outside the scope of this proceeding.

### III. CONCLUSION

82. In summary, based on the preponderance of the evidence, Entergy has demonstrated that it has taken, or will take, actions necessary to provide reasonable assurance that the effects of aging due to FAC will be adequately managed for in-scope systems, structures and components during the period of extended operations. Accordingly, Entergy has carried its burden of proof, and RK-TC-2 should be resolved in its favor.

Respectfully submitted,

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

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OPERATIONS, INC.

Dated in Washington, D.C.  
this 3rd day of May 2013

**UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION**

**BEFORE THE ATOMIC SAFETY AND LICENSING BOARD**

In the Matter of )	Docket Nos. 50-247-LR and
ENTERGY NUCLEAR OPERATIONS, INC. )	50-286-LR
(Indian Point Nuclear Generating Units 2 and 3) )	
	May 3, 2013

**CERTIFICATE OF SERVICE**

Pursuant to 10 C.F.R. § 2.305 (as revised), I certify that, on this date, copies of “Entergy’s Reply to Riverkeeper’s Findings of Fact and Conclusions of Law For Contention RK-TC-2 (Flow-Accelerated Corrosion)” were served upon the Electronic Information Exchange (the NRC’s E-Filing System), in the above-captioned proceeding.

*Signed (electronically) by Lance A. Escher*

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