UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
Entergy Nuclear Operations, Inc.	)	Docket Nos.
(Indian Point Nuclear Generating	)	50-247-LR
Units 2 and 3)	)	and 50-286-LR

RIVERKEEPER REPLY TO ENTERGY AND NRC STAFF PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW REGARDING CONTENTION RK-TC-2 – FLOW ACCELERATED CORROSION

May 3, 2013

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INTRODUCTION

In accordance with 10 C.F.R. §§ 2.712, 2.1209, the Atomic Safety and Licensing Board's ("ASLB") July 1, 2010 Scheduling Order,[1] and the ASLB's February 28, 2013 Order Granting Parties Joint Motion for Alteration of Filing Schedule,[2] Riverkeeper, Inc. ("Riverkeeper"), hereby submits the instant reply in response to Entergy and NRC Staff respective Proposed Findings of Fact and Conclusions of Law Regarding Contention RK-TC-2 – Flow Accelerated Corrosion, both dated March 22, 2013.[3] The procedural history and applicable legal and regulatory standards relating to Riverkeeper Contention RK-TC-2, which concerns Entergy's failure to demonstrate an effective program for managing FAC at Indian Point during proposed 20-year license renewal periods for Units 2 and 3, is described in Riverkeeper's Post-Hearing Proposed Findings of Fact and Conclusions, which is also dated March 22, 2013.[4]

For the reasons that follow, Entergy and NRC Staff's Proposed Findings of Fact and Conclusions of Law are largely without merit and must not be adopted by the ASLB. In contrast to the findings and conclusions suggested by Entergy and NRC Staff, the testimony and supporting exhibits in the record in the Indian Point license proceeding relating to Contention RK-TC-2 demonstrate that Entergy does *not* have an adequate program to manage the aging effects of flow accelerated corrosion during the proposed period of extended operation for the

[1] In the Matter of Entergy Nuclear Operations, Inc. (Indian Point Nuclear Generating Units 2 and 3), Docket Nos. 50-0247-LR and 50-286-LR, ASLBP No. 07-858-03-LR-BD01, Scheduling Order (July 1, 2010), at ¶ N.

[2] In the Matter of Entergy Nuclear Operations, Inc. (Indian Point Nuclear Generating Units 2 and 3), Docket Nos. 50-0247-LR and 50-286-LR, ASLBP No. 07-858-03-LR-BD01, Order (Granting Parties Joint Motion for Alteration of Filing Schedule) (Feb. 28, 2013).

[3] Entergy's Proposed Findings of Fact and Conclusions of Law for Contention RK-TC-2 (Flow-Accelerated Corrosion) (March 22, 2013) (hereinafter cited herein as "Entergy's Proposed Findings of Fact and Conclusions of Law"); NRC Staff's Proposed Findings of Fact and Conclusions of Law Part 9: Contention RK-TC-2 (Flow Accelerated Corrosion) (March 22, 2013) (hereinafter cited herein as "NRC Staff's Proposed Findings of Fact and Conclusions of Law").

[4] Riverkeeper Post-Hearing Proposed Findings of Fact and Conclusions of Law Regarding Contention RK-TC-2 – Flow Accelerated Corrosion (March 22, 2013), at 1-12 (hereinafter cited herein as "Riverkeeper's Proposed Findings of Fact and Conclusions of Law").

Indian Point nuclear power plant. Accordingly, the ASLB should reject Entergy and NRC Staff's proposed findings and conclusions, and instead adopt Riverkeeper's Proposed Findings of Fact and Conclusions of Law, which more accurately portrays the evidentiary record and appropriate factual and legal conclusions to be drawn therefrom.

DISCUSSION

I. REPLY TO ENTERGY'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW FOR CONTENTION RK-TC-2

Entergy's Proposed Findings of Fact and Conclusions of Law is rife with mischaracterizations of the evidence and unpersuasive assertions, and must not be adopted by the ASLB in relation to the resolution of Contention RK-TC-2. For the following specific reasons, Riverkeeper objects to Entergy's Proposed Findings of Fact and Conclusions of Law, and respectfully submits that the ASLB reject such findings and conclusions.

A. Entergy Mischaracterizes Dr. Hopenfeld's Qualifications to Provide Testimony on Contention RK-TC-2

Entergy's Proposed Findings of Fact and Conclusions of Law inaccurately describes the qualifications of Riverkeeper's witness, Dr. Joram Hopenfeld, to provide testimony on Contention RK-TC-2. In particular, despite the ASLB's repeated finding that Dr. Hopenfeld is qualified to testify as an expert witness in relation to Contention RK-TC-2,[5] which Entergy concedes,[6] Entergy would have the ASLB find that Dr. Hopenfeld "has limited direct experience with the management of the effects of aging due to FAC at nuclear power plants such as IPEC."[7] This is patently unfounded, since, as the record on Contention RK-TC-2 clearly demonstrates, Dr. Hopenfeld has extensive education, training, and experience with FAC-related issues, all of

[5] *See e.g.* Tr. at 1322:20-21 ("We've accepted you as an expert" (ALJ McDade)).

[6] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 80.

[7] *Id.*

which make him more than well qualified to testify in relation to Contention RK-TC-2. This is clear from a review of Dr. Hopenfeld's *curriculum vitae*, as well as his initial prefiled testimony, which described his relevant qualifications.[8] In addition, Dr. Hopenfeld provided lengthy prefiled rebuttal testimony explaining his relevant background, experience, and publications related to FAC issues.[9] Based on the detailed history of Dr. Hopenfeld's involvement in FAC-related issues, he undeniably has *direct* experience with the aging effects and management of FAC.[10]

Entergy further mischaracterizes the extent of Dr. Hopenfeld's review of Entergy's FAC-related documentation. Entergy would have the ASLB find that "Dr. Hopenfeld admitted at the hearing that he had only conducted a limited review of the FAC Program documents provided by Entergy."[11] This is inappropriately misleading and belied by the evidentiary record. In reality, Dr. Hopenfeld conducted a very extensive review of hundreds of Entergy's documents, including thousands of data points.[12] Entergy's attempt to mischaracterize Dr. Hopenfeld's clarification regarding whether he examined in depth *every* data point must be rejected.

Lastly, Entergy claims that Dr. Hopenfeld provided testimony that is inconsistent with testimony he provided in a wholly separate proceeding related to the Vermont Yankee nuclear power station license renewal proceeding.[13] For the reasons discussed below, Entergy's ongoing and repeated references to the Vermont Yankee proceeding are inapposite, inappropriate, and in

[8] Exh. RIV000004 (Hopenfeld CV); Exh. RIV000003 (Hopenfeld Testimony at 1-2).

[9] Exh. RIV000108 (Hopenfeld Rebuttal Testimony at 4-8).

[10] *See generally* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 1-4.

[11] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 80.

[12] Exh. RIV000003 (Hopenfeld Testimony at 2-3, 5-7); Exh. RIVR00005 (Hopenfeld Expert Report at 5); Exh. RIVR00005 (Hopenfeld Expert Report at 5).

[13] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 80.

no way dispositive in relation to the credibility of Dr. Hopenfeld's testimony in the instant proceeding.[14]

For these reasons, Entergy's proposed finding that "the Board accords limited weight to Dr. Hopenfeld's testimony" must be rejected. Instead, the evidence in the record demonstrates that Dr. Hopenfeld's testimony should be accorded significant weight in relation to the substantive matters at issue in Contention RK-TC-2.[15]

B. Entergy Mischaracterizes the Nature of the FAC Phenomenon

Entergy's Proposed Findings of Fact and Conclusions of Law recognizes disagreements between the parties in relation to various aspects of the nature of FAC, however, inappropriately suggests that the ASLB resolve such disagreements in Entergy's favor.[16] Entergy's suggested findings and conclusions are belied by convincing evidence in the record proffered by Dr. Hopenfeld relating to the nature of FAC, and, thus, must be rejected.

i. Entergy has Failed to Properly Define the Scope of Aging Mechanisms Encompassed by FAC or Justify Entergy's Alleged Ability to Effectively Manage all such Mechanisms

To begin with, Entergy suggests that the ASLB agree with Entergy's witnesses that FAC is solely a chemical dissolution phenomenon.[17] However the testimony cited to by Entergy to support this position is not dispositive. In particular, as detailed in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, Dr. Hopenfeld offered credible testimony, and the record includes documentary support, for the position that FAC should not be treated in such a

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[14] *See infra* § I.H.

[15] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 1-4; Exh. RIV000004 (Hopenfeld CV); Exh. RIV000003 (Hopenfeld Testimony at 1-3); Exh. RIVR00005 (Hopenfeld Expert Report at 1); Exh. RIV000108 (Hopenfeld Rebuttal Testimony at 4-8).

[16] Entergy's Proposed Findings of Fact and Conclusions of Law § IV.B

[17] *Id.* ¶¶ 82-84; *see also id.* ¶ 28.

limited fashion, and should be understood to also encompass mechanical processes.[18] Thus, there is inadequate evidence for the ASLB to adopt Entergy's proposed finding that "FAC is defined and managed as a chemical corrosion process and is not an erosive phenomenon."[19] Entergy's suggested finding that the "IPEC FAC Program is appropriately focused on addressing . . . the chemical corrosion phenomenon of FAC,"[20] is, likewise, undermined by the ample evidence in the record regarding the broad array of aging mechanisms implicated by FAC.[21]

Entergy further suggests that the ASLB find that, in any event, "the IPEC FAC Program appropriately accounts for other mechanisms."[22] However, Dr. Hopenfeld identified Entergy's failure to adequately account for mechanical wear phenomena as a fundamental flaw in various aspects of the FAC program at Indian Point.[23] Thus, the evidence provided by Entergy on this point is not dispositive. The fact that Dr. Hopenfeld may have "acknowledged . . . that pipe wall thickness measurements and inspections do not distinguish between particular wall-thinning mechanisms" does nothing to negate the position, which is supported by ample evidence, that Entergy has not adequately considered the impact of different erosive phenomena, which each result in drastically different thinning rates and timing of thinning, in the context of the

[18] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 14-25.

[19] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 84.

[20] *Id.* at ¶ 90.

[21] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 14-25.

[22] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 86-87, 89.

[23] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law at 17-25, 60, 199. Riverkeeper notes and calls to the ASLB's attention a substantive typo contained in Riverkeeper's Proposed Findings of Fact and Conclusions of Law: proposed finding ¶ 60 currently states as follows: "Thus, the assumption underlying the CHECWORKS model about the definition of FAC is a fundamental flaw, since the model does address all relevant forms of component wall thinning." As should be clear from the evidence discussed at length in the paragraphs preceding this finding, this should actually read: "Thus, the assumption underlying the CHECWORKS model about the definition of FAC is a fundamental flaw, since the model does ***not*** address all relevant forms of component wall thinning."

management of FAC at Indian Point.[24] Simply because wall thinning, whatever the cause, will ultimately be detected when actual measurements are taken clearly does not demonstrate that Entergy's FAC program adequately accounts for how varying erosion mechanisms will behave, or that Entergy's FAC program ensures sufficient component inspection frequencies or the reliable prediction of future unacceptable component degradation and thinning resulting from erosion mechanisms.

Entergy also points to Draft Interim Staff Guidance ("ISG") in which NRC Staff acknowledged the relevance of erosion mechanisms in the context of FAC management, however calls attention to NRC Staff's witness' testimony that this ISG "does not propose to broaden the definition of FAC to include other wall-thinning mechanism."[25] Notwithstanding NRC Staff's position, the text of the ISG itself, as well as Dr. Hopenfeld's explanatory testimony, does in fact suggest that NRC has broadened the definition of FAC.[26] In any event, the evidence in the record makes it clear that an essential flaw in the management of FAC at Indian Pont is Entergy's failure to adequately consider all relevant forms of corrosion and erosion.[27] Thus, there is inadequate evidentiary support for Entergy's proposed finding that Entergy adequately manages all forms of FAC.[28]

Based on the foregoing and the evidence in the record relating to Contention RK-TC-2, there is no basis for the ASLB to adopt Entergy's proposed finding that there is no need for Entergy to modify its FAC program to address the various forms of wall thinning identified by

[24] Riverkeeper's Proposed Findings of Fact and Conclusions of Law at 17-25, 60, 199; *see also* Exh. RIVR00005 (Hopenfeld Expert Report at 2).

[25] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 89.

[26] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law at 24.

[27] *Id.* at 17-25, 60, 199.

[28] Entergy's Proposed Findings of Fact and Conclusions of Law at ¶ 90.

Dr. Hopenfeld.[29] To the contrary, for the reasons explained in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, the evidence clearly shows Entergy's failure to consider and address all relevant corrosion and erosion mechanisms constitutes a major flaw in Entergy's program for managing FAC at Indian Point.[30]

ii. Entergy Improperly Dismisses the Overlapping Nature of Corrosion and Erosion Mechanisms

Entergy's Proposed Findings of Fact and Conclusions of Law minimizes the significance and reality of corrosion and erosion occurring in the same components. Entergy suggests that the ASLB find that at Indian Point erosion and corrosion do not occur simultaneously.[31] Entergy would have the ASLB find that Dr. Hopenfeld did not refute Entergy's witnesses' position that simultaneous erosion and corrosion in components at Indian Point is not possible.[32] However, this is not the case. As explained at length in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, Dr. Hopenfeld testified a great deal about the overlapping nature of corrosion and erosion mechanisms in Indian Point components; Dr. Hopenfeld explained credible scientific literature espousing this view, *and* demonstrated how variations in wall thickness measurements *at Indian Point,* indicated the occurrence of more than simply chemical dissolution processes.[33] As such, Dr. Hopenfeld amply refuted Entergy's witnesses on this point.

Entergy suggests that the ASLB find that Dr. Hopenfeld's reference to a particular profession paper by Dr. Digby MacDonald does not support the position taken by Dr. Hopenfeld

[29] *Id.*

[30] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 14-25, 60, 199.

[31] Entergy's Proposed Findings of Fact and Conclusions of Law at ¶¶ 91-92.

[32] *Id.* at 92.

[33] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 19-23.

regarding the coincident nature of chemical dissolution and erosion.[34] However, this paper, written by a distinguished professor of material sciences and engineering and the director of the Center for Electrochemical Science and Technology at Penn State University, provides clear evidence, in refutation of the position taken during the hearing by Entergy's witness, Dr. Horowitz, that Entergy's narrow understanding that FAC is strictly controlled by chemical dissolution is *not* "universally accepted."[35]

Yet Entergy cites to Dr. Horowitz's testimony that Dr. MacDonald assumed that "flow reaches critical velocity," which "does not occur under actual plant conditions at IPEC."[36] This interpretation of Dr. MacDonald's work is plainly wrong. The paper only schematically depicts critical velocity where the dissolution control process ends and the erosion-corrosion process begins, no numerical values were assigned to this local velocity.[37] Moreover, there is no evidence in the record relating to any measurements of local velocities at Indian Point, and, indeed, there is no way to measure such local velocities.[38] Entergy's witnesses' bare claim that flow does not reach critical velocities at Indian Point is unsupported since no such information exists that could confirm such a statement. Overall, Entergy's attempt to discredit and minimize the usefulness of the MacDonald paper is unfounded, and should be rejected. As a result, the ASLB should reject Entergy's proposed findings related to the alleged non-simultaneous nature of FAC at Indian Point, i.e., that "high-turbulence conditions that might be argued to cause

[34] Entergy's Proposed Findings of Fact and Conclusions of Law at ¶ 92.

[35] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 19; Exh. RIV000108 (Hopenfeld Rebuttal Testimony at 29:10-12); Tr. at 1323:15-17 (Hopenfeld); Exh. RIV000127 (Macdonald).

[36] Entergy's Proposed Findings of Fact and Conclusions of Law at ¶ 92.

[37] *See* Exh. RIV000127 (Macdonald).

[38] Exh. RIVR00005 (Hopenfeld Expert Report at 2 ("The identification of locations where FAC rates are highest is made difficult by the fact that neither the local turbulence nor local flow velocity are directly measured quantities.").

erosion and corrosion to occur simultaneously are not present at IPEC." Such a conclusion is unsupported by the evidence in the record, and refuted by the testimony of Dr. Hopenfeld.

Entergy further argues that that the ASLB should take notice of the assertion that "even if erosion did occur in piping covered by the IPEC FAC Program" "it would not cause degradation that would challenge the functionality of the components at issue" but rather "would result in smaller, localized leaks."[39] The ASLB should not view Entergy's reliance on this "leak-before-break" concept as acceptable.[40] Importantly, "small" leaks can still pose tangible safety related concerns.[41] Notably, leak-before-break circumstances can be critical when wall thinning has weakened the surrounding area due to synergistic effects of metal fatigue, or as a result of varying transient loads including station blackouts or seismic loads.[42] Thus, Entergy's attempt to justify unmanaged effects of erosion mechanisms is unconvincing.

In sum, the evidence in the record indicates that the ASLB should reject Entergy's proposed findings regarding Entergy's consideration of the effects of erosion mechanisms, and instead adopt the findings proposed by Riverkeeper.[43]

iii. Entergy Fails to Acknowledge the Non-Linear, Local Nature of FAC

Entergy posits proposed findings that support its position that FAC is "essentially constant over time" and not a local phenomenon.[44] Contrary Entergy's suggestion that Dr. Hopenfeld did not adequately support the position that FAC is non-linear and local in nature, there is ample testimony and documentary evidence in the record supporting this position. As

[39] Entergy's Proposed Findings of Fact and Conclusions of Law at ¶ 93.

[40] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 101.

[41] *See id.*

[42] *Id.* ¶¶ 165-172.

[43] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 14-25, 60, 199

[44] Entergy's Proposed Findings of Fact and Conclusions of Law at ¶¶ 95-106.

explained in detail in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, Entergy's witnesses conceded that FAC may occur in a non-linear manner, and, in any event, Dr. Hopenfeld provided convincing and ample testimony regarding his expert opinion about the non-linear and local manner in which FAC behaves.[45] Because more than just chemical dissolution is at work, it cannot be assumed that wall thinning occurs linearly with time, as evidenced by Indian Point-specific data discussed by Dr. Hopenfeld.[46] While FAC may be constant in straight pipes, none of Entergy's witnesses provided any credible testimony or evidence to prove that local wall thinning in *elbows, orifice, nozzles* does not vary with time. Notably, foreign data from a French model called CIROCO, included in the record by Entergy, was based on average wall thickness for relatively short periods of time and is not relevant to, and certainly does not refute, the position that local wall thinning rates of elbows, orifice's, and nozzles, etc, are not linear with time.[47]

Entergy suggests that the ASLB find that Dr. Hopenfeld's reference to the French BRT-CICERO software does not support Dr. Hopenfeld's position that FAC is non-linear because, allegedly that code assumes a linear wear rate.[48] However, Dr. Hopenfeld refuted Entergy's witness testimony that the BRT-CICERO™ model assumes linear corrosion rates by explaining that wear in that model is based on averages.[49] Notably, as BRT-CICERO™ is a proprietary code, it is impossible for Entergy's witness, Dr. Horowitz to unequivocally conclude that the

[45] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 26-38; *see* Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 111.

[46] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 26-38

[47] *See* Tr. at 1549:22-1552:11; *see also* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 26-38.

[48] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 98-99.

[49] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 125.

code is based on data that shows that FAC progresses at a constant rate,[50] as Entergy suggests.[51] Moreover, the comparison of BRT-CICERO™ predictions with plant data, as presented in a professional paper included as an exhibit in this proceeding, has no time element in it; rather, actual wall thickness measurements were presented, *not* variations of wall thinning over time.[52]

In light of Dr. Hopenfeld's testimony as well as ample documentary evidence, Entergy's witnesses' testimony regarding the alleged linear nature of FAC is not dispositive, and the ASLB should reject Entergy's proposed findings which espouse Entergy's position on the alleged linear nature of FAC. There is no basis for Entergy's suggested finding that Dr. Hopenfeld presented no evidence to support his assertions, or that "Dr. Hopenfeld's theory of non-linearity" is "unsupported by the record."[53] Entergy further suggests that the ASLB ascribe to Entergy's theory that FAC is purely a "line-level" phenomenon.[54] However, Dr. Hopenfeld's testimony amply refutes such a narrow, overly-simplistic understanding of FAC.[55] There is simply an inadequate basis for the ASLB to adopt Entergy's suggested finding that "FAC can generally be predicted as a line-level phenomenon."[56]

As detailed in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, at the hearing Dr. Hopenfeld explained how Indian Point-specific data supports his position regarding the non-linear and local nature of FAC since such data demonstrates that FAC *at Indian Point* has actually already manifested in large variations in component wall thicknesses, i.e., non-

[50] *See* Exh. RIV000110 (Trevin, Moutrille Study).

[51] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 99.

[52] *See* Exh. RIV000110 (Trevin, Moutrille Study).

[53] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 101.

[54] *Id.* ¶¶ 103-105, 154.

[55] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 29.

[56] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 106.

linear, local wear.[57] In contrast, Entergy suggests that the ASLB find that such variations cited to and described by Dr. Hopenfeld are due to the design of and/or lamination associated with such components.[58] However, Dr. Hopenfeld explained in detail how the examples he cited to demonstrated the existence of non-linear, local wear.[59] Moreover, notwithstanding Entergy's position regarding certain examples singled out by Dr. Hopenfeld, including one component subject to lamination, Entergy's witness testimony in no way negates Dr. Hopenfeld's analysis of *many* Entergy data reports containing component thickness measurements, which demonstrated the local, non-linear nature of FAC at Indian Point.[60] Furthermore, Dr. Hopenfeld specifically refuted Entergy's witnesses' position that large variations in component wall thicknesses at Indian Point are somehow attributable to manufacturing or design fabrication.[61]

In addition, Dr. Hopenfeld testified, and there is documentary evidence in the record, related to numerous instances of leaks and component wall thinning at Indian Point and other U.S. nuclear plants which demonstrate the localized effects of FAC.[62] Based upon such evidence, as well as the evidence discussed above, Entergy's suggested finding that "Dr. Hopenfeld's theory that significant, unexplained, localized, non-linear wall thinning is occurring in IPEC components . . . is unsupported speculation,"[63] is unfounded and belied by the evidentiary record, and must be rejected.

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[57] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 32-34.

[58] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 107-110.

[59] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 32-34.

[60] *See id.*

[61] *See id.* ¶ 35.

[62] *See id.* ¶¶ 36-37.

[63] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 112.

Entergy further suggests that the ASLB find that, to the extent FAC wear varies at different locations within a component,[64] Entergy employs inspection grid patterns in a manner that will "detect all FAC wear."[65] However, Dr. Hopenfeld's testimony regarding large variations in wear found in components at Indian point, as well as component leaks, clearly demonstrates Entergy's patent failure to "detect all FAC wear."[66] In addition, Dr. Hopenfeld provided testimony which refutes Entergy's purported ability to detect all local wear that can occur in FAC-susceptible components using grid patterns or otherwise.[67]

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Entergy's proposed findings of fact relating to the nature of FAC are not well-founded or convincing, and should be rejected by the ASLB. Contrary to Entergy's proposed findings, the evidence in the record demonstrates that FAC must be viewed as encompassing both chemical dissolution *and* erosion mechanisms, and must be viewed as a non-linear, local phenomenon. Entergy's failure to consider FAC in this manner results in critical flaws in Entergy's program for managing FAC at Indian Point. For these reasons, the ASLB should adopt Riverkeeper's proposed findings of fact relating to the nature of FAC, since they more accurately portray the evidence in the record.[68]

[64] Indeed, Entergy explicitly concedes that its witnesses agree "wear rates may vary at different locations within a component." *Id.* ¶ 111. Entergy's further suggestion that "each location will experience that wear at a constant rate" is not supported by any convincing evidence, aside from conclusory statements, and as discussed above, is actually refuted by the testimony and evidence proffered by Dr. Hopenfeld. *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 26-38.

[65] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 111.

[66] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 26-38.

[67] *See id.* ¶ 196.

[68] *See id.* ¶¶ 14-38.
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C. Entergy has Failed to Demonstrate that the FAC Program at Indian Point is Consistent with Applicable Regulatory Guidance

Entergy's Proposed Findings of Fact and Conclusions of Law suggest that the ASLB find that Entergy's FAC Program at Indian Point "is adequately documented and consistent with the GALL Report, including the guidance in NSAC-202L."[69] However, such a conclusion is not supported by the evidence in the record, and must be rejected.

As an initial matter, Entergy would have the ASLB find that the GALL Report indicates that the use of a quantitative predictive code such as CHECWORKS "constitutes one aspect of an effective FAC Program."[70] However, this is a mischaracterization of the GALL Report, since this guidance clearly *focuses* on the use of a quantitative predictive code for the purposes of monitoring and detecting FAC.[71] As such, the ASLB should not adopt this misrepresentation of the guidance contained in the GALL Report.sdn

Entergy goes on to suggest that the ASLB draw findings that the FAC Program at Indian Point is "adequately documented."[72] However, the record plainly establishes that the pithy FAC program description contained in Entergy's License Renewal Application ("LRA") cannot be deemed adequate.[73] Similarly, Entergy's incorporation by reference of the GALL Report and industry guidance contained in NSAC-202L[74] does not demonstrate that the FAC program at Indian Point is adequately documented, since these reports constitute generic, and *not* site-

[69] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 113; *see also id.* ¶ 196.

[70] *Id.* ¶ 114.

[71] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 107-110.

[72] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 116-121.

[73] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 173

[74] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 118-119.

specific guidance documents which provide no details about the program as it specifically relates to Indian Point.[75]

The record demonstrates, and Entergy's witnesses repeatedly conceded and agreed, that numerous implementing procedures are needed in order for Entergy to execute its FAC program at Indian Point.[76] However, these implementing procedures are not captured in Entergy's LRA or Updated Final Safety Analysis Report ("UFSAR") and, notably, are not binding on Entergy or enforceable by NRC Staff.[77] Thus, the record is not actually clear as to what constitutes Entergy's AMP, nor is it clear what aspects of any such program are actually binding and enforceable upon Entergy for the period of extended operation.[78] In any event, the record shows that the implementing procedures used by Entergy to execute the FAC program at Indian Point are also devoid of *any* site-specific detail, but instead are generic fleet-wide documents.[79] Thus, these procedures cannot be deemed to "adequately document" the FAC program at Indian Point.

Based on the foregoing, the ASLB should not adopt Entergy's proposed findings that "there is a discrete set of documents sufficiently describing the IPEC FAC Program," and that "[t]he LRA and its supporting documents and incorporated references, taken together, sufficiently and specifically document the FAC Program."[80] To the contrary, Entergy has failed to demonstrate that its LRA, together with the documents reference therein, contain sufficient

[75] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 174-180, 184-185.

[76] *See id.* ¶¶ 181-183.

[77] *See id.* ¶ 183.

[78] *See id.* (citing Tr. at 1405:18-23 (Cox) (Entergy's witness, Mr. Cox, explaining that actually finding the Entergy FAC AMP is not something that can be accomplished "without coming onsite and auditing implementing procedures.").

[79] *See id.* ¶¶ 181-182; *see also* Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 119.

[80] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 121.

detail regarding Entergy's plan to manage FAC during the PEO, and the ASLB should adopt Riverkeeper's proposed findings since they more accurately describe the circumstances.[81]

Entergy next proposes that the ASLB adopt findings that "the IPEC FAC Program is consistent with . . . the GALL Report."[82] However, such a finding is not well-supported by the record. First, Dr. Hopenfeld provided persuasive testimony about the various ways in which Entergy reliance on and use of the CHECWORKS computer model results in inconsistencies with the guidance contained in the GALL Report.[83] This testimony is credible and convincing, and Entergy's position and proposed finding that Dr. Hopenfeld's critique of Entergy's use of CHECWORKS "lacks merit"[84] is not dispositive. Moreover, as detailed in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, Dr. Hopenfeld further testified about numerous other ways in which Entergy's FAC program is inconsistent with the GALL Report, including the fact that Entergy's FAC program lacks adequate detail in light of various deficiencies of the program.[85]

Furthermore, the ASLB should not indulge Entergy's apparent suggestion that Entergy's reliance on and reference to generic guidance documents is unequivocally sufficient to meet the regulatory standard for license renewal.[86] It is unquestionable that license renewal applicants cannot generically claim consistency with this guidance document, and instead must "provide a

[81] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 173-188.

[82] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 122-127.

[83] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 104-118.

[84] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 124-125.

[85] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 192-196.

[86] *See* Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 123, 127; *see also id.* ¶¶ 61-63.

reasonably thorough description of its AMP to show conclusively how th[e] program will ensure that the effects of aging will be managed."[87] In contrast, an applicant

> merely stating that its AMP meets NUREG-1801 without any specificity falls short of the required demonstration. . . . [W]hether an applicant is successful depends upon whether it is [sic] has shown that the specific plant details of its AMP have adequately addressed this guidance. But a bald reference to NUREG-1801 fails to show how the recommendations of NUREG-1801 are proposed to be implemented for [the facility] . . . and does not demonstrate that the effects of aging are adequately managed for the plant.[88]

That is, a license renewal applicant must conclusively show, by articulating plant-specific details, that its AMP actually and sufficiently addresses the guidance set forth in the GALL Report.[89] Thus, mere "adherence" via a reference to the GALL Report is simply not enough to demonstrate that aging effects of FAC will be adequately managed at Indian Point. Notably, "[t]he fact that the Commission has stated that the use of an AMP identified in NUREG-1801 constitutes reasonable assurance . . . does not mean that an AMP that consists solely of a bald statement that it is 'comparable to,' 'based on,' or 'consistent with' NUREG-1801 provides such reasonable assurance or 'demonstrates' that aging will be adequately managed."[90] As discussed above, Entergy relies on references to the GALL Report and the non-site-specific, generic documentation referenced therein in relation to managing FAC at Indian Point,[91] and Entergy's

[87] *Entergy Nuclear Vermont Yankee* (Vermont Yankee Nuclear Power Station), LBP-08-25, 68 NRC 763, 870 (Nov. 24, 2008).

[88] *Id.* at 871.

[89] *Id.* at 870-71.

[90] *Id.* at 871.

[91] *See* Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 127.

LRA for Indian Point demonstrably fails to adequately describe or incorporate "*how* the recommendations" of the GALL Report will be implemented at Indian Point.[92]

Based on the foregoing, the ASLB should reject Entergy's proposed findings that the FAC program at Indian Point is "adequately documented" and "consistent with the GALL Report"[93] and instead adopt Riverkeeper's proposed findings relating to the inadequacy of Entergy's documentation of the Indian Point FAC program and the program's various inconsistencies with the GALL Report.[94]

D. Entergy's "Technical Description of the IPEC FAC Program" Mischaracterizes the Evidence

Entergy's Proposed Findings of Fact and Conclusions of Law contains a section entitled "Technical Description of the IPEC FAC Program."[95] While this section largely contains Entergy's explanation of the alleged "complementary tools" Entergy uses to identify inspection locations, and Riverkeeper responds to Entergy's respective positions regarding the use and effectiveness of these tools in greater detail below, a mischaracterization of the evidence necessitates a response.

In particular, Entergy would have the ASLB adopt a misleading description of the evidence in relation to the degree to which susceptible non-modeled ("SNM") components have been inspected to date at Indian Point. Entergy states that "[a]t IP3, more than 90% of the high consequence/high susceptibility SNM components have been inspected to date."[96] This

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[92] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 173-188; *see supra* pp. 14-15 (explaining Entergy's reliance on implementing procedures which are not part of Entergy's LRA); *Entergy Nuclear Vermont Yankee* (Vermont Yankee Nuclear Power Station), LBP-08-25, 68 NRC 763, 870 (Nov. 24, 2008) (emphasis added).

[93] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 121, 127, 196.

[94] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 104-118, 173-196.

[95] Entergy's Proposed Findings of Fact and Conclusions of Law § IV.D.

[96] *Id.* ¶ 140.

misrepresents the degree to which SNM components as a whole have been inspected at Indian Point. The evidence can more accurately be characterized to reflect Entergy's witnesses' testimony that, while it is unknown precisely how many SNM components at Indian Point had been inspected over the life of the plant, "roughly" 50% of such components had been inspected to date.[97]

E. Entergy's Has Failed to Demonstrate that CHECWORKS is Used Properly or Performs Adequately at Indian Point

i. The Extent of Entergy's Reliance on CHECWORKS

Entergy would have the ASLB find that applicable guidance does not focus on the use of a quantitative computer code, such as CHECWORKS, as a prominent feature of an adequate FAC program.[98] This is clearly not the case. Both revisions 1 and 2 of the GALL Report indisputably emphasize the use of computer modeling in order to adequately manage FAC.[99] Similarly, the industry document Entergy relies upon for its FAC program at Indian Point, NSAC-202L, also discusses the important role ascribed to the CHECWORKS computer model in a FAC management program.[100] Thus, the ASLB should not agree with Entergy's proposed finding that Entergy's stated limited use of CHECWORKS in the FAC program at Indian Point is consistent with applicable guidance.[101] The ASLB should likewise reject Entergy's proposed finding that Entergy's relegation of CHECWORKS to a minor role within the FAC program at Indian Point does not constitute a deficiency with the program.[102]

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[97] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 52.

[98] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 150, 183, 185, 188.

[99] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 107, 110.

[100] Exh. RIV000012 (NSAC-202L at p.1-1) ("CHECWORKS™ was developed as a predictive tool to assist utilities in planning inspections and evaluating the inspection data to prevent piping failures caused by FAC.").

[101] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 150.

[102] *Id.* ¶ 188.

Importantly, notwithstanding the degree to which Entergy relies on CHECWORKS versus other tools, Entergy's limited use of CHECWORKS and reliance on various other tools also fails to meet applicable regulatory guidance due to the ineffective manner in which these tools are used, as explained further below.

In any event, Entergy misconstrues the evidence with respect to the extent of Entergy's actual reliance on CHECWORKS in its FAC program at Indian Point. While the evidence does indicate that CHECWORKS is not the only tool employed at Indian Point to attempt to manage FAC, Entergy would have the ASLB adopt findings that minimize the role CHECWORKS actually plays at Indian Point.[103] Riverkeeper's Proposed Findings of Fact and Conclusions of Law more accurately portrays the significance of CHECWORKS at Indian Point.[104] In sum, the evidence in the record indicates that CHECWORKS plays an integral and primary role in determinations at Indian Point regarding what *new*, *modeled* components to inspect for FAC-related degradation.[105]

ii. Entergy has Failed to Show that CHECWORKS Performs in an Effective or Useful Manner at Indian Point

Entergy proposes that the ASLB find that "CHECWORKS, as it is used in the IPEC FAC Program, is sufficiently accurate to serve its intended purpose."[106] However, the evidence in the record does not support Entergy's proposed findings related to CHECWORKS. In fact, as explained for accurately in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, the evidence demonstrates that the CHECWORKS computer model as employed at Indian Point is highly inaccurate and produces results that demonstrate a complete lack of correlation between

[103] *Id.* ¶¶ 179.

[104] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 63-71.

[105] *See id.* ¶ 70.

[106] *See* Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 3, 152, 155, 156, 159, 161, 162, 165; *see also id.* ¶¶ 18, 28-29.

component wear predictions and actual wall thickness measurements.[107] Thus, CHECWORKS does *not* adequately serve its purported purpose of assisting in the selection of components for inspections so as to avoid reaching critical wall thicknesses in all in-scope components.

Entergy makes much of a distinction between "[c]alibrated analysis lines" which allegedly have "a reasonably good correlation between the predicted and measured wall thicknesses," and "[n]on-calibrated analysis lines" which "lack good correlation."[108] However, the evidence shows that *most* of the CHECWORKS data provided by Entergy and reviewed by Dr. Hopenfeld, which did not distinguish between calibrated versus non-calibrated lines, exhibited wide scatter and a complete lack of correlation between CHECWORKS predictions and actual measurements.[109] Thus, the ASLB should clearly not adopt Entergy's proposed finding that predictions related to calibrated lines "can be relied upon."[110] Moreover, Entergy's admission that CHECWORKS predictions related to non-calibrated lines cannot be relied upon, and that instead "more" inspections are conducted on such lines, is evidence that CHECWORKS does not perform adequately for such lines, and that components with critical wall thicknesses may be not be sufficiently inspected as a result.[111]

Entergy also attempts to misconstrue the degree of inaccuracy produced by CHECWORKS at Indian Point. In particular, Entergy would have the ASLB find that "Dr. Hopenfeld's claim that CHECWORKS is inaccurate by a factor of ten is ultimately based on two isolated points in Entergy's CHECWORKS reports—two points out of thousands."[112] This is a

[107] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 72-87.

[108] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 155-156.

[109] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 72-81, 85-87.

[110] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 155-156.

[111] *See id.*; *see* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 108-110.

[112] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 164.

blatant mischaracterization of the evidence. Indeed, Dr. Hopenfeld's conclusion that CHECWORKS predictions at Indian Point vary by *upwards* of a factor of 10 was based on his review of *thousands* of data points, not the two which he discussed only *as examples* two demonstrate his point.[113] The evidence in the record, i.e., Entergy's own data spanning 11 years, shows that, on the whole, CHECWORKS produces unacceptably inaccurate results at Indian Point, rendering the model ineffective for determining inspection locations at the plant.[114] Notably, even Entergy admits that for almost half of all CHECWORKS analysis lines at Indian Point, i.e., clearly a significant number of components for which the code is used, CHECWORKS produces unreliable, non-calibrated results.[115]

Entergy would further have the ASLB draw unsupported findings related to Entergy's use of a "line correction factor" or "LCF" in relation to CHECWORKS data. In particular, Entergy proposes that the ASLB agree with a bare, as yet unsubstantiated, claim that Entergy relies on an "acceptable" LCF range.[116] There remains no justification in the record for why this range is "acceptable."[117] Simply because Dr. Hopenfeld did not "provide an alternative" range does not justify the range that Energy uses.[118] In any event, in *many* instances at Indian Point, LCF's are reported to be *outside* Entergy's arbitrary "acceptable" range, which is a clear demonstration that CHECWORKS is unreasonably failing to predict wear rates.[119]

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[113] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 75-79.

[114] *Id.* ¶¶ 72-87.

[115] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 162.

[116] *Id.* ¶ 157.

[117] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 82-83.

[118] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 157.

[119] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 84. Indeed, Entergy concedes that approximately a third of the time, LCF's in relation to Indian Point data are found to be outside the range that Entergy deems "acceptable." Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 162

Thus, the ASLB should not adopt Entergy's proposed findings that CHECWORKS is sufficiently accurate and a useful tool, and instead accept Riverkeeper's proposed findings related to the efficacy of Entergy's use of CHECWORKS at Indian Point.[120]

iii. Entergy has Failed to Demonstrate that the CHECWORKS Model at Indian Point is Adequately Benchmarked

Entergy suggests that the ASLB draw findings related to Dr. Hopenfeld's initial position[121] (i.e., taken at the time Riverkeeper filed its petition to intervene in the Indian Point license renewal proceeding, prior to any document disclosure) that approximately 10-15 years of post power uprate benchmarking was necessary to properly calibrate the CHECWORKS code at Indian Point.[122] However, as detailed in Riverkeeper's proposed findings of fact, based on his subsequent review of the data from Entergy's use of CHECWORKS at Indian Point, Dr. Hopenfeld has explained that CHECWORKS predictions are not improving at all with time, and that this indicates an ongoing lack of adequate benchmarking, and inability of the code to become successfully calibrated or benchmarked in the future prior to the start of Entergy's proposed PEO, or otherwise.[123] Entergy's witnesses' position that there is adequate "level of correlation"[124] is unconvincing and plainly undermined by actual data showing an utter *lack* of adequate correlation.[125] Yet Entergy proposes that the ASLB adopt findings that "Dr. Hopenfeld's claim that the IPEC CHECWORKS model cannot be calibrated" is

[120] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 72-87.

[121] *See* Exh. RIV000002 (Riverkeeper Statement of Position at 13-14); Riverkeeper, Inc.'s Request for Hearing and Petition to Intervene in the License Renewal Proceedings for the Indian Point Nuclear Power Plant (November 30, 2007), ADAMS Accession No. ML073410093, at 21.

[122] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 203-204

[123] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 85, 86.

[124] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 207.

[125] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 85, 86.

"unpersuasive."[126] However, such findings are unsupported by the evidence and must be rejected.

Based on the foregoing, there is no basis for the ASLB to adopt Entergy's suggested finding that "extended benchmarking . . . is unreasonable and unnecessary,"[127] since this is undermined by clear evidence that the CHECWORKS code at Indian Point is *not* currently benchmarked, and will not become adequately benchmarked. Notably, in light of the site-specific data clearly indicating a lack of adequate benchmarking of the CHECWORKS code at Indian Point, findings of a licensing board in the *Vermont Yankee* license renewal proceeding regarding the need for additional benchmarking *at* Vermont Yankee, where no such data was available, are clearly inapposite, and the ASLB should ignore Entergy's references thereto.[128]

iv. Entergy's Use of CHECWORKS is Not Consistent with Applicable Regulatory Guidance and Requirements

Entergy proposes that the ASLB find that Entergy properly uses CHECWORKS as a "best-estimate" model.[129] However, Entergy's characterization of the evidence and applicable regulatory guidance is not persuasive. In particular, Entergy ignores the fact that the GALL Report is premised upon the use of CHECWORKS in a conservative manner and in such a way as to allow for adequate FAC inspections prior to components reaching critical wall thicknesses.[130] While Entergy points to the fact that NRC ISG proposes to delete certain language contained in revision 2 of the GALL Report, the proposed changes[131] would leave

[126] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 215-216.

[127] *Id.* ¶ 208; *see id.* ¶ 18.

[128] *Id.* ¶¶ 204, 208.

[129] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 166-171.

[130] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 104-118.

[131] Since the time of the parties' filings of proposed findings of fact and conclusions of law, the referenced ISG was finalized by NRC. This fact does not change the reality that Entergy's reliance on and use of CHECWORKS at Indian Point fails to comply with the GALL Report.

undisturbed the following language: "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."[132] Thus, the language of the GALL Report would continue to indicate that the use of CHECWORKS is acceptable only if non-conservative results can be corrected by re-calibrating the model. Thus, Entergy's use of CHECWORKS at Indian Point in such an ineffective manner, is *not* appropriate, since doing so fails to be consistent with the *GALL Report*, with or without the changes articulated in the ISG.

As Riverkeeper's Proposed Findings of Fact and Conclusions of Law more accurately describes Entergy's ongoing inappropriate reliance on CHECWORKS, the ASLB should adopt Riverkeeper's proposed findings.[133]

v. Entergy Mischaracterizes the "Availability" of Historic Data within the CHECWORKS Model

Entergy suggests that the ASLB adopt a misleading characterization about the CHECWORKS data that was made available in this proceeding. In particular, Entergy proposes that the ASLB find that historical data dating from the inception of the use of CHECWORKS at Indian Point has been incorporated into the model and is reflected in every bi-annual CHECWORKS modeling report.[134] Entergy raises Dr. Hopenfeld's concern regarding the availability of historical data relating to the CHECWORKS model.[135]

While historical data may be incorporated into the current CHECWORKS model, Entergy must not be permitted to mischaracterize the record and history of this proceeding. In

[132] Exh. ENT000573 (Draft LR-ISG-2012-01 at D-7, ¶ 5; *see* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 115-118.

[133] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 104-118.

[134] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 173-177.

[135] *Id.* ¶ 173.

fact, Dr. Hopenfeld's concern stems from Entergy's refusal to provide CHECWORKS reports and/or graphs containing comparisons of predicted wear versus actual wear dating prior to approximately 2000/2001, notwithstanding the fact that CHECWORKS has been employed at Indian Point since the 1990s.[136] Though the ASLB ultimately determined that Entergy was not required to disclose such reports or data, Dr. Hopenfeld maintained the credible position that such earlier comparison data was relevant and could be helpful for determining the behavior and calibration of the model over time.[137] The fact that such historical data is incorporated into the model as described in Entergy's proposed findings, does not change the fact that Dr. Hopenfeld was never provided the opportunity to review older, historical CHECWORKS reports, comparable to those related to outage inspections which occurred since approximately 2000.

In any event, despite the alleged incorporation of data into the CHECWORKS model and notwithstanding the fact that Dr. Hopenfeld was never given the opportunity to review older CHECWORKS reports, there remains no basis for Entergy's proposed finding that the model has "sufficient" data "for the software to play its role as an effective inspection location selection tool within the IPEC FAC Program."[138] That is, the evidence in the record, as discussed above as well as in detail in Riverkeeper's proposed findings, clearly shows that despite years of data,

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[136] *See* Riverkeeper, Inc. Motion *in Limine* to Exclude Portions of Pre-Filed Testimony and Statement of Position Regarding RK-TC-2 (Flow Accelerated Corrosion) (April 30, 2012) ("Riverkeeper Motion *in Limine*") ((objecting to Entergy's witnesses' reference to historical data purportedly used to benchmark the CHECWORKS computer code, which is used by Entergy to manage FAC at Indian Point, in light of a discovery ruling from earlier in the proceeding in which the ASLB found that "Entergy does not have ready access to the data [] and thus has not, and *cannot, rely on it* to provide the track record for its AMP [aging management program]" or to "demonstrate that its use of CHECWORKS is adequately benchmarked." (Quoting In the Matter of Entergy Nuclear Operations, Inc. (Indian Point Nuclear Generating Units 2 and 3), Docket Nos. 50-0247-LR and 50-286-LR, ASLBP No. 07-858-03-LR-BD01, Order (Ruling on Riverkeeper's Motion to Compel) (November 4, 2010), available at http://pbadupws.nrc.gov/docs/ML1030/ML103080978.pdf, at 5 (emphasis added))).

[137] *See* Riverkeeper, Inc. Motion to Compel Disclosure of Documents Relevant to Riverkeeper Contention TC-2 (August 3, 2010), *available at*, http://pbadupws.nrc.gov/docs/ML1022/ML102250183.pdf.

[138] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 172.

the CHECWORKS model at Indian Point does not perform adequately.[139] Moreover, due to the fact that the CHECWORKS model is based on several inherently flawed assumptions, the usefulness of the model is greatly limited, notwithstanding the amount of data contained in it.[140]

F. Entergy's Has Failed to Demonstrate that Methods "Other" than CHECWORKS for Selecting Inspection Locations are Adequate to Manage FAC

Entergy's Proposed Findings of Fact and Conclusions of Law suggest that the ASLB minimize the credible testimony provided by Dr. Hopenfeld regarding the inadequacy of Entergy's "other tools" in the FAC program at Indian Point aside from CHECWORKS.[141] However, Dr. Hopenfeld's testimony dispels the notion that the tools identified by Entergy taken together result in "robust inspection coverage of FAC-susceptible systems."[142] Riverkeeper's Proposed Findings of Fact and Conclusions of Law accurately describes the deficiencies with Entergy's reliance on "other tools," and should be adopted by the ASLB.[143]

As an initial matter, while Dr. Hopenfeld correctly questioned whether certain of the identified tools were truly "independent" of CHECWORKS,[144] Dr. Hopenfeld did not only evaluate each tool as a "stand-alone" tool, or "in isolation" as Entergy suggests.[145] Rather, Dr. Hopenfeld assessed such tools in terms of their respective usefulness for preventing undetected FAC, as they are described and apparently employed by Entergy.[146] In fact, Dr. Hopenfeld used the term "stand-alone" in parts of his prefiled testimony *only* in response to *Entergy's* witnesses

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[139] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 72-87.

[140] *Id.* ¶¶ 59-62.

[141] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 189-195.

[142] *Id.* ¶¶ 190, 195; *see id.* ¶¶ 2, 28, 29.

[143] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 127-164.

[144] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 132-133, 139-140.

[145] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 190, 195.

[146] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 127-164.

identification of such tools as being *separate and apart from CHECWORKS*.[147] Entergy's attempt to improperly manipulate the record and misconstrue Dr. Hopenfeld's testimony by criticizing his assessment of Entergy's "other tools" must not be given any credence.

In any event, in addition to the description of the evidence contained in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, which thoroughly demonstrates the inadequacy of Entergy's reliance on "other tools" for managing FAC at Indian Point, Riverkeeper responds to Entergy's proposed findings related to such "other tools" as follows:

i. Entergy Fails to Demonstrate that Engineering Judgment is Employed in a Manner that will Result in the Adequate Aging Management of FAC at Indian Point

Entergy suggests that the ASLB find that engineering judgment is adequately used as part of the FAC program at Indian Point.[148] Such a finding is not supported by the evidence in the record. Entergy proposes that the ASLB find that "the subjectivity of engineering judgment is not a deficiency in the FAC program."[149] However, the fact that engineering judgment is subjective in nature is not in dispute. Rather, the issue is Entergy's demonstrable failure to justify *how* subjective engineering judgments result in the adequate management of FAC and the detection of thinning before components reach critical thicknesses, aside from bare, unsubstantiated assurances from Entergy's witnesses.[150] Riverkeeper's Proposed Findings of Fact and Conclusions of Law more accurately describes the evidence relating to Entergy's unsupported reliance engineering judgment, and should be adopted.[151]

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[147] *See, e.g.,* Exh. RIV000108 (Hopenfeld Rebuttal Testimony at 13:3-4).

[148] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 145, 191.

[149] *Id.* ¶ 191.

[150] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 143-155.

[151] *Id.*

Riverkeeper also disputes Entergy's proposed characterization of the extent to which Entergy relies on engineering judgment in its FAC program. Entergy would have the ASLB find that engineering judgment "is only used to select a relatively small percentage of the inspection scope in any given outage."[152] However, Dr. Hopenfeld explained how engineering judgment plays a larger role in the FAC program at Indian Point than Entergy's witnesses portray.[153] Thus, the ASLB should reject Entergy's proposed finding relating to Entergy's degree of reliance on engineering judgment.

In addition, Entergy also mischaracterizes Entergy's use of engineering judgment. In particular, Entergy states that, with respect to Entergy's use of engineering judgment as a tool for determining FAC inspection scope, "if a component does not have adequate wall thickness, then it must be repaired or replaced; subjective judgment is not involved."[154] However, such a conclusion is unsupported. That is, based on the documentation Entergy purports to rely on, corrective action decisions indisputably involve subjective judgments. For example, NSAC-202L guidance lists three different options for a FAC engineer to consider if "predicted remaining service life is shorter than the amount of time until the next inspection," and provides a variety of factors that "should be considered in making replacement decisions," including cost, feasibility, etc.[155] There are clearly subjective aspects to every part of Entergy's FAC program at Indian Point, including corrective action determinations. Entergy's suggested finding that "[e]ngineering judgment does not impact repair or replacement decisions" is not accurate and should not be adopted.

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[152] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 191.

[153] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 143-144.

[154] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 146.

[155] Exh. RIV000012 (NSAC-202L at p.4-26).

ii. Entergy Fails to Demonstrate that "Operating Experience" is Employed in a Manner that will Result in the Adequate Aging Management of FAC at Indian Point

Entergy misconstrues Dr. Hopenfeld's understanding of Entergy's use of operating experience.[156] Dr. Hopenfeld provided credible testimony demonstrating Entergy's failure to provide sufficient details to assure that this "tool" establishes inspection locations so as to prevent undetected FAC.[157] The fact that Entergy memorializes which components are selected as a result of operating experience in certain Entergy reports is not a substitute for an explanation or justification of how operating experience led to such determinations.[158] The bottom line is that Entergy has simply failed to demonstrate that operating experience is employed in a manner that will result in the adequate aging management of FAC at Indian Point.

iii. Entergy Fails to Demonstrate that "Trending" is Employed in a Manner that will Result in the Adequate Aging Management of FAC at Indian Point

Entergy again tries to criticize Dr. Hopenfeld's assessment of Entergy's use of trending as a "stand-alone" tool.[159] As discussed above, this manipulation of the record is not convincing. Moreover, Dr. Hopenfeld provided credible testimony regarding Entergy's failure to demonstrate that Entergy's use of "trending" as a tool for selecting inspection scope results in adequate aging management of FAC at Indian Point.[160] Furthermore, Entergy does not dispute that its use of trending is premised upon the notion that wear rates are constant with time.[161] This remains a fundamental flaw in Entergy's reliance on trending, since the evidence in the record shows that,

[156] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 192.

[157] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 138-140.

[158] *See id.*

[159] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 193.

[160] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 129-137.

[161] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 141, 194.

at Indian Point, FAC wear is *not* linear with time.[162] Indeed Entergy has pointed to no evidence, nor is there any, to support the notion that actual measurements of total wall thinning result in inspection schedules on the basis of linear extrapolation, or that such circumstances would prevent wall thicknesses from reaching critical levels. Nor has Entergy provided any convincing evidence to establish that Entergy's use of trending sufficiently establishes inspection frequencies. Moreover, Entergy's suggestion that the ASLB adopt a finding that Dr. Hopenfeld has made a "concession regarding the effectiveness of trending"[163] is utterly unfounded and must be rejected.

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Based on the testimony provided by Riverkeeper's witness, Dr. Hopenfeld, Entergy's proposed conclusion that "Entergy has a robust set of complimentary tools that allow it to select FAC Program inspection locations"[164] cannot be adopted. Contrary to Entergy's proposed finding, ample explanations in Dr. Hopenfeld's testimony should lead the ASLB to question such a conclusion.[165] Although the evidence in the record indicates that Entergy uses "other tools" that are allegedly suggested by industry guidance, the record does not establish that Entergy employs tools to select inspection locations in such a manner as to meet the criteria established in the GALL Report and industry guidance, i.e. so as to adequately identified wall thinning prior to critical thicknesses being reached.[166]

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[162] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 26-37, 136.

[163] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 194.

[164] *Id.* ¶ 195.

[165] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 127-164.

[166] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 192; *see also* Exh. NYS00146C (*GALL Report*, Revision 1, at pp. XI M-61 to XI M-62); Exhibit NYS00147D (*GALL Report*, Revision 2, at pp. XI M17-1, XI M17-2); . RIV000012 (NSAC-202L at § 2.2); *see also* Tr. at 1674:3-9, 1675:4-9 (Yoder) (the "entire program" contained in the *GALL Report* "must rely on your ability to inspect prior to reaching a critical thickness for a component.").
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G. Entergy's has Failed to Demonstrate that FAC in Steam Generator Components Will Be Adequately Managed Throughout the Proposed PEO

Entergy proposes that the ASLB find there is no "deficiency in Entergy's management of potential FAC in steam generator components."[167] However, Entergy gives short shrift to the testimony of Dr. Hopenfeld in relation to Entergy's failure to adequately consider the impact of FAC on steam generators at Indian Point. As more accurately reflected in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, the evidence in the record shows that despite the fact that FAC can affect steam generator components, Entergy does not monitor steam generator components in CHECWORKS or otherwise adequately consider the effect of FAC on risk-significant, FAC-susceptible components in the steam generators.[168]

This is certainly cause for concern and a deficiency with Entergy's FAC program at Indian Point. For example, with severely degraded walls, the feed water distribution piping ring inside the steam generators, which is subjected to high local velocities and turbulence, may rupture under transient loads causing damage to other structures within the steam generators.[169] The categorical exclusion of steam generators from the FAC management program prevents Entergy from effectively selecting inspection locations, and ultimately detecting and managing FAC at Indian Point. Accordingly, the ASLB should reject Entergy's proposed findings related to the alleged adequacy of Entergy's treatment of and attention to steam generator components in relation to FAC.[170]

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[167] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 200; *see id.* ¶ 234.

[168] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 15, 54, 71, 167, 190.

[169] *Id.* ¶ 167.

[170] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 200, 234.

Entergy indicates that certain susceptible steam generator components are within lines that are SNM, i.e., not suitable for modeling in CHECWORKS.[171] However, this does not demonstrate that such components are adequately monitored and inspected for FAC. Though Entergy would have the ASLB find that Dr. Hopenfeld did not explicitly criticize Entergy's SNM inspection ranking process, the record does not demonstrate that Entergy has a track record of performance in managing FAC in SNM components through its alleged ranking process, and thus that SNM steam generator components will be adequately managed for FAC during the proposed period of extended operation for Indian Point.[172]

H. Entergy's Repeated References to Findings Made in the Vermont Yankee License Renewal Proceeding are Inapposite and Inappropriate

Entergy's Proposed Findings of Fact and Conclusions of Law makes repeated references to findings of a different ASLB in the Vermont Yankee license renewal proceeding (hereinafter "VY ASLB"), and suggests that these findings should be dispositive in the instant proceeding.[173] Generally speaking, the conclusions of the VY ASLB were specific to the continued operation of VY and, therefore, cannot be generically applied in the instant proceeding. Nowhere did the VY ASLB state that their conclusions were universal. In fact, that board's decision referenced the role of plant specific inputs and data in the FAC program at VY numerous times, leaving no doubt that the conclusions reached by the VY ASLB were restricted to the VY plant.[174] As Dr. Hopenfeld explains, safety must be evaluated in *each* plant separately to account for the

[171] *Id.* ¶ 199.

[172] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 156-161.

[173] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 209-217; *see also id.* ¶¶ 8, 18, 123, 204, 208, and footnote 580.

[174] *See Entergy Nuclear Vermont Yankee* (Vermont Yankee Nuclear Power Station), LBP-08-25, 68 NRC 763, 871-72 (Nov. 24, 2008) ("To address the adequacy of Entergy's FAC AMP, we [the VY ASLB] reviewed . . . Entergy's updates to CHECWORKS with *plant-specific* data") (emphasis added).

differences in flow velocities, temperatures, geometry, material, and coolant chemistry.[175] Clearly, the conclusions of the VY ASLB are specific to the continued operation of VY and, therefore, cannot be generically applied in the Indian Point proceeding, especially when there is now an evidentiary record for the ASLB to base a sound, site-specific determination on.

Notwithstanding the obvious inappropriateness of relying upon the findings of a licensing board in a wholly separate and distinct proceeding, Entergy suggests that the ASLB rely upon various findings of the VY ASLB in this case. In particular, Entergy proposes that the ASLB rely on the VY ASLB findings that there was no need to conduct extended benchmarking of CHECWORKS *at* Vermont Yankee, and that Entergy's fleet-wide FAC Program as implemented *at* Vermont Yankee was adequate.[176]

However, the record establishes that there are important differences between the Vermont Yankee and the Indian Point plants, including the fact that Indian Point is a much larger facility in comparison to Vermont Yankee, as well as a pressurized water reactor ("PWR"), as opposed to a boiling water reactor, which are known to be significantly more prone to failures from wall thinning due to FAC than the latter.[177] Moreover, it is improper to assume that the changes in plant operating conditions at Indian Point due to power uprates are accounted or bounded by data from and changed conditions at other plants like Vermont Yankee.[178] In sum, a site-specific, independent evaluation of Entergy's program for managing FAC, and the use of CHECWORKS, *at Indian Point* is necessary. Indeed, a license renewal applicant must show "that the *specific*

[175] *See* Exh. RIV000003 (Hopenfeld Testimony at 9); Exh. RIVR00005 (Hopenfeld Report at 19).

[176] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 8, 18, 123, 204, 209-217.

[177] *See* Exh. RIV000023 (NUREG/CR-6936 at p.5.25).

[178] *See* Exh. RIV000003 (Hopenfeld Testimony at 9); Exh. RIVR00005 (Hopenfeld Report at 19-20).

plant details of its AMP have adequately addressed [NUREG-1801]"[179] and cannot simply defer to findings related to an allegedly similar program at a different plant.

Entergy proposes that the ASLB adopt findings that the important operational distinctions between Indian Point and Vermont Yankee identified by Dr. Hopenfeld are essentially not significant.[180] Such conclusions are belied by the evidence in the record. For example, Dr. Hopenfeld testified that the impact of a power uprate on plant conditions is necessarily relative to the size of the particular plant,[181] and provided documentary support for the position that PWRs and more prone to FAC-related failures.[182] Entergy's proposed findings should therefore not be adopted. The bigger size and output of the Indian Point plant relative to Vermont Yankee, and the fact that it is an entirely different kind of reactor remain important distinctions that make the findings in the *Vermont Yankee* proceeding inapplicable.

Entergy's position that the ASLB should adopt the VY ASLB's finding that *at* Vermont Yankee extended benchmarking of CHECWORKS was not necessary[183] is untenable, since the circumstances leading to that determination in the Vermont Yankee proceeding versus in the circumstances in the instant Indian Point proceeding are remarkably different. In particular, the VY ASLB specifically found that benchmarking was not necessary because Entergy *would* have three sets of data at the uprated power levels that would "refine the model calibration for the EPU [extended power uprate] prior to the PEO."[184] That is, the VY ASLB did not have the benefit of any data for the Vermont Yankee plant at the uprated power levels because the

[179] *See Entergy Nuclear Vermont Yankee*, 68 NRC 763, 871 (emphasis added).

[180] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 209-213.

[181] *See* Exh. RIV000003 (Hopenfeld Testimony at 9); Exh. RIVR00005 (Hopenfeld Report at 19-20).

[182] *See* Exh. RIV000023 (NUREG/CR-6936 at p.5.25).

[183] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 204, 208.

[184] *See Entergy Nuclear Vermont Yankee*, 68 NRC 763, 889.

adjudicatory hearings were held shortly after power uprate occurred and before additional data was produced. The VY ASLB could, therefore, not assess the ability of CHECWORKS to detect wall thinning in light of the changed operating conditions. In contrast, several sets of post-power uprate data have already been produced, which, as discussed in Riverkeeper's Proposed Findings of Fact and Conclusions of Law as well as above, unequivocally demonstrate that the CHECWORKS model *at* Indian Point remains inaccurate and is not sufficiently benchmarked, nor can be sufficiently benchmarked, to account for the new plant conditions.[185] Notably, Entergy's claims that the CHECWORKS code is "self-benchmarking," and that it "adequately performs," improves over time, and accounts for changes in plant parameters,[186] are refuted by convincing evidence in the record that the code is not and cannot be adequately calibrated.[187]

Dr. Hopenfeld explicitly explains that accessibility for inspections, past history with respect to the number of components and frequency of wall measurements that were used in the calibration of CHECWORKS, the quality of the correlation of predictions with measurements, and the number of component failures from wall thinning, will necessarily vary depending on the facility, further warranting an individual assessment of the use of CHECWORKS at Indian Point.[188] It is illogical to use a generic assessment of CHECWORKS and simply assume that the code is sufficiently benchmarked and accurate, or bounding for the power uprate at Indian Point, especially in light of evidence to the contrary. Due regard must be given to how CHECWORKS is implemented at Indian Point, and how it has performed. For these reasons, the conclusions of

[185] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 72-87.

[186] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 215, 216.

[187] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 72-87.

[188] *See* Exh. RIV000003 (Hopenfeld Testimony at 9); Exh. RIVR00005 (Hopenfeld Report at 20).

the VY ASLB regarding the benchmarking of CHECWORKS are inapplicable in the instant proceeding.

Based on the foregoing, it would be incorrect for the ASLB in this proceeding to defer to the findings of a licensing board relating to a plant specific determination at VY, especially in light of the now completed evidentiary record in this proceeding. Thus, Entergy's proposal that the ALSB "agree with the *Vermont Yankee* Board's finding[s]" must be rejected.

I. Entergy Mischaracterizes Evidence Relating to Available Alternative Superior Computer Modeling for Managing FAC

Entergy's Proposed Findings of Fact and Conclusions of Law suggests that the ASLB adopt findings that would mischaracterize evidence relating to an available alternative computer model for managing FAC.[189] In particular, Entergy would have the ASLB dismiss relevant and credible evidence relating to the BRT-CICERO™ model.

As an initial matter, Entergy's claim that Dr. Hopenfeld has argued that Entergy "should" use the BRT-CICERO™ model[190] mischaracterizes the evidence. In reality, Dr. Hopenfeld discussed the BRT-CICERO™ model in order to demonstrate the point that better accuracy in FAC modeling is possible and that CHECWORKS contains inherent deficiencies.[191] While Dr. Hopenfeld has presented a potential suitable and more accurate alternative, as Entergy states, it is not anyone's role but Entergy's to come up with *adequate* aging management program for FAC. Dr. Hopenfeld's testimony reveals numerous flaws in Entergy's current FAC management

[189] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 218-224.

[190] *Id.*

[191] Exh. RIV000108 (Hopenfeld Rebuttal Testimony at 24:5-11 ("In reality, the reason for the lack of correlation is that CHECWORKS has inherent deficiencies in its design. State-of-the-art computer codes, such as the one described in Stéphane Trevin & Marie-Pierre Moutrille, *Optimization of EDF's NPPs Maintenance due to Flow Accelerated Corrosion and BRT-CICEROTM Improvement by NDT Results Analysis*,[191] show an order of magnitude better accuracy of predicting wall thicknesses, and relatively little scatter in comparison to CHECWORKS."); *Id.* at 30:14-15 ("Based on my review of Entergy's witnesses' testimony, as well as a recently published study on new data and a different computer code [i.e., the BRT-CICERO model] I believe that the design of CHECWORKS is so fundamentally flawed that recalibration efforts will not be successful.").

program, as supported by references to the BRT-CICERO™ model,[192] and it is Entergy legal obligation to ensure that such flaws are addressed. The manner in which Entergy chooses to do so is up to Entergy. Thus, Entergy's proposed findings that the ASLB not "direct" Entergy to use the BRT-CICERO™ model are inappropriate and not necessary.

Moreover, Entergy would have the ASLB make patently incorrect findings regarding the accuracy of the BRT-CICERO™ model.[193] The evidence in the record clearly demonstrates that the BRT-CICERO™ model is more accurate than the CHECWORKS model by an order of magnitude.[194] Entergy's attempt to have the ASLB adopt findings that dismiss the significance and relevance of BRT-CICERO™ scatter data must be rejected.[195] As Dr. Hopenfeld explained, the fact that the scales on a relevant data plot are different does not undermine the value and validity of the BRT-CICERO™ data.[196]

Furthermore, although Entergy argues that the BRT-CICERO™ model narrowly focuses on only certain FAC degradation mechanisms,[197] Entergy's position is not dispositive or proven, since the evidence shows that the model more accurately reflects non-linear wear and may, in fact, consider all mechanisms that are properly encompassed by the term, FAC, i.e., more than just chemical dissolution processes.[198]

In addition, Entergy disputes the credible position that the BRT-CICERO™ model is superior merely because it is based on actual measurements of chromium content.[199] This

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[192] *See generally* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 119-126.

[193] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 220-221.

[194] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 122-123.

[195] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 220-221.

[196] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 124.

[197] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 222.

[198] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 125, 126.

[199] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 223.

position is undermined by the evidence indicating that the BRT-CICERO™ model does, in fact, more properly consider chromium content than CHECWORKS.[200] While Entergy attempts to convince the ASLB that Entergy adequately considers the impact of chromium on FAC, the evidence actually indicates that Entergy only measures chromium content "on a limited basis," and certainly not enough to affect CHECWORKS results.[201] Given the sensitivity of FAC to chromium content, the failure of CHECWORKS to adequately consider chromium represents a significant deficiency with the model,[202] which is not present in the BRT-CICERO™ model.[203] Indeed, Entergy's witness, Dr. Horowitz, testified that the uncertainty in chromium content is a major source for CHECWORKS' inability to predict FAC with certainty.[204]

Based on the foregoing, the ASLB must reject Entergy's proposed finding that the BRT-CICERO™ model does not represent a "superior" approach to managing FAC.[205] Moreover, contrary to Entergy's proposed finding, the BRT-CICERO™ model highlights numerous inadequacies with the CHECWORKS code.[206] Generally, Riverkeeper has proposed findings relating to the BRT-CICERO™ model that more accurately describe the efficacy of the model, and should be adopted by the ASLB.[207]

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[200] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 62, 126.

[201] *See id.* ¶ 62.

[202] *Id.*

[203] *Id.* ¶ 126.

[204] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 62 (citing Exh. ENT000029 (Entergy Testimony at A110); Tr. at 1323:23-1324:19-1326:5, 1729:2-9 (Hopenfeld); Tr. at 1645:12-18 (Horowitz)).

[205] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 224.

[206] *Id.*; Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 62, 126.

[207] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 119-126.

J. Entergy Mischaracterizes the Significance of Unacceptable FAC-Related Thinning and Leakage Events at Indian Point

Entergy proposes that the ASLB assign little significance to numerous instances of unacceptable FAC-related thinning events and component leaks that have occurred at Indian Point.[208] However, Entergy's position that the fact that numerous leaks and thinning events have happened at Indian Point "does not reflect poorly on the IPEC FAC Program,"[209] is unfounded and belied by the evidence in the record.

Entergy would have the ASLB find that the many FAC events that have occurred at Indian Point "show examples of where wall thinning was *identified* . . . *before* loss of component intended function."[210] However, this does not prove that FAC that has occurred at Indian Point does not indicate deficiencies in the program. Entergy neglects to mention that the instances of FAC memorialized in the record of this proceeding included *numerous* circumstances where thinning was found *below* what *Entergy* deems "critical" thickness, notwithstanding whether the component experienced a loss of intended function.[211] Such circumstances are absolutely indicative of deficiencies in the program, in that they demonstrate that Entergy has no track record of performance in preventing excessive FAC and/or leaks, no track record of performance under post-power uprate conditions, and that Entergy's FAC program is not adequate to *ensure* that components will be inspected *prior* to reaching critical wall thicknesses.[212] Notably, the

[208] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 225-230.

[209] *Id.* ¶ 226.

[210] *Id.* ¶ 227 (emphasis in original); *see also id.* ¶¶ 228-229

[211] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 36; Exh. RIV000024 (Entergy Operating Experience Report); Exh. RIV000025 (Entergy Daily Event Report), RIV000026 (Entergy Condition Report List), RIV000027 (Entergy Condition Report List), RIV000028 (Entergy Condition Report); RIV000029 (Entergy Condition Report).

[212] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 36, 99-102, 211, 214.

history of excessive wall thinning at Indian Point completely undermines Entergy's position that Entergy's FAC program has a "proven track record" of effectively managing FAC at the plant.[213]

There is inadequate basis for the ASLB to adopt Entergy's proposed finding that events raised by Dr. Hopenfeld constitute "[p]rogram successes rather than failures" or that the reports memorializing numerous instances of unacceptable FAC at Indian Point "are evidence of a FAC Program that provides reasonable assurance that the effects of aging will be adequately managed."[214] The documents themselves, which show FAC below allowable or acceptable levels, indicate that the opposite is true.[215] Accordingly, the ASLB should reject Entergy's proposed findings related to Indian Point operating experience.

K. Entergy Mischaracterizes the Significance and Relevance of FAC Occurrences at Other Nuclear Plants

Entergy mischaracterizes the evidence in the record relating to catastrophic FAC events that have occurred at other nuclear power plants in the United States and worldwide.[216] Although Entergy proposes that the ASLB adopt findings distinguishing and minimizing the relevance of various FAC related incidents at other nuclear facilities, the record establishes that the events memorialized in the record of this proceeding are, in fact, relevant. In particular, the evidence establishes that FAC events at the Surry, San Onofre, Fort Calhoun, and Mihama resulted in catastrophic consequences of *undetected* FAC.[217] Coupled with the ample evidence

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[213] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 3.

[214] *Id.* ¶ 230.

[215] Exh. RIV000024 (Entergy Operating Experience Report); Exh. RIV000025 (Entergy Daily Event Report), RIV000026 (Entergy Condition Report List), RIV000027 (Entergy Condition Report List), RIV000028 (Entergy Condition Report); RIV000029 (Entergy Condition Report); *see also* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 36, 99-102, 211, 214.

[216] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 231-239.

[217] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 40; Exh. RIV000006 (NRC IN 86-106); Exh. RIV000007 (NRC Bulletin 87-01); Exh. RIVR00008 (NRC IN 1991-019); Exh. RIV000009 (NRC Monitoring Report 5-93-0042); Exh. RIV000010 (NRC IN 1997-084); Exh. RIVR00005 (Hopenfeld Expert Report, at 3); Exh. RIV000011 (NRC IN 2006-008).

in the record relating to the flaws in Entergy's program for adequately managing FAC, as discussed above and in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, the events cited to demonstrate the serious safety implications associated with Entergy's inability to adequately detect FAC.

Accordingly, the ASLB should reject Entergy's attempt to minimize the relevance of industry operating experience.

L. Entergy Mischaracterizes the Significance of the Safety Consequences of Improperly Managed FAC at Indian Point

Entergy's Proposed Findings of Fact and Conclusions of Law suggests that the ASLB dismiss credible evidence in the record demonstrating Entergy's complete failure to account for the safety implications of improperly managed FAC at Indian Point.[218] Such findings are not supported by the evidentiary record and must be rejected.

As an initial matter, Entergy improperly attempts to minimize the significance of the safety issues raised by Dr. Hopenfeld, by characterizing them as "not 'central'" to Riverkeeper's Contention RK-TC-2.[219] When Entergy requested that the ASLB exclude Dr. Hopenfeld's discussion of critical safety issues from evidence, Riverkeeper vehemently opposed, explaining that such issues were an integral part of Riverkeeper's *original* contention.[220] Indeed, the safety implications of undetected FAC in degraded, weakened components are of paramount

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[218] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 240-245.

[219] *Id.* ¶ 240; *see id.* ¶ 27.

[220] Riverkeeper, Inc. Opposition to Entergy's Motion in Limine to Exclude Portions of Pre-Filed Testimony, Expert Report, Exhibits, and Statement of Position for Contention Riverkeeper TC-2 (Flow Accelerated Corrosion) (Feb. 17, 2012), *available at*, http://pbadupws.nrc.gov/docs/ML1204/ML12048B483.pdf, at 4-16 ("The 'reasonably inferred bounds'[]of Contention TC-2 unquestionably includes important safety considerations. In fact, Riverkeeper's originally proffered contention *explicitly* raised the safety implications posed by undetected FAC, and was entirely premised upon seeking to ensure that Indian Point will operate *safely* during the proposed period of extended operation.[] . . . [I]n order to demonstrate an AMP that is sufficient to manage the effects of FAC, the precise issue raised by Contention TC-2, Entergy must show that its program ensures component integrity *under all CLB conditions*" including "design basis loss of coolant accidents . . . under normal operations and under other transient loads, including earthquakes and station blackouts. . . .").

importance and must be considered in the context of assessing the adequacy of a FAC management program.[221] Moreover, the ASLB rejected Entergy's attempt to sideline the safety issues raised by Dr. Hopenfeld, finding that the issues objected to by Entergy were "related and relevant to whether FAC will be adequately managed during the period of extended operations"[222] Entergy should not be allowed to distort the record by mischaracterizing the significance and relevance of the safety issues raised by Riverkeeper.

In any event, Entergy's proposed findings otherwise suggest that the ASLB find that critical safety issues related to undetected FAC are not a problem at Indian Point.[223] Such findings are not supported by the evidence in the record. In particular, as described more accurately in Riverkeeper's Proposed Findings of Fact and Conclusions of Law than in Entergy's proposed findings, in light of Entergy's inability to adequately determine which components require inspections to avoid reaching critical wall thicknesses, undetected FAC degradation may result in significant safety consequences if Indian Point is subject to sudden transient loads, including operational transients, design basis accident (DBA) transients, earthquake loads, station blackouts (SBOs), and transients without scrams (ATWS).[224] Yet Entergy has not considered the implications of these kinds of accidents.[225] Moreover, the evidence further establishes that Entergy has also failed to consider the synergistic effects of an aging phenomenon known as metal fatigue.[226] Contrary to Entergy's distorted description of the

[221] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 165-172.

[222] In the Matter of Entergy Nuclear Operations, Inc. (Indian Point Nuclear Generating Units 2 and 3), Docket Nos. 50-0247-LR and 50-286-LR, ASLBP No. 07-858-03-LR-BD01, Order (Granting in Part and Denying in Part Applicant's Motions *in Limine*) at 23 (March 6, 2012).

[223] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 241-245.

[224] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 165-172.

[225] *See id.*

[226] *See id.* ¶ 171.

record, Dr. Hopenfeld has nowhere "conceded"[227] that such synergistic effects will not occur in various FAC-susceptible components.

The ASLB must reject Entergy's proposed findings related to the adequacy of Entergy's consideration of critical safety issues in relation to the FAC program at Indian Point. Notably, Entergy admits that because Entergy assumes that its FAC program at Indian Point is adequate, Entergy's believes it "unnecessary to consider" the safety issues raised by Riverkeeper.[228] However, because Entergy's FAC program at Indian Point does *not* provide "reasonable assurance that the effects of aging due to FAC would be adequately managed" as Entergy claims,[229] Entergy has clearly failed to demonstrate that it has adequately considered, let alone addressed, relevant critical safety issues.

M. The ASLB Should Reject Entergy's Proposed Conclusions and Board Order

Based on the foregoing, there is a wholly inadequate basis for the ASLB to adopt the conclusions and board order proposed by Entergy.[230] Contrary to Entergy's assertions, the evidence in the record does not support Entergy's proposed conclusions that (1) the term FAC is or can be limited to chemical dissolution processes, and that erosion mechanism are adequately accounted for;[231] (2) FAC can be understood as a linear and non-local phenomenon, which is an accurate assumption underlying Entergy's use of CHECWORKS and wall thickness measurement trending;[232] (3) Entergy's FAC program is consistent with applicable regulatory

[227] *See* Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 242-244.

[228] *Id.* ¶ 245.

[229] *See id.*

[230] Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 247-255.

[231] *Id.* ¶ 247.

[232] *Id.* ¶ 248.

guidance and contains a sufficient level of detail;[233] (4) Entergy's "tools" for selecting the scope of FAC inspections are adequate for purposes of identifying inspection locations so as to avoid components reaching critical wall thicknesses;[234] (5) CHECWORKS performs adequately at Indian Point;[235] (6) Entergy adequately addresses the impact of FAC on steam generators;[236] (7) the findings of an ASLB in the completely separate Vermont Yankee license renewal proceeding are relevant to the instant proceeding;[237] (8) alternative computer modeling is not superior to Entergy's use of CHECWORKS;[238] and (9) Indian Point and industry experience with FAC occurrences are not relevant and do not indicate deficiencies in Entergy's FAC program at Indian Point.[239]

Instead, as more accurately detailed in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, which the ASLB should adopt instead of Entergy's proposed findings and conclusions, the record supports the conclusions that: (1) FAC is best understood to encompass chemical dissolution processes *and* erosion mechanisms and Entergy's FAC program is deficient for failing to adequately account for this reality;[240] (2) FAC behaves in a local, non-linear fashion at Indian Point, and Entergy's assumptions to the contrary constitute systemic program deficiencies;[241] (3) Entergy's FAC program, including its use of CHECWORKS is *not* consistent

[233] *Id.* ¶¶ 249, 250.

[234] *Id.* ¶ 251.

[235] *Id.* ¶¶ 251, 252, 253, 254.

[236] *Id.* ¶ 254.

[237] *Id.*

[238] *Id.*

[239] *Id.*

[240] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 14-25, 60.

[241] *Id.* ¶¶ 26-38, 61, 190.

with applicable regulatory guidance;[242] (4) Entergy's "tools" for selecting the scope of FAC inspections are *inadequate* for ensuring the identification of inspection locations so as to avoid components reaching critical wall thicknesses;[243] (5) CHECWORKS does *not* perform adequately and is not a useful tool for ensuring the selection of components that will experience excessive FAC wear;[244] (6) Entergy does *not* adequately addresses the impact of FAC on steam generators;[245] (7) the findings of an ASLB in the completely separate and distinct Vermont Yankee license renewal proceeding are *not* relevant to the instant proceeding;[246] (8) available alternative computer modeling *is* superior to CHECWORKS;[247] and (9) Indian Point and industry experience with FAC occurrences *are* relevant and *do* indicate deficiencies in Entergy's FAC program at Indian Point.[248]

In sum, the evidence in the record does not establish that Entergy's FAC program "provides reasonable assurance that the effects of aging due to FAC on in-scope components will be adequately managed throughout the PEO."[249] Based on the foregoing and as explained in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, Entergy has failed to carry its burden of proof to demonstrate that FAC will be adequately managed in accordance with 10 C.F.R. §§ 54.21, 54.29.[250] The ASLB must reject Entergy proposed conclusion to the contrary.[251]

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[242] *Id.* ¶¶ 104-118, 173-196.

[243] *Id.* ¶¶ 59-87, 127-164.

[244] *Id.* § IV.

[245] *Id.* ¶¶ 15, 54, 71, 167, 190.

[246] *See supra* § I.H.

[247] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 119-126.

[248] *Id.* ¶¶ 36-37, 40.

[249] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 254; *see also id.* ¶ 255.

[250] The "ultimate burden of proof on the question of whether the permit or the license should be issued is . . . upon the applicant." *See* 10 C.F.R. § 2.325; *Amergen Energy Co.* (Oyster Creek Nuclear Generating Station), CLI-09-7,

Likewise, the ASLB must reject Entergy's proposed Board Order that "Contention RK-TC-2 is resolved on the merits in favor of Entergy."[252] Rather, for the reasons described in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, the ASLB should adopt the proposed Board Order articulated by Riverkeeper and resolve Contention RK-TC-2 in favor of Riverkeeper.[253]

II. REPLY TO NRC STAFF'S PROPOSED FINDINGS OF FACT AND CONCLUSIONS OF LAW FOR CONTENTION RK-TC-2

NRC Staff's Proposed Findings of Fact and Conclusions of Law, like Entergy's, misconstrues the evidence in the record, and NRC Staff's conclusion that Entergy has demonstrated an adequate program for managing FAC at Indian Point during proposed periods of extended operations should not be adopted. For the following specific reasons, Riverkeeper objects to NRC Staff's Proposed Findings of Fact and Conclusions of Law, and respectfully submits that the ASLB reject such findings and conclusions.

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69 NRC 235, 269 (2009); *Metropolitan Edison Co. (Three Mile Island Nuclear Station, Unit* 1), ALAB-697, 16 NRC 1265, 1271 (1982); In the Matter of Carolina Power & Light Company (Shearon Harris Nuclear Power Plant), Docket No. 50-400-LA; ASLBP No. 99-762-02-LA; LBP-00-12, 51 NRC 247 (2000) ("the agency's rules of practice . . . place the ultimate burden of proof on CP&L, as the license applicant, with respect to a merits disposition of any substantive matter at issue in this proceeding (i.e., the admitted BCOC contentions)." The license renewal applicant must assure that "public health, safety, and environmental concerns" are protected. *Amergen Energy Co.* (Oyster Creek Nuclear Generating Station), CLI-09-7, 69 NRC 235, 263 (2009); *Metropolitan Edison Co. (Three Mile Island Nuclear Station, Unit* 1), ALAB-697, 16 NRC 1265, 1271 (1982); *Commonwealth Edison Co. (Zion Units 1 and 2)*, ALAB-616, 12 NRC 419, 421 (1980) (Applicants have to "provide 'reasonable assurance' that public health, safety, and environmental concerns were protected, and to demonstrate that assurance by "a preponderance of the evidence.").

[251] Entergy's Proposed Findings of Fact and Conclusions of Law ¶ 255.

[252] *Id.* at 106-107; *see also id.* ¶ 3.

[253] Riverkeeper's Proposed Findings of Fact and Conclusions of Law at 83.

A. NRC Staff's Proposed Findings Regarding the Appropriate Scope and Definition of FAC are Unsupported by the Record

NRC Staff, like Entergy, proposes that the ASLB agree with Entergy and NRC Staff that FAC is properly viewed only as encompassing chemical dissolution processes.[254] For the same reasons discussed above in response to Entergy's unfounded position regarding the definition of FAC for purposes of having an adequate aging management program, the ASLB should reject NRC Staff's proposed findings.[255]

Notably, while NRC Staff suggests that the ASLB find that "the effects of erosion *can* be included as an integral part of the FAC program"[256] at Indian Point, NRC Staff does not suggest, nor could suggest, that the ASLB conclude that NRC adequately accounts for *all* FAC mechanism such as erosion processes. In fact, Entergy's FAC program does *not* ensure that all FAC, whether caused by chemical dissolution, or erosion mechanisms, will be adequately managed at Indian Point.[257]

Moreover, NRC Staff mischaracterizes Dr. Hopenfeld's testimony related to the appropriate scope of the definition of FAC. In particular, NRC Staff would have the ASLB find that Dr. Hopenfeld's position is that Entergy "fails to understand the principles of FAC" and the "underlying assumptions in CHECWORKS."[258] However, Dr. Hopenfeld testified, not in relation to a lack of understanding about the scope of FAC or the underlying assumptions in CHECWORKS, but rather, about Entergy's failure to accept as fact and *address* all the of the mechanisms which, in his well-supported expert opinion, are all properly considered FAC, or to

[254] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶¶ 9.91-9.93.

[255] *See supra* § I.B.i.

[256] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.92 (emphasis added); *see also id.* ¶ 9.90.

[257] *See supra* § I.B.i.

[258] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶¶ 9.87, 9.93.

recognize and *account for* the faulty assumptions inherent in the CHECWORKS code.[259] NRC Staff should not be permitted to distort the record in this manner.

B. NRC Staff's Proposed Findings Regarding the Sufficiency of Detail in Entergy's LRA AMP for FAC are Unsupported by the Record

NRC Staff suggests that the ASLB find that Entergy has provided a "robust description of the AMP for FAC."[260] In particular, NRC Staff believes that the ASLB should find that Entergy's various statements that its FAC program is consistent with the GALL Report and the guidance documents contained therein, Entergy has done enough to demonstrate an adequate program for managing FAC during the proposed periods of extended operation at Indian Point.[261] NRC Staff essentially cites to the same reasons as Entergy to support its proposed findings. As such, for the reasons already discussed in detail above, NRC Staff's proposed findings, like Entergy's, must be rejected.[262]

In short, due to Entergy's reliance on generic documents, and non-enforceable implementing procedures that are admittedly *not* part of Entergy's LRA and which are also "fleet-wide" and generic in nature, the ASLB cannot conclude that Entergy's FAC program is adequately documented.[263] Entergy has failed to demonstrate that its LRA, together with the documents reference therein, contain sufficient detail regarding Entergy's plan to manage FAC during the PEO, and the ASLB should adopt Riverkeeper's proposed findings since they more accurately describe the circumstances.[264]

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[259] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 18, 60.

[260] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.95.

[261] *Id.* ¶¶ 9.95-9.137, 9.140-9.168, 9.171-9.175.

[262] *See supra* § I.C.

[263] *Id.*

[264] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 173-188.

Moreover, despite NRC Staff's lengthy discussion of the alleged consistency of Entergy's FAC program with the GALL Report, the evidence in the record demonstrates that Entergy's program is *not* consistent with the GALL Report in various respects.[265] The record establishes that Entergy's improper use of and reliance on CHECWORKS, and lack of adequate detail in light of the current flaws in Entergy's FAC program which prevent the timely detection of FAC prior to components wall thicknesses reaching unacceptable critical levels, renders Entergy's program wholly inconsistent with the GALL Report.[266] Thus, NRC Staff's proposed findings regarding the adequacy of detail in Entergy's FAC program must be rejected.

Notably, NRC Staff would have the ASLB mischaracterize a license renewal applicant's obligation to articulate an adequate program. In particular, NRC Staff indicates that "[i]t is sufficient for an applicant to state that its AMP is comparable to NUREG-1801 [the GALL Report] in order to demonstrate that the effects of aging will be managed for the PEO."[267] This position contravenes clear NRC precedent eschewing mere bald statements of consistency in order to demonstrate the adequacy of an aging management program.[268]

In addition, NRC improperly mischaracterizes Dr. Hopenfeld's testimony and Riverkeeper's position with regard to the sufficiency of detail presented in relation to Entergy program for managing FAC at Indian Point. In particular, NRC Staff would have the ASLB find that Riverkeeper and Dr. Hopenfeld have conceded that details are available.[269] However, NRC Staff only points to the fact that Dr. Hopenfeld agreed that there is a "general framework"

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[265] *See supra* § I.C.

[266] *See id.*

[267] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.159.

[268] *See Entergy Nuclear Vermont Yankee* (Vermont Yankee Nuclear Power Station), LBP-08-25, 68 NRC 763, 870 (Nov. 24, 2008).

[269] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶¶ 9.169-9.170.

relating to Entergy's processes for determining inspection frequency, inspection method, and corrective actions.[270] This is a far cry from an admission regarding an adequate level of details regarding such processes. The testimony of Dr. Hopenfeld NRC Staff cites to does not in any way undermine Dr. Hopenfeld's ample and well-supported testimony relating to the dearth of sufficient details related to inspection frequency, method, and repair/replacement criteria.[271]

In sum, there is an inadequate basis for the ASLB to adopt NRC Staff's proposed board findings relating to the adequacy of the level of detail of Entergy's FAC program at Indian Point.

C. NRC Staff's Proposed Findings Regarding the Performance of CHECWORKS at Indian Point are Unsupported by the Record

NRC Staff, like Entergy, believes that the ASLB should find that Entergy's use of CHECWORKS at Indian Point to manage FAC is appropriate and in compliance with applicable regulatory standards.[272] However, like Entergy, NRC Staff's position is simply not supported by the evidence in the record related to Contention RK-TC-2.

To begin with, NRC Staff mischaracterizes Riverkeeper and Dr. Hopenfeld's undoubtedly valid "challenge" to Entergy's use of CHECWORKS to manage FAC during Entergy's proposed periods of extended operation for Indian Point. First, NRC Staff makes much of the fact that at the time the ASLB initially admitted Contention RK-TC-2 for adjudication, it stated that it viewed the contention as questioning the "sufficiency of the benchmarking needed to provide valid results at IPEC once the plant parameters changed with . . . power uprates," and not as challenge to the use of CHECWORKS.[273] However, this is precisely how Riverkeeper and Dr. Hopenfeld have criticized Entergy's reliance on

[270] *Id.*

[271] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 194-196.

[272] *See generally* NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶¶ 9.176-9.239.

[273] *Id.* ¶¶ 9.176, 9.227 (quoting ASLB Memorandum and Order (Ruling on Petitions to Intervene and Requests for Hearing), LPB-08-13, 68 NRC 43, 176-77 (2008)).

CHECWORKS throughout this proceeding.[274] In fact, Dr. Hopenfeld's analysis of CHECWORKS as it is used at Indian Point revealed that the code is *not* sufficiently benchmarked and valid in relation to the changed plant parameters that occurred as a result of power uprates, nor likely to become so.[275] Only because of this fact, which is clearly evidenced in the record of this proceeding, has Dr. Hopenfeld questioned Entergy's proposed future use of CHECWORKS during the proposed PEO. NRC Staff draws a distinction that is essentially semantic in nature and clearly illogical. Accordingly, Riverkeeper and Dr. Hopenfeld's conclusions regarding Entergy's use of CHECWORKS are relevant and valid.

Yet NRC Staff goes on to argue that Riverkeeper and Dr. Hopenfeld's criticisms of Entergy's use of CHECWORKS constitute improper challenges to Indian Point's current licensing basis ("CLB"), and are allegedly outside the scope of this proceeding.[276] NRC Staff's proposed findings in this regard grossly misconstrue the record. Contention RK-TC-2 is appropriately a challenge to whether Entergy's use of CHECWORKS will result in the adequate management of FAC *during the proposed periods of extended operation.*[277] The evidence proffered into the record relating to Entergy's "historical" and current use of CHECWORKS has been raised and discussed by Dr. Hopenfeld in relation to how the model can be expected to behave *during the proposed periods of extended operation,* and is clearly relevant and within the scope of the proceeding in that regard.

Thus, Riverkeeper and Dr. Hopenfeld's position regarding Entergy's reliance on CHECWORKS for managing FAC during the proposed extended period of operation is not a

[274] *See generally* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 72-87.

[275] *Id.*

[276] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶¶ 9.227-9.229; *see id.* ¶ 9.203-9.204.

[277] *See generally* Riverkeeper's Proposed Findings of Fact and Conclusions of Law at 1-2.

direct challenge to the CLB in any way. As one licensing board has explained, "[w]hile a challenge to the CLB is outside the scope of a license renewal, the CLB itself is relevant to the extent that a plant's *current practices* will form part of its aging management program during the license renewal term."[278] That licensing board was not willing to discredit evidence "merely because it touches upon Entergy's CLB."[279] Thus, the concerns raised Dr. Hopenfeld relating to Entergy "historic" and current use of CHECWORKS, as it relates to how effective the computer model will be during the PEO, is entirely permissible.

Moreover, NRC Staff boldly claims that the ASLB should find that "the evidence proffered to show that CHECWORKS™ is or is not being used correctly at the uprated powers [sic] is outside the scope of this proceeding."[280] This is directly contradictory to the ASLB's initial contention admissibility order, which expressly indicated that Contention RK-TC-2 was admitted as a challenge to whether CHECWORKS performed correctly in light of power uprate conditions.[281]

NRC Staff further proposes that, notwithstanding NRC Staff's position that Riverkeeper has raised challenges to CHECWORKS that are allegedly outside the scope of this proceeding, the ASLB should find that, in any event, CHECWORKS at Indian Point is adequately benchmarked and has adequately handled, and adequately handles, "new operating parameters"

[278] In the Matter of Entergy Nuclear Vermont Yankee, LLC and Entergy Nuclear Operations, Inc. (Vermont Yankee Nuclear Power Station), Docket Nos. 50-271-LR, ASLBP No. 06-849-03-LR, Order (Ruling on Motions to Strike and Motions in Limine), July 16, 2008, at 10 (emphasis added).

[279] *Id.*

[280] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.229.

[281] *See* ASLB Memorandum and Order (Ruling on Petitions to Intervene and Requests for Hearing), LPB-08-13, 68 NRC 43, 176-77 (2008) (finding that Contention RK-TC-2 "questions the sufficiency of the benchmarking needed to provide *valid results* at IPEC once the plant parameters changed with the 3.26% and 4.85% *power uprates* during 2004 and 2005") (emphasis added).

resulting from the power uprates at the plant.[282] Such arguments largely echo those made by Entergy to support the same position, and NRC Staff largely relies upon the same reasoning as Entergy.[283] For the same reasons discussed above, the ASLB should reject NRC Staff's proposed findings.[284]

In short, the evidence in the record, as more accurately described in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, demonstrates that at Indian Point, CHECWORKS is not adequately benchmarked or reliable, and cannot be used as an effective tool for selecting inspection locations so as to timely detect FAC prior to component wall thicknesses reaching critical levels.[285] There is no basis for the ASLB to adopt NRC Staff's patently incorrect proposed finding that "Riverkeeper provided no evidentiary support" demonstrating that CHECWORKS "hasn't been properly calibrated to reflect power uprates" that occurred at Indian Point.[286]

Certain specific proposed findings warrant certain further discussion. First, strangely, NRC Staff proposes that the ASLB find that the LCF employed by Entergy "can be used to correct (or calibrate or benchmark) other wear predictions thereby giving a better wear rate estimate,"[287] and that LCFs "allow[] for more accurate future predictions of wear rates."[288] However, there is no evidence in the record to support such findings. Indeed, the evidence in the

[282] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶¶ 9.230-9.239; *see also id.* ¶ 9.202

[283] *See id.*

[284] *See supra* § I.E.

[285] *See generally id.*; *see also* Riverkeeper's Proposed Findings of Fact and Conclusions of Law §§ IV.B., IV.D.

[286] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.204.

[287] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.83.

[288] *Id.* 9.84.

record demonstrates that despite the use of LCFs, the model is not getting "better" at predicting wear.[289] Thus, the ASLB should reject these proposed findings proffered by NRC Staff.

Next, NRC Staff mischaracterizes the evidence relating to the lack of adequate calibration of the CHECWORKS code. In particular, NRC Staff suggests that the ASLB find that no additional calibration of CHECWORKS is necessary in light of an alleged "admission" by Dr. Hopenfeld that "he could not tell any difference in the wear rates when he contrasted re-uprate data with post-uprate data."[290] However, Dr. Hopenfeld has certainly never conceded that CHECWORKS is adequately benchmarked, and his testimony related to the lack of change in CHECWORKS predictions from pre- to post-power uprate conditions was proffered to demonstrate the exact opposite of what NRC suggests, i.e., that the code is *still* not adequately calibrated, and is unlikely to become adequately calibrated.[291]

Entergy also mischaracterizes Dr. Hopenfeld's testimony with respect to the ability of CHECWORKS to become adequately calibrated. In particular, NRC Staff proposes that the ASLB find that Dr. Hopenfeld has only offered "vague and non-specific" statements "regarding how many outages . . . must occur for sufficient data to be gathered to complete calibration."[292] Yet Dr. Hopenfeld has been quite clear on this point: he has concluded that in light of the ongoing nature of CHECWORKS' inaccurate predictions, CHECWORKS *cannot* be successfully calibrated or benchmarked in the future prior to the start of Entergy's proposed PEO, or otherwise.[293] NRC Staff's position that the CHECWORKS code is adequately benchmarked at Indian Point simply because the post-power uprate "inspection data sets have

[289] Riverkeeper's Proposed Findings of Fact and Conclusions of Law § IV.D.

[290] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.238.

[291] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 85.

[292] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.239.

[293] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 85.

been entered into CHECWORKS" and "a substantial number of years and inspection cycles have passed since the small[294] uprates" occurred,[295] is untenable, especially in light of evidence indicating that the code is not currently benchmarked so as to provide accurate, useful results.[296]

In addition, NRC Staff focuses much attention on "Calibrated Line Analysis" in an attempt to allegedly demonstrate that the CHECWORKS code at Indian Point is adequately "calibrated" as Dr. Hopenfeld has used that term.[297] However, notwithstanding Entergy's "Calibrated Line Analysis," Dr. Hopenfeld's used the term "calibration" in relation to the accuracy of the model, and, in this regard, the evidence in the record clearly shows the code is not adequately "calibrated.[298] Whether or not certain analysis lines meet Entergy's criteria for being a "calibrated line" as that term is understood in industry guidance, does not undermine the credible evidence regarding the lack of accuracy of the CHECWORKS model.

Notably, in drawing proposed findings related to the adequacy of Entergy's reliance on CHECWORKS, NRC Staff, like Entergy, makes references to findings made in the Vermont Yankee license renewal proceeding related to CHECWORKS (and otherwise).[299] For the same reasons discussed above, such findings are not dispositive in relation to Contention RK-TC-2 in this proceeding.[300]

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[294] NRC Staff's characterization of the power uprates that occurred at Indian Point as "small" is misleading and unnecessary, since, as no party disputes, "even small power uprates can have a significant affect on FAC rates." Exh. RIV000012 (NSAC-202L). *See also* NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.200.

[295] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.239.

[296] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law § IV.D.

[297] *See* NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.213-9.2.18.

[298] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law § IV.D.

[299] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶¶ 9.192, 9.225.

[300] *See supra* § I.H.

D. NRC Staff's Proposed Findings Regarding the Degree of Entergy's Reliance on CHECWORKS at Indian Point and the Adequacy of Entergy's Reliance on "Other" Tools is Unsupported by the Record

NRC Staff, like Entergy, proposes that the ASLB adopt findings that would mischaracterize the record in regards to the degree of Entergy's reliance on CHECWORKS and the sufficiency of "other" tools identified by Entergy to manage FAC at Indian Point.[301] To start, like Entergy, NRC Staff minimizes the significance of CHECWORKS' role in Entergy's FAC program, i.e. for determinations at Indian Point regarding what *new, modeled* components to inspect for FAC-related degradation.[302] Thus, NRC Staff proposed findings regarding the "small" degree to which the FAC program at Indian Point relies on CHECWORKS impacts[303] are misleading and must be rejected. Moreover, for the same reasons discussed above, NRC Staff's position that the FAC Program at Indian Point operates "independently from CHECWORKS" "the majority of the time"[304] is not well founded.[305] In particular, despite Entergy and NRC Staff's attempt to portray certain tools as independent from CHECWORKS,[306] Dr. Hopenfeld provided persuasive testimony as to why such tools cannot necessarily all be considered independent from CHECWORKS.[307]

Moreover, NRC Staff's position regarding the adequacy of Entergy's limited reliance on CHECWORKS is inconsistent with the GALL Report, which focuses on the use of a quantitative

[301] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶¶ 9.241-9.267.

[302] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶ 70.

[303] *See* NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶¶ 9.263-9.266, 2.255.

[304] *Id.* ¶¶ 9.240, 9.263, 9.251.

[305] *See supra* § I.F.; *see also* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 132-133, 139-140 (describing the evidence in the record demonstrating that certain of Entergy's "other" tools are not necessarily entirely independent of the use CHECWORKS).

[306] *See, e.g.*, NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.258

[307] *see also* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 132-133, 139-140

predictive code for managing FAC.[308] Thus, NRC Staff's references to Dr. Hopenfeld's alleged "concessions" that CHECWORKS plays a limited role in the overall FAC program at Indian Point[309] does not demonstrate that the code is used properly and in compliance with applicable regulatory guidance.

Notably, NRC Staff mischaracterizes the description of CHECWORKS contained in the GALL Report. In particular, NRC Staff proposes that the ASLB find that "Element 5, 'Monitoring and Trending' of the GALL [Report Rev.] . . . references CHECWORKS™ as *one* tool used to predict component degradation in systems conducive to FAC."[310] However, CHECWORKS is the *only* tool discussed in this element of the GALL Report, in both revisions 1 *and* 2.[311] Similarly, NRC Staff proposes that the ASLB find that "Element 6, 'Acceptance Criteria' of the GALL [Report] . . . references CHECWORKS™ as *a* method used to calculate the number of refueling or operating cycles remaining before the component reaches the minimum allowable wall thickness."[312] However, this element of the GALL Report, in revisions 1 *and* 2 of the report, focuses on the use of a "predictive computer code" as the *only* method for calculating operating cycles, not *a* method.[313] NRC Staff's characterization of how CHECWORKS is referenced in the GALL Report improperly minimizes the role and importance that that the GALL Report attributes to a quantitative predictive computer model. Indeed, as

[308] *See id.* § IV.G.

[309] *See* NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.261.

[310] *Id.* ¶ 9.50 (emphasis added).

[311] Exhibit NYS00146C (*GALL Report*, Revision 1, at pp. XI M-61 to XI M-62); Exhibit NYS00147D (*GALL Report*, Revision 2, at pp. XI M17-1 to XI M17-2).

[312] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.51 (emphasis added).

[313] Exhibit NYS00146C (*GALL Report*, Revision 1, at pp. XI M-62); Exhibit NYS00147D (*GALL Report*, Revision 2, at pp. XI M17-2).

previously discussed, The GALL Report focuses on the use of such a code in order to have an adequate aging management program for FAC.[314]

In addition, regardless of the degree of Entergy's reliance on CHECWORKS, NRC Staff's proposed findings do not reflect the fact that the evidence in the record establishes that, to the extent Entergy relies on CHECWORKS *at all*, Entergy's FAC program at Indian Point is deficient and fails to comply with the GALL Report, since CHECWORKS is not an effective tool for assisting Entergy in adequately selecting inspection locations.[315] On a related note, like Entergy, NRC Staff references the fact that NRC ISG proposes to alter certain portions of the GALL Report, revision 2.[316] However, as discussed in response to Entergy, even with the changes proposed in the ISG, the GALL Report still indicates that the use of CHECWORKS is acceptable only if non-conservative results can be corrected by re-calibrating the model.[317] Thus, Entergy's use of CHECWORKS at Indian Point in an ineffective manner, is *not* appropriate, since doing so fails to be consistent with the *GALL Report*, with or without the changes articulated in the ISG.

Furthermore, NRC Staff's proposed findings suggest that the ASLB find that Entergy's use of "other" tools to select inspection locations follows relevant guidance.[318] This is similar to Entergy's position related to Entergy's use of "other" tools.[319] However, for the reasons stated above in response to Entergy's proposed findings related to Entergy's "other" tools, the evidence in the record plainly establishes that Entergy has failed to demonstrate that such "other" tools are

[314] Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 107-110.

[315] *See* Riverkeeper's Proposed Findings of Fact and Conclusions of Law § IV.G.

[316] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶¶ 9.55

[317] *See* Exh. ENT000573 (Draft LR-ISG-2012-01 at D-7, ¶ 5; *see* Riverkeeper's Proposed Findings of Fact and Conclusions of Law ¶¶ 115-118.

[318] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶¶ 9.242-9.249, 9.254.

[319] *See* Entergy's Proposed Findings of Fact and Conclusions of Law ¶¶ 189-195.

employed in a manner that will result in the adequate aging management of FAC at Indian Point.[320]

E. The ASLB Should Reject NRC Staff's Proposed Conclusions

Based on the foregoing, there is a wholly inadequate basis for the ASLB to adopt the conclusions proposed by NRC Staff.[321] Contrary to NRC Staff's assertions, the evidence in the record does not support proposed conclusions that Entergy's aging management program for FAC "is sufficiently-detailed" and "follows NUREG-1801 [the GALL Report]," or that Entergy uses CHECWORKS as part of its FAC program in an adequate or useful manner.[322] To the contrary, as more accurately described in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, Entergy's FAC program is neither adequately detailed, nor compliant with the guidance contained in the GALL Report,[323] and CHECWORKS is not an adequate tool for managing FAC during Entergy's proposed periods of extended operation at Indian Point.[324]

In sum, the evidence in the record does not establish that Entergy's FAC program will assure that the effects of aging due to FAC will be adequately managed throughout the PEO. Based on the foregoing and as explained in Riverkeeper's Proposed Findings of Fact and Conclusions of Law, Entergy has failed to carry its burden of proof to demonstrate that FAC will be adequately managed in accordance with 10 C.F.R. §§ 54.21, 54.29. The ASLB must reject NRC Staff's proposed conclusions to the contrary.

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[320] *See supra* § I.F.

[321] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶¶ 9.268-9.271.

[322] NRC Staff's Proposed Findings of Fact and Conclusions of Law ¶ 9.270.

[323] *See* Proposed Findings of Fact and Conclusions of Law §§ IV.G, VII.

[324] *Id.* §IV.

CONCLUSION

Based on the foregoing, the ASLB should reject Entergy and NRC Staff's respective Proposed Findings of Fact and Conclusions of Law, adopt Riverkeeper's Proposed Findings of Fact and Conclusions of Law, and resolve Contention RK-TC-2 in favor of Riverkeeper.

Respectfully submitted,

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Dated: May 3, 2013

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	Docket Nos.
	)	50-247-LR
Entergy Nuclear Operations, Inc.	)	and 50-286-LR
(Indian Point Nuclear Generating	)	
Units 2 and 3)	)	May 3, 2013

CERTIFICATE OF SERVICE

I certify that on May 3, 2013, copies of Riverkeeper Reply to Entergy and NRC Staff Proposed Findings of Fact and Conclusions of Law Regarding Contention RK-TC-2 – Flow Accelerated Corrosion, were served on the following by NRC's Electronic Information Exchange:

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Signed (electronically) by Deborah Brancato
Deborah Brancato

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