UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

In the Matter of TENNESSEE VALLEY AUTHORITY (Watts Bar Nuclear Plant Unit 2)	Docket No. 50-391 November 21, 2011

TENNESSEE VALLEY AUTHORITY'S MOTION FOR SUMMARY DISPOSITION OF CONTENTION 7

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I. INTRODUCTION

In accordance with 10 C.F.R. § 2.1205 and the Atomic Safety and Licensing Board's ("ASLB" or "Board") May 26, 2010 Scheduling Order,[1] the Tennessee Valley Authority ("TVA"), applicant in the above-captioned proceeding, hereby submits this motion for summary disposition, requesting that the Board dismiss Contention 7, which was submitted by Southern Alliance for Clean Energy ("SACE").[2] As admitted by the Board, Contention 7 alleged that TVA's analysis of the aquatic impacts resulting from operation of Watts Bar Nuclear Plant ("WBN") Unit 2 is deficient in three respects: (i) it inaccurately describes the baseline health of the aquatic ecosystem, (ii) it uses outdated and inadequate data, and (iii) it fails to analyze the cumulative effects of existing impacts and impacts from WBN Unit 2 on the ecosystem. As described further below, TVA has addressed and resolved all of these issues and, therefore, Contention 7 should now be dismissed as a matter of law.

II. PRELIMINARY STATEMENT

SACE's Contention 7 is fundamentally a contention of omission. Simply put, Contention 7 alleged that TVA's aquatic studies were inadequate and outdated and that as a result, TVA incorrectly described the health of the relevant aquatic ecosystem and the potential impact on that ecosystem from operation of WBN Unit 2. In direct response to SACE's alleged deficiencies, TVA voluntarily undertook a substantial, aquatic-focused data collection and analysis effort. TVA deliberately and methodically addressed each of the alleged omissions identified by SACE, including SACE's request for updated raw data on impingement,

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1 "Scheduling Order" (unpublished).

2 TVA supports this Motion with the accompanying "Statement of Material Facts on Which No Genuine Issue Exists in Support of TVA's Motion for Summary Disposition of Contention 7" ("Statement of Material Facts"); and "Joint Affidavit by Dennis Scott Baxter, John Tracy Baxter, Dr. Charles Coe Coutant, and Dr. Paul Neil Hopping" ("Joint Affidavit"). The Motion and supporting Statement of Material Facts and Joint Affidavit reference twenty-eight attachments that are included herein.

entrainment, and hydrothermal impacts. Specifically, TVA significantly expanded and updated its monitoring efforts of the current impacts on the aquatic environment of WBN Unit 1, which has been operating at full power since 1996. TVA compared that new data to available historical information, analyzed and documented the results in a series of studies, and corrected errors in historical studies as identified by SACE. TVA provided the resulting data and analyses to SACE and the U. S. Nuclear Regulatory Commission ("NRC") Staff as they became available. Although TVA has disclosed these reports to SACE over the course of more than a year, SACE has not challenged the methodology or results of any of these studies with the NRC or with this Board. Accordingly, TVA has cured any alleged omissions in its environmental analyses associated with operation of WBN Unit 2, and there is no longer a genuine issue as to material fact. And to the extent SACE attempts to challenge this information in response to this Motion, such challenges are untimely.[3] The Board should therefore dismiss Contention 7 in its entirety.

III. PROCEDURAL BACKGROUND

In its August 7, 2009 Answer opposing SACE et al.'s Petition to Intervene, TVA described the relevant procedural history in detail.[4] That history – with all relevant citations – is provided in the attached Statement of Material Facts, and is summarized briefly here.[5]

A. Licensing History for Watts Bar Nuclear Plant

On May 14, 1971, TVA applied for a Construction Permit ("CP") for WBN. The NRC issued CPs for WBN Units 1 and 2 on January 23, 1973, and construction began. On June 30, 1976, TVA filed an application for an operating license ("OL") for WBN Units 1 and 2. TVA

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[3] *See* Scheduling Order at 5 (instructing that any new or amended contention filed in this proceeding is deemed timely only if filed within 30 days of the date on which the information upon which it is based first became available).

[4] *See* [TVA's] Answer Opposing the [SACE] et al. Petition to Intervene and Request for Hearing at 2-5 (Aug. 7, 2009), *available at* ADAMS Accession No. ML092190926.

[5] *See* Statement of Material Facts at 1-5.

substantially completed construction of Unit 1 in 1985, but suspended construction on Unit 2 shortly thereafter. On February 7, 1996, the NRC issued a full power OL for Unit 1.

Between 1973 and 2008, the NRC extended the CP for Unit 2 on several occasions. On August 3, 2007, TVA informed the NRC Staff of its intention to resume construction of WBN Unit 2. TVA updated its original OL application on March 4, 2009, and the NRC published a notice of hearing on the OL application in the *Federal Register* on May 1, 2009.

Throughout this time, TVA and the NRC completed a number of environmental reviews of the construction and operation of WBN Units 1 and 2. On February 15, 2008, in support of the reactivated construction, TVA submitted its Final Supplemental Environmental Impact Statement ("FSEIS") for operation of WBN Unit 2 to the NRC. The NRC published its draft supplement to the final environmental statement ("Draft SFES") on October 31, 2011.[6]

B. Intervention in Current Proceeding

In response to the NRC's May 1, 2009 Notice of Opportunity for Hearing, five organizations, including SACE, jointly filed a Petition to Intervene and Request for Hearing that included seven contentions.[7] Among those, Contention 7 challenged TVA's analysis of the impact of operation of WBN Unit 2 on the aquatic environment, alleging:

> TVA claims that the cumulative impacts of WBN Unit 2 on aquatic ecology will be insignificant (FSEIS Table S-1 at page. S-2, and Table 2-1 at page. 30). [sic] TVA's conclusion is not reasonable or adequately supported, and therefore fails to satisfy 10 C.F.R. § 51.53(b) and NEPA.
>
> TVA's discussion of aquatic impacts is deficient in three key respects. First; TVA mischaracterizes the current health of the ecosystem as good, and therefore fails to evaluate the impacts of WBN2 in light of the fragility of the host environment. Second, TVA relies on outdated and inadequate data to predict thermal impacts and the impacts of entrainment and impingement of aquatic organisms in the plant's cooling system.

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6 NUREG-0498, Supp. 2, Draft Final Environmental Statement Related to the Operation of [WBN] Unit 2, (Oct. 2011), *available at* ADAMS Accession No. ML112980199

7 [SACE] Petition to Intervene and Request for Hearing (July 13, 2009) ("Petition").

> Third, TVA fails completely to analyze the cumulative effects of WBN2 when taken together with the impacts of other industrial facilities and the effects of the many dams on the Tennessee River.[8]

On November 19, 2009, this Board granted the Petition to Intervene on behalf of SACE, admitting Contention 7 "as originally presented."[9] Although the Board admitted Contention 1 along with Contention 7, TVA moved to dismiss Contention 1 as moot on April 19, 2010. The Intervenors did not oppose that motion, and the Board granted TVA's unopposed Motion and dismissed Contention 1 accordingly. As a result, only Contention 7 remains to be resolved.

C. New Information on the Record – TVA's Aquatic Studies

In order to comprehensively address the alleged omissions and errors identified in Contention 7, TVA undertook a significant data collection and analysis effort in 2010 and 2011. Specifically, TVA collected extensive new data, prepared numerous updated and expanded aquatics-related analyses, documented the analyses in reports and studies, and disclosed these reports and studies to the NRC Staff and SACE.[10] These analyses include:

(1) Aquatic Environmental Conditions in the Vicinity of [WBN] During Two Years of Operation, 1996-1997 (June 1998, Revised June 2010) ("Revised Aquatics Study"),

(2) Comparison of Fish Species Occurrence and Trends in Reservoir Fish Assemblage Index Results in Chickamauga Reservoir Before and After [WBN] Unit 1 Operation (June 2010) ("RFAI Study"),

(3) Analysis of Fish Species Occurrences in Chickamauga Reservoir – A Comparison of Historic and Recent Data (Aug. 2010) ("Fish Species Occurrences Study"),

(4) Mollusk Survey of the Tennessee River Near [WBN] (Rhea County, Tennessee) (Nov. 2010) ("Mollusk Survey"),

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8 *Id.* at 31-32.

9 *Tenn. Valley Auth.* (Watts Bar Nuclear Plant, Unit 2), LBP-09-26, 70 NRC 939, 946, 988 (2009). The Board, however, denied the Request for Hearing submitted on behalf of the remaining four petitioners on the basis that it was not timely. *Id*.

10 *See generally* Statement of Material Facts (describing each of these studies and providing the date that each was disclosed to SACE and the NRC Staff.)

(5) Hydrothermal Effects on the Ichthyoplankton from the [WBN] Supplemental Condenser Cooling Water Outfall in Upper Chickamauga Reservoir (Jan. 2011) ("Hydrothermal Study"),

(6) Discussion of the Results of the 2010 Mollusk Survey of the Tennessee River Near [WBN] (Rhea County, Tennessee) (Mar. 2011) ("Discussion of Mollusk Survey"),

(7) Fish Impingement at [WBN] Intake Pumping Station Cooling Water Intake Structure during March 2010 through March 2011 (Mar. 2011, Revised Apr. 2011) ("Impingement Study"), and

(8) Comparison of 2010 Peak Spawning Seasonal Densities of Ichthyoplankton at [WBN] at Tennessee River Mile 528 with Historical Densities during 1996 and 1997 (Apr. 2011, Revised Nov. 2011) ("Peak Spawning Entrainment Study").

IV. STATEMENT OF THE LAW

A. Law Governing Summary Disposition

1. Applicable Law

In its May 26, 2010 Scheduling Order, the Board directed that dispositive motions be governed by 10 C.F.R. Part 2, Subpart L and the instructions provided in that Scheduling Order.[11] As provided in 10 C.F.R. § 2.1205 of Subpart L, a motion for summary disposition must be in writing and include a written explanation of the basis of the motion, and affidavits to support statements of fact.[12] The Board further instructed that any dispositive motion relating to a NEPA contention may not be filed more than 30 days after the Staff publishes the SFES.[13]

Pursuant to Supreme Court and NRC case law, the party seeking summary disposition must show the absence of a genuine issue as to any material fact.[14] In ruling on a motion for

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[11] *See* Scheduling Order at 9-11.

[12] 10 C.F.R. § 2.1205(a).

[13] Scheduling Order at 11. The NRC published the Draft SFES on October 31, 2011. Accordingly, this motion is timely if filed on or before November 30, 2011.

[14] *See Advanced Med. Sys., Inc.* (One Factor Row, Geneva, Ohio 44041), CLI-93-22, 38 NRC 98, 102-03, (*citing Adickes v. S.H. Kress & Co.*, 398 U.S. 144, 157 (1970)) (holding also that the Commission applies the same standards that Federal courts apply to motions for summary judgment under Rule 56 of the Federal Rules of Civil Procedure), *recons. denied*, CLI-93-24, 38 NRC 187 (1993).

summary disposition, a licensing board is directed by Subpart L to apply the standards set forth in 10 C.F.R. § 2.710(d)(2).[15] Pursuant to that provision, summary disposition is warranted:

> [I]f the filings in the proceeding, depositions, answers to interrogatories, and admissions on file, together with the statements of the parties and the affidavits, if any, show that there is no genuine issue as to any material fact and that the moving party is entitled to a decision as a matter of law.[16]

Furthermore, Section 2.710(d)(1) authorizes the Board to consider a summary disposition motion if "its resolution will serve to expedite the proceeding if the motion is granted."[17]

2. Burden of the Nonmoving Party

Initially, the burden of proof is on the movant.[18] But if the movant makes a proper showing, and the non-moving party does not show that a genuine issue of material fact exists, the Board may grant summary disposition on the basis of those pleadings.[19] The Commission has therefore held that "[t]o preclude summary disposition, when the proponent has met its burden, the party opposing the motion may not rest upon 'mere allegations or denials,' but must set forth *specific facts* showing that there is a genuine issue."[20]

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15 10 C.F.R. § 2.1205(c).

16 *Id.* § 2.710(d)(2).

17 *See also Celotex Corp. v. Catrett*, 477 U.S. 317, 327 (1986) ("[summary disposition is designed] to secure the just, speedy and inexpensive determination of every action"); *Anderson v. Liberty Lobby, Inc.*, 477 U.S. 242, 248 (1986) ("Only disputes over facts *that might affect the outcome of the suit under the governing law* will properly preclude the entry of summary judgment. Factual disputes that are irrelevant or unnecessary will not be counted.") (emphasis added); *Private Fuel Storage, L.L.C.* (Indep. Spent Fuel Storage Installation), LBP-01-39, 54 NRC 497, 509 (2001) (stating that summary disposition "is a useful tool for resolving in short order those contentions that . . . are shown by undisputed facts to have nothing to commend them").

18 *Duke Cogema Stone & Webster* (Savannah River Mixed Oxide Fuel Fabrication Facility), LBP-05-4, 61 NRC 71, 79 (2005) ("*DCS*").

19 *Advanced Med. Sys.*, CLI-93-22, 38 NRC at 102.

20 *Id*. (emphasis added) ("Bare assertions or general denials are not sufficient."). Although the opposing party does not need to show that it would prevail on the issues, it must at least demonstrate that there is a genuine factual issue to be tried. *Id. See also* 10 C.F.R. § 2.710(b).

Indeed, the level of factual support necessary to withstand summary disposition is expected to be of a much "higher level" than at the contention filing stage.[21] The Commission has stated that the opposing party must "present *contrary evidence that is so significantly probative* that it creates a material factual issue."[22] If the party opposing the motion fails to controvert *any* material fact, then that fact will be deemed admitted.[23]

Importantly, conflicting expert opinions cannot alone defeat a motion for summary disposition.[24] Licensing boards have held that "the nonmoving party and its expert, in opposing summary disposition, must clearly and thoroughly explain the basis for the expert's opinion," and they cannot defeat summary disposition simply by presenting "subjective belief or unsupported speculation."[25]

3. Contentions of Omission

The Commission has held that "[w]here a contention alleges the omission of particular information or an issue from an application, and the information is later supplied by the applicant or considered by the Staff in a draft EIS, the contention is moot."[26] Indeed, once the applicant

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21 Final Rule, Rules of Practice for Domestic Licensing Proceedings – Procedural Changes in the Hearing Process, 54 Fed. Reg. 33,168, 33,171 (Aug. 11, 1989).

22 *Advanced Med. Sys.*, CLI-93-22, 38 NRC at 102 n.13 (*citing Pub. Serv. Co. of N. H.* (Seabrook Station, Units 1 & 2), CLI-92-8, 35 NRC 145, 154 (1992)) (emphasis added); *see also Lujan v. Nat'l Wildlife Fed'n*, 497 U.S. 871, 898-99 (1990) (granting summary judgment because the plaintiff did not set forth facts specific enough to support its claim).

23 10 C.F.R. § 2.710(a).

24 *DCS*, LBP-05-04, 61 NRC at 81 ("Conflicting expert opinions . . . do not necessarily preclude summary disposition"); s*ee also Raskin v. Wyatt Co*., 125 F.3d 55, 66 (2d Cir. 1997) (holding that a mere proffer of expert testimony is not a "talisman against summary judgment").

25 *DCS*, LBP-05-04, 61 NRC at 80-81 (*quoting Daubert v. Merrell Dow Pharms., Inc.,* 509 U.S. 579, 589-90 (1993)). In opposing summary disposition, "expert opinion is admissible only if the affiant is competent to give an expert opinion and only if the factual basis for that opinion is adequately stated and explained in the affidavit." *Id.; see also United States v. Various Slot Machines on Guam*, 658 F.2d 697, 700 (9th Cir. 1981) (holding that "in the context of a motion for summary judgment, an expert must back up his opinion with specific facts" in an affidavit); *Brown v. City of Houston*, 337 F.3d 539, 541 (5th Cir. 2003) ("Unsubstantiated assertions, improbable inferences, and unsupported speculation are not sufficient to defeat a motion for summary judgment.").

26 *Duke Energy Corp.* (McGuire Nuclear Station, Units 1 & 2; Catawba Nuclear Station, Units 1 & 1), CLI-02-28, 56 NRC 373, 383 (2002) (*citing Private Fuel Storage, L.L.C.* (Indep. Spent Fuel Storage Installation), LBP-01-

provides the information sought by the Intervenor, the Commission has instructed that "it [is] incumbent upon the Intervenors to amend their original contention to set forth with specificity any concern over [the applicant's] discussion of the [subject] information."[27] If the Intervenor does not, the Commission has stated that the contention must be disposed of.[28]

B. **Law Governing Environmental Impacts**

Contention 7 raises environmental issues under the National Environmental Policy Act of 1969, as amended ("NEPA").[29] NRC regulations at 10 C.F.R. Part 51 implement NEPA requirements for environmental analyses on NRC licensees and applicants.

NEPA-implementing regulations require analysis of the cumulative impacts of the proposed action with "other past, present, and reasonably foreseeable future actions."[30] At base, this process includes identification of the relevant scope of the proposed project, description of the affected environment, and determination of the environmental consequences on the affected environment from the proposed project.[31] The Council on Environmental Quality ("CEQ") has explained that a cumulative effects analysis may consider the current aggregate effects of past actions, without distinguishing the impacts of individual past actions.[32] An understanding of

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26, 54 NRC 199, 207-09 (2001); LBP-01-23, 54 NRC 163, 171-72 (2001); LBP-02-2, 55 NRC 20, 29-30 (2002)).

27 *Id.* at 382.

28 *Id*. ("where a contention is 'superseded by the subsequent issuance of licensing-related documents' — whether a draft EIS or an applicant's response to a request for additional information — the contention must be disposed of or modified").

29 42 U.S.C. § 4321, et seq. (2006).

30 40 C.F.R. § 1508.7.

31 *See* [President's] Council on Environmental Quality, Considering Cumulative Effects Under the [NEPA] at 10 (Jan. 1997) ("Considering Cumulative Effects"), *available at* http://digital.library.unt.edu/ark:/67531/metadc31126/m1/19/.

32 [President's] Council on Environmental Quality, Guidance on the Consideration of Past Actions in Cumulative Effects Analysis at 2 (June 25, 2005) ("CEQ Guidance"), *available at* http://ceq.hss.doe.gov/nepa/regs/Guidance_on_CE.pdf.

those aggregate effects will permit agencies to better anticipate the ability of the subject environment to withstand additional stresses.[33]

Determination of the current, or "baseline," health of the ecosystem is necessary for a cumulative impacts analysis, although neither NEPA nor the NRC has imposed requirements on the *methodology* for establishing such a baseline.[34] Indeed, rather than meet a certain baseline standard, an applicant must explain how operation of the proposed facility will affect the established baseline.[35] As the Licensing Board explained in *Vogtle*, "the appropriate scope of the baseline for a project is a functional concept: an applicant must provide enough information and in sufficient detail *to allow for an evaluation of important impacts*."[36]

Further, NEPA does not mandate substantive results; rather, it imposes procedural restraints on agencies, requiring them to take a "hard look" at the environmental impacts of a proposed action.[37] This hard look is subject to the "rule of reason," which licensing boards have long understood to mean that an "agency's environmental review, rather than addressing every impact that could possibly result, need only account for those that have some likelihood of occurring or are reasonably foreseeable."[38] Consideration of "remote and speculative" or "inconsequentially small" impacts is not required.[39]

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33 *See, id.*; Considering Cumulative Effects at 10.

34 *See, e.g.*, *S. Nuclear Operating Co.* (Early Site Permit for Vogtle ESP Site), LBP-07-3, 65 NRC 237, 255 (2007) ("[A] NEPA analysis relating to aquatic impacts must, as a practical matter, have a baseline from which to operate. It is equally apparent, however, that nothing in the agency's Part 51 NEPA regulations, or the Staff's ER preparation guidance regarding providing a description of the local environment, indicates exactly how, as a general matter, such a baseline is to be established") (citations omitted)).

35 *See Tenn. Valley Auth.* (Bellefonte Nuclear Power Plant, Units 3 & 4), LBP-08-16, 68 NRC 361, 398-402 (2008).

36 *Vogtle*, LBP-07-3, 65 NRC at 257 (emphasis added).

37 *See La. Energy Servs., L.P.* (Claiborne Enrichment Ctr.), CLI-98-3, 47 NRC 77, 87-88 (1998); *see also Balt. Gas & Elec. Co. v. Natural Res. Def. Council, Inc.*, 462 U.S. 87, 97-98 (1983) (NEPA requires agency to take a "hard look" at environmental consequences prior to taking major action).

38 *La. Energy Servs., L.P.* (Nat'l Enrichment Facility), LBP-06-8, 63 NRC 241, 258-59 (2006) (*citing Long Island Lighting Co.* (Shoreham Nuclear Power Station), ALAB-156, 6 AEC 831, 836 (1973)); *see also Dep't of*

There is likewise no NEPA requirement that certain methodology, or even the best available methodology, be employed for an environmental review, or that all possible analyses be conducted.[40] Similarly, NRC Licensing Boards have even held that site-specific studies are not required in a NEPA analysis.[41]

In short, NRC regulations implementing NEPA require a description of the baseline health of the affected ecosystem, but do not establish a specific standard for that baseline. And although they require a description of the reasonably foreseeable impacts of the proposed project on that baseline, taking into account the cumulative impacts of other actions, they do not require consideration of every possible impact or endless studies.

V. NO GENUINE ISSUES OF MATERIAL DISPUTE ON CONTENTION 7 REMAIN

As presented by SACE, Contention 7 is at base a contention of omission. SACE alleged that TVA's conclusions regarding the aquatic health in the WBN vicinity are "*inadequately supported*" and its "discussion of aquatic impacts is *deficient in three key respects*."[42] First, SACE alleged that TVA "*fails to evaluate* the impacts of [WBN Unit 2] in light of the fragility of

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Transp. v. Pub. Citizen, 541 U.S. 752, 767-69 (2004) (stating that the rule of reason is inherent in NEPA and its implementing regulations).

39 *Vt. Yankee Nuclear Power Corp.* (Vt. Yankee Nuclear Power Station), ALAB-919, 30 NRC 29, 44 (1989) (*citing Limerick Ecology Action, Inc. v. NRC*, 869 F.2d 719, 739 (3d Cir. 1989)); *see also La. Energy Servs. L.P.* (Nat'l Enrichment Facility), CLI-05-20, 62 NRC 523, 536 (2005) ("*LES*") ("NEPA also does not call for certainty or precision, but an *estimate* of anticipated (not unduly speculative) impacts."); *Scientists' Inst. for Pub. Info., Inc. v. AEC*, 481 F.2d 1079, 1092 (D.C. Cir. 1973) (holding that when faced with uncertainty, NEPA only requires "reasonable forecasting.").

40 *Entergy Nuclear Generation Co.* (Pilgrim Nuclear Power Station), CLI-10-11, 71 NRC 287, 315 ("There is no NEPA requirement to use the best scientific methodology, and NEPA 'should be construed in the light of reason if it is not to demand' virtually infinite study and resources. . . . And while there 'will always be more data that could be gathered,' agencies 'must have some discretion to draw the line and move forward with decisionmaking.'") (internal citations omitted).

41 *Vogtle*, LBP-07-3, 65 NRC at 257 ("[I]n support of their argument that the ER is deficient because of its lack of site-specific studies, Joint Petitioners have not demonstrated with any references – nor are we aware of any – that suggest site-specific studies are generally required."); *see also Bellefonte*, LBP-08-16, 68 NRC at 398-402.

42 Petition at 31, 32 (emphasis added).

the host environment."[43] Second, SACE alleged that TVA improperly relies on "*outdated and inadequate* data" to predict the impacts of entrainment and impingement as well as thermal impacts on aquatic organisms.[44] Third, SACE alleged that "TVA *fails completely* to analyze the cumulative effects of [WBN Unit 2] . . . with the impacts of other industrial facilities and the effects of the many dams on the Tennessee River."[45]

In direct response to the specific deficiencies raised by SACE, TVA voluntarily initiated a series of comprehensive surveys to update and collect new data on the current health of the relevant aquatic environment and the impact of current operation of WBN Unit 1 and proposed operation of WBN Unit 2 on that environment.[46] TVA disclosed the results of these surveys in analytical reports to SACE and the NRC Staff over the course of the past year and a half.[47] Importantly for purposes of this motion, SACE has not raised *any* concerns with these new data and analyses with the NRC or this Board.[48] Moreover, the NRC concurred with the findings of these studies in its October 31, 2011 Draft SFES.[49] As a result and as discussed in more detail below, these studies render Contention 7 moot.[50]

A. The Allegation in Contention 7 that TVA Failed to Evaluate the Impacts of WBN Unit 2 in Light of the Current Health of the Aquatic Ecosystem is Moot

In the first element of Contention 7, SACE apparently asserts that TVA provided an inadequate discussion of the baseline health of the aquatic ecosystem in the vicinity of WBN, and therefore

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43 *Id.* at 31 (emphasis added).

44 *Id.* (emphasis added). SACE identified the alleged ways in which that data is inadequate in Contention 7 and in the statement of its expert, Dr. Shawn Paul Young. *See* Petition at 33-36; Declaration of Shawn Paul Young, Ph.D. at 10-19 (July 11, 2009) ("Young Affidavit").

45 *Id.* at 31-32 (emphasis added).

46 *See* Statement of Material Facts ¶ 10.

47 *See* Statement of Material Facts ¶ 10.

48 *See* Statement of Material Facts ¶ 11.

49 *See* Statement of Material Facts ¶ 12.

50 As stated previously, should SACE now challenge the results of these studies or submit a new or amended contention, any such challenge would be late. *See supra* page 2 and note 2.

failed to sufficiently evaluate the impact of WBN operation on that baseline.[51] In support, Dr. Young questioned TVA's characterization of the current health of fish and mussel populations, alleging that it is based on existing studies that are deficient because they "do not attempt to evaluate, to any meaningful degree, the contribution of the existing [WBN Unit 1] cooling system to the declining health of the aquatic ecosystem."[52] He concluded that TVA should conduct additional surveys and provide new data on the health of the ecosystem and potential impacts on that ecosystem from nuclear expansion.[53]

In direct response to Dr. Young's assertions, TVA collected and reviewed extensive additional fish and mussel-related data in 2010 to 2011 and compared that new data to historical data to understand and document the *present health* of fish and mussel communities in the WBN vicinity and how operation of WBN Unit 1 has contributed to stress on those communities.[54] TVA disclosed the data collected and the resulting analyses in the following studies:

- RFAI Study, which provides a detailed explanation of the methodology employed in TVA's biological index, evaluates the health of the aquatic community using recent fish survey data and the RFAI methodology, and compares the health of the aquatic community before and after WBN Unit 1 operation;[55]
- Fish Species Occurrences Study, which analyzes new and historic fish survey data to determine the current prevalence of fish species, and compares the prevalence of species before and after operation of WBN Unit 1;[56]
- Mollusk Survey, which provides new data collected during a 2010 survey of mussel populations in the WBN vicinity;[57] and
- Discussion of Mollusk Survey, which compares the results of the Mollusk Survey to data collected at three mussel beds previously monitored by TVA.[58] The previous

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51 *See* Petition at 31-33; Young Affidavit at 6-10.

52 Young Affidavit at 9-10.

53 *See* Young Affidavit at 10; *see also* Petition at 33.

54 *See* Statement of Material Facts ¶ 10.

55 *See* Joint Affidavit ¶¶ 47-59; Statement of Material Facts ¶¶ 10, 32-37.

56 *See* Joint Affidavit ¶¶ 60-67; Statement of Material Facts ¶¶ 10, 39-46.

57 *See* Joint Affidavit ¶¶ 68-76; Statement of Material Facts ¶¶ 10, 48-53.

data includes preoperational (1983 to 1994) and operational (1996 to 1997) monitoring at WBN.[59]

In addition, TVA conducted the following studies to measure the *present effects* of operation of WBN Unit 1 on fish communities:

- Impingement Study, which analyzes new, raw data on impingement resulting from operation of WBN Unit 1 collected over the course of a full calendar year (March 2010 through March 2011);[60]
- Peak Spawning Entrainment Study, which measures entrainment resulting from operation of WBN Unit 1 during peak aquatic spawning periods in the WBN vicinity (April through June 2010);[61] and
- Hydrothermal Study, which analyzes hydrothermal impacts from operation of WBN Unit 1 based on in-river testing conducted in May and August 2010.[62]

In total, these studies provide substantial, additional recent data on the present health of the aquatic communities in the WBN vicinity (*i.e.*, the environmental baseline), including the impacts of the existing WBN cooling system.[63] TVA disclosed all of these studies to SACE and the NRC Staff, and SACE has not challenged the methodology or the results of those studies with this Board.[64] Accordingly, SACE's assertion that TVA should provide additional data on the baseline health of the ecosystem including on the impacts of WBN Unit 1 is now moot, and no genuine dispute on a material issue remains for this first aspect of Contention 7.

B. The Allegation in Contention 7 that TVA's Data is Outdated and Inadequate is Moot

In the second prong of Contention 7, SACE alleged that TVA "understates the potential impacts of the coolant intake system (*i.e.*, entrainment and impingement) and the thermal

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58 *See* Joint Affidavit ¶¶ 68-76; Statement of Material Facts ¶¶ 10, ¶¶ 48-53.

59 *See* Joint Affidavit ¶ 68; Statement of Material Facts ¶ 51.

60 *See* Joint Affidavit ¶¶ 93-98; Statement of Material Facts ¶¶ 10, 68-72.

61 *See* Joint Affidavit ¶¶ 84-92; Statement of Material Facts ¶¶ 10, 62-66.

62 *See* Joint Affidavit ¶¶ 99-109; Statement of Material Facts ¶¶ 10 and 74-78.

63 *See* Statement of Material Facts ¶ 31.

64 *See* Statement of Material Facts ¶¶ 10-11.

impacts of the coolant discharge system on fish and benthic organisms, by relying on poor or outdated data, distorted interpretations of data, and assumptions and extrapolations in lieu of recent monitoring studies."[65] SACE and Dr. Young thereafter identified specific aspects of entrainment, impingement, and hydrothermal studies that they deem necessary and appropriate.[66] As described below, TVA has conducted such studies following the parameters recommended by SACE and Dr. Young and, therefore, this portion of Contention 7 is also now moot.

1. SACE's Assertion that TVA Should Study Entrainment During Operation of WBN Unit 1 is Moot

SACE and its expert raised concerns with TVA's methodology for estimating entrainment, and asserted that because TVA failed to take direct measurements of actual entrainment at WBN Unit 1, TVA does not have adequate support for its conclusion that the cumulative effects of operation of Units 1 and 2 would be insignificant.[67]

In direct response to these assertions, TVA revised its methodology for estimating entrainment employed in its Aquatics Study, deliberately following the recommendations of Dr. Young.[68] The original Aquatics Study, which TVA initially completed in 1998, compares pre-operational and operational aquatic monitoring conducted at WBN from 1973 to 1979, 1982 to 1985, and 1996 to 1997, in order to detect significant effects of the first two years of operation of WBN Unit 1 on the aquatic community.[69] After conducting the revised entrainment analysis, TVA found that its conclusions regarding the impacts of WBN operation on the aquatic environment, namely that relatively few ichthyoplankton were vulnerable to entrainment in

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65 Petition at 33.

66 *See id.* at 34-36; Young Affidavit at 10-19.

67 Petition at 34; Young Affidavit at 12, 13, 15.

68 *See* Statement of Material Facts ¶¶ 57-58.

69 *See* Statement of Material Facts ¶ 55.

WBN, remained unchanged.[70] The NRC Staff drew the same conclusion, after review of the Revised Aquatics Study, in the Draft SFES.[71] The Revised Aquatics Study is discussed in more detail in the Joint Affidavit.[72]

Importantly, in addition to revising its method for *estimating* entrainment, TVA collected raw data on *actual* entrainment associated with operation of WBN Unit 1 for one year (March 2010 through March 2011).[73] TVA prepared a study that analyzed the results of monitoring from April through June, 2010, which is a significant timeframe because it is the peak aquatic spawning period in the WBN vicinity.[74] TVA also focused on this timeframe in order to respond to SACE and Dr. Young's assertion that entrainment monitoring should account for seasonal abundance of ichthyoplankton.[75] TVA's resulting Peak Spawning Entrainment Study serves to update and verify historical entrainment monitoring conducted in 1996 and 1997, immediately after Unit 1 began full power operation, and to respond directly to SACE and Dr. Young's concerns that TVA had not taken direct measurements of actual entrainment.[76] The study concluded that the measured actual entrainment rates were very low – below one half of one percent of the ichthyoplankton population.[77] The study also concluded that entrainment percentages were within range of those calculated during the same periods in 1996 and 1997, and that these entrainment rates were not adversely affecting the relevant population.[78] Again, the NRC Staff drew the same conclusion that the low entrainment rates did not have a noticeable

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70 *See* Statement of Material Facts ¶ 59.
71 *See* Statement of Material Facts ¶ 80.
72 *See* Joint Affidavit ¶¶ 77-83.
73 *See* Statement of Material Facts ¶ 62.
74 *See* Statement of Material Facts ¶ 63.
75 *See* Petition at 34-35; Young Affidavit at 14.
76 *See* Statement of Material Facts ¶ 62.
77 *See* Statement of Material Facts ¶¶ 64-65.
78 *See* Statement of Material Facts ¶¶ 64-65.

effect on the aquatic community, relying in part on the Peak Spawning Entrainment Study.[79] This study is discussed in more detail in the Joint Affidavit.[80]

TVA disclosed the Revised Aquatics Study and the Peak Spawning Entrainment Study to SACE on July 15, 2010, and April 15, 2011, respectively.[81] Importantly, SACE has not challenged any of the data or conclusions in these reports before this Board.[82] This aspect of SACE's Contention 7 is now moot because TVA has conducted the entrainment study sought by SACE, and SACE has not challenged the methodology or results of that study. Accordingly, no genuine dispute on this aspect of Contention 7 remains.

2. SACE's Assertion that TVA Should Study Impingement During Operation of WBN Unit 1 is Moot

SACE also raised concerns with TVA's impingement data and alleged that TVA's impingement data are "inadequate."[83] Specifically, SACE questioned TVA's reliance on historical data documenting impingement impacts at the Condenser Cooling Water ("CCW") intake.[84] In addition, SACE alleged that TVA should not use impingement data from the Supplemental Condenser Cooling Water ("SCCW") system to estimate impingement for the entire WBN facility because the SCCW intake is not located near the CCW intake, the latter of which is below the Watts Bar Dam.[85]

In response, TVA collected raw data of actual impingement at the CCW intake over the course of one year (March 2010 through March 2011), to supplement its existing data on SCCW

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79 *See* Statement of Material Facts ¶ 80.

80 *See* Joint Affidavit ¶¶ 84-92.

81 *See* Statement of Material Facts ¶ 10. Although TVA subsequently revised the Peak Spawning Entrainment Study, that revision did not alter any of the conclusions of the initial Study. *See id*. at 10 n.34.

82 *See* Statement of Material Facts ¶ 11.

83 Petition at 35; Young Affidavit at 15.

84 Petition at 35; Young Affidavit at 15.

85 *See* Petition at 35; Young Affidavit at 15-16.

impingement.[86] The survey showed that impingement rates under normal conditions were unchanged from those that TVA historically measured at the CCW intake, but that unusually cold weather in the winter of 2011 produced high impingement rates.[87] In fact, the dominating factor for fish impingement mortality in 2010 to 2011 was cold shock, to which shad in the Chickamauga Reservoir are particularly susceptible.[88] The study concluded that these natural causes dwarf the low rates of impingement due to plant operation.[89] Upon reviewing the Impingement Study, the Staff also concluded in the Draft SFES that impingement, even under dual unit operation, would be too low to "noticeably alter" the aquatic community.[90] The Joint Affidavit discusses the methodology and results of TVA's Impingement Study in more detail.[91]

This aspect of SACE's Contention 7 should thus be dismissed as moot because TVA has conducted the impingement study sought by SACE, disclosed this study to SACE on May 16, 2011, and SACE has not challenged the methodology or results of that study.[92] Accordingly, no genuine dispute on this aspect of Contention 7 remains.

3. SACE's Assertion that TVA Should Study Thermal Effects of Operation of WBN Unit 1 is Moot

SACE also claims that "TVA provides no evidence, such as scientific studies or field observations, to justify its conclusion [that the thermal impacts of WBN Unit 2 on the aquatic environment will be insignificant]."[93] SACE claimed that TVA was missing "basic data sets with respect to thermal impacts, including data on overall drift communities, and data on spatial

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86 *See* Statement of Material Facts ¶ 68.

87 *See* Statement of Material Facts ¶ 69.

88 Statement of Material Facts ¶ 69.

89 *See* Statement of Material Facts ¶¶ 70, 72.

90 *See* Statement of Material Facts ¶ 81.

91 *See* Joint Affidavit ¶¶ 93-98.

92 *See* Statement of Material Facts ¶¶ 68, 73. This was the revised version of the report. TVA disclosed the first version of this study to SACE on April 15, 2011.

93 Petition at 35; *see also* Young Affidavit at 16-17.

and temporal distribution of ichthyoplankton in relation to thermal mixing zones."[94] SACE also claimed that the following factors were neglected by TVA, although they "must be understood in order to properly assess thermal impacts on aquatic life": characteristics of the thermal plume; variation in the size and temperature profile of the mixing zone; the temperatures in the core of the thermal plume (rather than at the edge) and whether they have an effect on aquatic organisms; and the effects of high temperatures on fish eggs and larvae.[95]

In the Hydrothermal Study, described in detail in the Joint Affidavit, TVA proactively responded to the alleged deficiencies identified by SACE and Dr. Young.[96] TVA's Hydrothermal Study, conducted during May and August 2010, documented the flow patterns and characteristics of the thermal plume from WBN, and tracked and measured the thermal plume in conjunction with day and night ichthyoplankton sampling to describe temporal and spatial distribution of fish eggs and larvae and exposure rates to the thermal plume.[97] TVA conducted the Hydrothermal Study under extreme conditions – involving the peak abundance of fish eggs and larvae, near maximum ambient water temperatures, and "no flow" conditions from the upstream Watts Bar Dam – in order to analyze the effects of high temperatures on fish eggs and larvae.[98] The Hydrothermal Study concluded that, even under these extreme conditions, water temperatures did not approach discharge permit limits established by TVA's National Pollutant Discharge Elimination System ("NPDES") permit for operation of WBN Units 1 and 2.[99] It therefore concluded that there was no risk of thermal damage to ichthyoplankton from operation

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94 Petition at 35.

95 *Id.* 35-36.

96 *See* Statement of Material Facts ¶ 74.

97 *See* Statement of Material Facts ¶¶ 75-76.

98 *See* Statement of Material Facts ¶ 76.

99 *See* Statement of Material Facts ¶ 77.

of WBN.[100] The NRC Staff reviewed the Hydrothermal Study and also concluded that thermal discharges would be undetectable and not noticeably alter the aquatic community.[101]

It bears noting that SACE also alleged that "TVA fails to show that it accounted for the [hydrothermal] impacts of overflow from the holding ponds."[102] As Dr. Young himself admits, under Unit 1 operation and low- or no-flow conditions for Watts Bar Dam, "this scenario has not occurred."[103] TVA need not account for every possible scenario in its NEPA analysis. As discussed in Section IV.B above, the Commission has held that NEPA requires only "an *estimate* of anticipated (not unduly speculative) impacts."[104] Likewise, the U.S. Supreme Court has concurred with CEQ regulations and guidance that hold that NEPA does not require a "worst case analysis."[105] Because the analysis sought by SACE pertains to an event that has not occurred and is essentially a worst case scenario, this analysis is not required by NEPA and the absence of such analysis cannot sustain a genuine dispute of material fact.

In sum, this aspect of SACE's Contention 7 should be dismissed as moot because TVA has conducted a study of the hydrothermal effects of operation of WBN Unit 1, disclosed this study to SACE on February 15, 2011, and SACE has not challenged the methodology or results of that study.[106] Because TVA has conducted the additional surveys and provided the data sought by SACE, no genuine dispute on this aspect of Contention 7 remains.

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100 *See* Statement of Material Facts ¶ 77.

101 *See* Statement of Material Facts ¶ 82.

102 Petition at 36; *see also* Young Affidavit at 18-19.

103 Young Affidavit at 19, ¶ III.E.4..

104 *LES*, CLI-05-20, 62 NRC at 536.

105 *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 354-55 (1989) (*citing* [NEPA] Regulations, Proposed Rules, 50 Fed. Reg. 32, 234, 32,236 (Aug. 9, 1985) ("the [previous rule requiring a "worst case analysis"] has proved counterproductive, because it has led to agencies being required to devote substantial time and resources to preparation of analyses which are not considered useful to decisionmakers and divert the EIS process from its intended purpose")).

106 *See* Statement of Material Facts ¶¶ 10-11.

C. The Allegation in Contention 7 that TVA Does Not Consider Cumulative Industrial Impacts on the Aquatic Ecosystem is In Part Moot and In Part Legally and Factually Flawed

In the third element of Contention 7, SACE alleged that "[t]he FSEIS is thus inadequate because it does not contain a discussion of these cumulative industrial impacts or the degree to which [WBN Unit 2] will contribute to them."[107] As discussed below, the first aspect of this assertion is legally and factually flawed, as TVA has provided sufficient information regarding the cumulative impacts on the affected aquatic ecosystem that is entirely consistent with NEPA requirements. There is likewise no remaining issue of material dispute with respect to the second aspect of SACE's assertion. TVA's new aquatics studies account for the anticipated impact of operation of WBN Unit 2, and moreover, they demonstrate that operation of Unit 2 will not result in material impacts to the aquatic ecosystem.

1. SACE's Allegation Regarding TVA's Analysis of Cumulative Impacts is Legally and Factually Flawed

SACE asserts that TVA has not adequately assessed the cumulative impacts on the aquatic environment that will be affected by the proposed operation of WBN Unit 2.[108] As described by SACE, those cumulative impacts include "numerous water impoundments on the Tennessee River" and "other industrial facilities such as the ten fossil fuel-burning plants, the six operating nuclear reactors, and the five additional reactors for which TVA has sought operating licenses."[109] SACE's expert, Dr. Young, acknowledges that "[i]n Section 3.0 of the FSEIS, TVA states that cumulative impacts were considered (page 3.0). But the FSEIS does not contain the

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[107] Petition at 36.

[108] *See id*.

[109] *Id*.

discussion that I would expect to see."[110] Yet because the information provided by TVA is fully consistent with NEPA requirements, no material dispute exists.

As explained in Section IV.B above, regulations implementing NEPA require analysis of the cumulative impacts of the proposed action with "other past, present, and reasonably foreseeable future actions."[111] In the *Calvert Cliffs Unit 3* COL proceeding, joint petitioners raised a similar contention challenging the applicant's cumulative impacts analysis.[112] The joint petitioners were concerned by the "already severely degraded and declining Chesapeake Bay" and the impact of the proposed unit in combination with eleven operational reactor units and two additional proposed units.[113] They contended that the applicant's ER did not account for the impacts of the existing reactor units on the Bay.[114] In ruling on the petition to intervene, the Licensing Board described the applicant's cumulative effects analysis as follows:

> [T]he ER examines existing conditions in the Bay to form an environmental baseline against which to measure the cumulative impact of the proposed new reactor. Because the environmental baseline reflects the effects of all currently existing pollution sources in the Bay's watershed, it necessarily includes any contribution by nuclear power plants in the watershed, although it does not separately identify or quantify that contribution (or the contribution of any other industry).[115]

In other words, the applicant's ER provided a snapshot of the current condition of the aquatic environment, and thereby inherently accounted for all existing industrial impacts. The Board also referenced guidance on 40 C.F.R. § 1508.7 from CEQ: "agencies can conduct an adequate cumulative effects analysis by focusing on the current aggregate effects of past actions without

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110 Young Affidavit at 19.

111 40 C.F.R. § 1508.7.

112 *See Calvert Cliffs Unit 3 Nuclear Project, LLC* (Combined License Application for Calvert Cliffs Unit 3), LBP-09-04, 69 NRC 170, 201 (2009).

113 *Id*.

114 *Id*.

115 *Id.* at 202.

delving into the historical details of individual past actions."[116] The Board concluded that this approach – which requires an analysis of the baseline environment and the impact of the proposed facility to satisfy the cumulative effects analysis – is consistent with NEPA's rule of reason and requirements regarding cumulative impacts assessment.[117] The Board thereafter denied admission of a petitioner's proposed challenge to the adequacy of that cumulative effects analysis.[118] Accordingly, the Calvert Cliffs Licensing Board found that there is no NEPA requirement to conduct the type of cumulative impacts analysis sought by SACE here.

Like the applicant in *Calvert Cliffs Unit 3*, TVA has monitored and adequately described the existing conditions of the Tennessee River in the vicinity of WBN in detail to form an environmental baseline. In addition, in direct response to criticism by SACE, TVA conducted numerous additional studies and remedied some of its previous analyses in order to establish an even more accurate and updated baseline on which to evaluate the incremental impacts of Unit 2 operation.[119] In particular, TVA conducted a fulsome assessment of fish and mussel community health and species composition, and existing effects of operation of WBN Unit 1.[120] TVA conducted certain of these studies under various flow conditions at Watts Bar Dam, in order to account for existing upstream impacts.[121] As a result, these studies provide a comprehensive snapshot of the Chickamauga Reservoir, inherently reflecting cumulative existing stresses to the resource. This is entirely consistent with NEPA requirements for a cumulative impacts analysis.

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116 *Id*. at 203.

117 *See id.*

118 *Id.* at 205.

119 *See* Statement of Material Facts ¶ 10.

120 *See* Statement of Material Facts ¶ 31.

121 *See* Statement of Material Facts at ¶¶ 58, 76.

2. SACE's Allegation Regarding TVA's Consideration of Impacts from WBN Unit 2 is Moot

SACE also asserts that TVA has not considered the additional impact on the aquatic environment resulting from operation of WBN Unit 2.[122] This assertion is rendered moot by the numerous additional aquatic studies discussed above that take into account the potential impacts from Unit 2 operation. The analysis presented in these studies demonstrates, and the NRC Staff in the Draft SFES concurs, that impacts to the aquatic ecosystem from operation of WBN Unit 2 will *not* be materially different from the present effects of operation of Unit 1.[123]

WBN Unit 2 shares intake channels and discharge outfalls with Unit 1 and, importantly, the cooling water demands for combined operation of Units 1 and 2 will not be materially different than those for operation of Unit 1.[124] Dual unit operation will draw on cooling water from the CCW and SCCW intake channels, as does Unit 1 operation.[125] Because the SCCW system is gravity driven, the intake flow for the SCCW varies based on the water level behind the Watts Bar Dam, and not the demands of WBN.[126] Although the CCW, which is not gravity driven, is expected to divert proportionally more water to support dual unit operation, that increase will not exceed 0.2% of the reservoir flow.[127] As explained in the Entrainment Study and Joint Affidavit, this *de minimis* increase in hydraulic entrainment would result in a proportionally *de minimis* increase in entrainment of fish eggs and larvae.[128] Similarly, dual unit operation will not increase the intake flow velocities or flow rates for the SCCW, but it will

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122 *See* Petition at 36.

123 *See* Statement of Material Facts ¶¶ 66, 72, 78, 81-83.

124 *See* Statement of Material Facts at ¶¶ 19-30.

125 *See* Statement of Material Facts ¶ 19.

126 Statement of Material Facts ¶ 20.

127 *See* Statement of Material Facts ¶¶ 21-22.

128 *See* Joint Affidavit ¶ 90; Statement of Material Facts ¶¶ 22, 66.

increase the flow rate for the CCW intake channel.[129] Again, this would result in proportionally larger impingement values, but as explained in the Impingement Study and Joint Affidavit, these values likely would be dwarfed by naturally occurring mortality events.[130]

Hydrothermal impacts will likewise not be materially different under operation of Unit 2.[131] Again, the outfall points for operation of WBN Unit 2 are the same as those for Unit 1.[132] Importantly, TVA is bound by thermal effluent limits set by its NPDES permit, which establish legally enforceable, aquatic health-based limits on hydrothermal discharges at the WBN outfall points.[133] The conditions on WBN discharge in TVA's NPDES permit for dual unit operation are unchanged from those in TVA's NPDES permit for Unit 1.[134] In other words, TVA is required to ensure that hydrothermal impacts from operation of Unit 2 do not exceed the limits set for operation of Unit 1. The inquiry could end there. Nevertheless, TVA conducted new hydrothermal studies to model the hydrothermal effluent from operation of WBN Unit 1 under worst case scenarios, as reported in TVA's new Hydrothermal Study discussed above, and still found that discharge temperatures did not approach TVA's NPDES permit limits.[135] Because operation of WBN Unit 2 cannot, by the terms of the NPDES permit, result in hydrothermal impacts that exceed the aquatic health-based limits set for operation of Unit 1, operation of Unit 2 will not result in a material increase in adverse thermal impacts on the aquatic ecosystem.[136]

Accordingly, this aspect of SACE's Contention 7 should be dismissed because TVA's baseline analysis complies fully with NEPA and inherently considers the cumulative effects of

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[129] *See* Statement of Material Facts ¶ 23.

[130] *See* Joint Affidavit ¶ 97; Statement of Material Facts ¶ 72.

[131] *See* Statement of Material Facts ¶ 30.

[132] *See* Statement of Material Facts ¶ 24.

[133] *See* Statement of Material Facts ¶ 25.

[134] *See* Statement of Material Facts ¶ 26.

[135] *See* Statement of Material Facts ¶ 77.

[136] *See* Statement of Material Facts ¶ 30.

operation of WBN Unit 2 with other Tennessee River impoundments and facilities. Further, TVA's environmental analysis explicitly considers the incremental effects of WBN Unit 2 operation by comparing pre-operational aquatic data with data from the first several years after WBN Unit 1 became operational, and assessing the impact that will result from the marginal changes in cooling water intake that will result from dual unit operation. Therefore, no genuine dispute on this aspect of Contention 7 remains.

VI. CONCLUSION

For the foregoing reasons, there is no genuine issue of material fact on Contention 7. Therefore, the Board should grant TVA's request for summary disposition on this contention.

Respectfully submitted,

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November 21, 2011

CERTIFICATIONS

I certify, in accordance with 10 C.F.R. § 2.304(d) and paragraph I.1 of the Board's May 26, 2010 Scheduling Order, that this motion is not interposed for delay or any other improper purpose, that I believe in good faith that there is no genuine issue as to any material fact relating to this motion, and that the moving party is entitled to a decision as a matter of law, as required by 10 C.F.R. §§ 2.1205 and 2.710(d).

I also certify, in accordance with 10 C.F.R. § 2.323(b) and paragraph H.6 of the Scheduling Order, that I have made a sincere effort to contact the other parties in this proceeding, to explain to them the factual and legal issues raised in this motion, and to resolve those issues, and I certify that my efforts have been partially unsuccessful. Specifically, I initiated contact with SACE and the NRC Staff on November 14, 2011, in accordance with paragraph I.2 of the Scheduling Order. TVA and SACE were unable to reach agreement on this motion. The NRC Staff does not oppose the filing of this motion for summary disposition, and notes that the NRC Staff addressed the additional aquatic studies conducted by TVA in the draft SFES.

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November 21, 2011

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of TENNESSEE VALLEY AUTHORITY (Watts Bar Nuclear Plant Unit 2)	Docket No. 50-391-OL November 21, 2011

CERTIFICATE OF SERVICE

I hereby certify that, on November 21, 2011, copies of "Tennessee Valley Authority's Motion for Summary Disposition of Southern Alliance for Clean Energy's Contention 7"; "Statement of Material Facts on Which No Genuine Dispute Exists"; and "Joint Affidavit of Dennis Scott Baxter, John Tracy Baxter, Dr. Charles Coe Coutant, and Dr. Paul Neil Hopping" were served by the Electronic Information Exchange on the following recipients:

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November 21, 2011

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

In the Matter of TENNESSEE VALLEY AUTHORITY (Watts Bar Nuclear Plant Unit 2)	Docket No. 50-391 November 21, 2011

STATEMENT OF MATERIAL FACTS ON WHICH NO GENUINE ISSUE EXISTS
IN SUPPORT OF TENNESSEE VALLEY AUTHORITY'S
MOTION FOR SUMMARY DISPOSITION OF CONTENTION 7

TABLE OF CONTENTS

Tennessee Valley Authority ("TVA") submits, in support of its Motion for Summary Disposition of Contention 7, this Statement of Material Facts as to which there is no genuine issue to be heard.

I. Procedural Background

A. Licensing History for Watts Bar Nuclear Plant

1. On May 14, 1971, TVA applied for a Construction Permit ("CP") for the Watts Bar Nuclear Plant ("WBN").[1] The NRC issued CPs for WBN Units 1 and 2 on January 23, 1973, and construction began.[2] TVA substantially completed construction of Unit 1 in 1985.[3]

2. On June 30, 1976, TVA first filed an application for an operating license ("OL") for WBN Units 1 and 2.[4] On February 7, 1996, the NRC issued an OL for Unit 1 that authorized operation at 100% power.[5]

3. Between 1973 and 2008, the NRC extended the CP for Unit 2 on several occasions.[6] During this time, TVA maintained WBN Unit 2 in deferred plant status, in accordance with the NRC's "Policy Statement on Deferred Plants."[7]

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1 Att. 1, Letter from A. Wagner, TVA, to P. Morris, AEC, License Application – Watts Bar Nuclear Plant Units 1 and 2 (May 14, 1971), *available at* ADAMS Accession No. ML072990489.

2 *See* Watts Bar Nuclear Plant; Notice of Issuance of Construction Permits, 38 Fed. Reg. 3001 (Jan. 31, 1973).

3 Att. 2, History of Watts Bar Unit 2 Reactivation (Apr. 1, 2011), http://www.nrc.gov/info-finder/reactor/wb/watts-bar/history.html.

4 Att. 3, Letter from T. Wells, Jr. TVA, to Benard C. Rusche, NRC, In the Matter of the Application of [TVA] (June 30, 1976), *available at* ADAMS Accession No. ML073400595.

5 *See* Att. 4, Notice of Issuance of Facility Operating License (Feb. 7, 1996) (cover letter only), *available at* ADAMS Accession No. ML073460319; *see also* NUREG-0847, Supp. 20, Safety Evaluation Report Related to the Operation of the Watts Bar Nuclear Plant, Units 1 and 2, at 1-2 (Feb. 1996), *available at* ADAMS Accession No. ML072060498.

4. On August 3, 2007, TVA informed the NRC Staff of its intention to resume and complete construction of WBN Unit 2.[8] TVA updated its original OL application for WBN Unit 2 on March 4, 2009,[9] prompting the NRC to publish a notice of hearing in the *Federal Register* on May 1, 2009.[10]

5. Throughout this time, TVA and the NRC completed a number of environmental reviews of WBN. On November 9, 1972, TVA issued a Final Environmental Statement for WBN Units 1 and 2 ("TVA 1972 FES").[11] On December 1, 1978, the NRC issued its Final Environmental Statement evaluating the operation of Units 1 and 2 ("NRC 1978 FES").[12] The NRC supplemented its 1978 FES on April 1, 1995 ("NRC 1995b"), in order to re-examine environmental considerations before issuing an OL for WBN Unit 1.[13]

6. When TVA reactivated construction of WBN Unit 2, it also submitted its Final Supplemental Environmental Impact Statement ("2007 FSEIS") to the NRC on February 15,

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6 *See* Order Extending Construction Completion Dates, 51 Fed. Reg. 15,981 (Apr. 29, 1986); Order Extending Construction Completion Dates, 52 Fed. Reg. 25,676 (July 8, 1987); Order, 54 Fed. Reg. 213 (Jan 4, 1989); Order, Order, 56 Fed. Reg. 30,778 (July 5, 1991); Order, 65 Fed. Reg. 64,725 (Oct. 30, 2000); 73 Fed. Reg. 39,995 (July 11, 2008).

7 Commission Policy Statement on Deferred Plants, 52 Fed. Reg. 38,077 (Oct. 14, 1987).

8 Att. 5, Letter from W. McCollum, Jr., TVA, to NRC, [WBN] Unit 2 – Reactivation of Construction Activities, (Aug. 3, 2007), *available at* ADAMS Accession No. ML072190047.

9 Att. 6, Letter from M. Bajestani, TVA, to NRC, [WBN] Unit 2 – Operating License Application Update (Mar. 4, 2009), *available at* ADAMS Accession No. ML090700378.

10 Notice of Receipt of Update to Application for Facility Operating License and Notice of Opportunity for Hearing for the [WBN], Unit 2 and Order Imposing Procedures for Access to Sensitive Unclassified Non-Safeguards Information and Safeguards Information for Contention Preparation, 74 Fed. Reg. 20,350 (May 1, 2009).

11 Att. 7, Letter from TVA to AEC, In the Matter of the Applications of [TVA] (Nov. 1972).

12 NUREG-0498, Final Environmental Statement Related to the Operation of Watts Bar Nuclear Plant, Units 1 and 2 (Dec. 1978) ("NRC 1978 FES"), *available at* ADAMS Accession No. ML082540803.

13 NUREG-0498, Supp. 1, Final Environmental Statement Related to the Operation of Watts Bar Nuclear Plant, Units 1 and 2 (Apr. 1995), *available at* ADAMS Accession No. ML081430592.

2008.[14] The NRC published its draft supplement to the final environmental statement ("Draft SFES") on October 31, 2011.[15]

B. Intervention in Current Proceeding

7. After TVA updated its OL application for WBN Unit 2 and the NRC issued a Notice of Opportunity for Hearing on May 1, 2009, five organizations (Southern Alliance for Clean Energy ("SACE"), Tennessee Environmental Council, We the People, the Sierra Club, and Blue Ridge Environmental Defense League) jointly filed a Petition to Intervene and Request for Hearing, which included seven contentions.[16] Among those, Contention 7 challenged TVA's analysis of the impact of operation of WBN Unit 2 on the aquatic environment.[17] In Contention 7, SACE alleged:

> TVA claims that the cumulative impacts of WBN Unit 2 on aquatic ecology will be insignificant (FSEIS Table S-1 at page. S-2, and Table 2-1 at page. 30). [sic] TVA's conclusion is not reasonable or adequately supported, and therefore fails to satisfy 10 C.F.R. § 51.53(b) and NEPA.
>
> TVA's discussion of aquatic impacts is deficient in three key respects. First; TVA mischaracterizes the current health of the ecosystem as good, and therefore fails to evaluate the impacts of WBN2 in light of the fragility of the host environment. Second, TVA relies on outdated and inadquate data to predict thermal impacts and the impacts of entrainment and impingement of aquatic organisms in the plant's cooling system. Third, TVA fails completely to analyze the cumulative effects of WBN2 when taken

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14 Att. 8, Letter from M. Bajestani, TVA, to NRC (Feb. 15, 2008) (cover letter only), *available at* ADAMS Accession No. ML080510469.

15 NUREG-0498, Supp. 2, Draft Final Environmental Statement Related to the Operation of [WBN] Unit 2, (Oct. 2011) ("Draft SFES"), *available at* ADAMS Accession No. ML112980199.

16 *See generally* Petition to Intervene and Request for Hearing (July 13, 2009) ("Petition").

17 *Id.* at 31.

> together with the impacts of other industrial facilities and the effects of the many dams on the Tennessee River.[18]

8. The NRC Staff and TVA subsequently filed answers addressing the Petition.[19] On September 3, 2009, SACE filed a Motion for Leave to Amend Contention 7, along with an Amended Contention 7.[20] Both TVA and the NRC Staff filed responses opposing SACE's Motion and Answers to the Amended Contention.[21] SACE thereafter filed a reply to the Answers to the Amended Contention on October 5, 2009.[22]

9. On November 19, 2009, this Board granted the Petition to Intervene on behalf of SACE, admitting two contentions.[23] The Board denied SACE's Motion to Amend Contention 7, instead admitting Contention 7 as originally presented.[24] Although the Board admitted Contention 1 along with Contention 7, TVA moved to dismiss Contention 1 as moot on April 19, 2010.[25] The Intervenors did not oppose that motion,[26] and the Board granted TVA's unopposed

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18 *Id.* at 31-32.

19 [TVA's] Answer Opposing the [SACE] et al., Petition to Intervene and Request for Hearing (Aug. 7, 2009); NRC Staff's Answer to Petition to Intervene and Request for Hearing (Aug. 7, 2009).

20 Petitioners' Motion for Leave to Amend Contention 7 Regarding TVA Aquatic Study (Sept. 3, 2009); Petitioners' Amended Contention 7 Regarding TVA Aquatic Study (Sept. 3, 2009).

21 [TVA's] Response in Opposition to Petitioner's Motion for Leave to Amend Contention 7 Regarding TVA Aquatic Study (Sept. 8, 2009); NRC Staff's Response in Opposition to Motion for Leave to Amend Contention 7 Regarding TVA Aquatic Study (Sept. 10, 2009); [TVA's] Response in Opposition to Petitioners' Amended Contention 7 Regarding TVA Aquatic Study (Sept. 28, 2009); NRC Staff's Answer to Petitioners' Amended Contention 7 Regarding TVA Aquatic Study (Sept. 28, 2009).

22 Petitioners' Reply to Responses of NRC Staff and [TVA] to Petitioners' Amended Contention 7 (Oct. 5, 2009).

23 *Tenn. Valley Auth*. (Watts Bar Nuclear Plant Unit 2), LBP-09-26, 70 NRC 939, 946 2009). The Board denied the Request for Hearing submitted on behalf of the remaining four petitioners on the basis that it was not timely. *Id*.

24 *Watts Bar 2,* LBP-09-26, at 988.

25 [TVA's] Motion to Dismiss [SACE's] Contention 1 as Moot (Apr. 19, 2010).

26 Letter from D. Curran , SACE Counsel, to Board Chairman L. McDade, Watts Bar Unit 2 Operating License Proceeding (May 6, 2010), *available at* ADAMS Accession No. ML101260546.

Motion and dismissed Contention 1 accordingly.[27] As a result, only Contention 7 remains to be resolved.

C. New Information on the Record – TVA's Aquatic Studies and NRC's Draft SFES

10. In direct response to the issues raised by SACE in Contention 7, TVA collected extensive new data on the current health of the aquatic environment and the impact of operation of WBN Unit 1 on that environment, prepared numerous updated and expanded aquatics-related analyses, documented the analyses in published reports and studies, and disclosed these reports and studies to the NRC Staff and SACE.[28] A complete list of those studies, including the dates that TVA disclosed each to SACE and the NRC Staff, follows:

a. Comparison of Fish Species Occurrence and Trends in Reservoir Fish Assemblage Index Results in Chickamauga Reservoir Before and After [WBN] Unit 1 Operation (June 2010) ("RFAI Study"), which TVA disclosed to SACE and the NRC Staff on July 15, 2010[29];

b. Analysis of Fish Species Occurrences in Chickamauga Reservoir – A Comparison of Historic and Recent Data (Oct. 2010) ("Fish Species

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27 Order (Granting TVA's Unopposed Motion to Dismiss SACE Contention 1) (June 2, 2010) (unpublished).

28 *See* Joint Affidavit by Dennis Scott Baxter, John Tracy Baxter, Dr. Charles Coe Coutant, and Dr. Paul Neil Hopping at ¶ 46 ("Joint Affidavit").

29 *See* Att. 9, TVA, Comparison of Fish Species Occurrence and Trends in Reservoir Fish Assemblage Index Results in Chickamauga Reservoir Before and After [WBN] Unit 1 Operation (June 2010); TVA's Sixth Supplemental Disclosures at 8 (July 15, 2010), *available at* ADAMS Accession No. ML101960302.

Occurrences Study"), which TVA disclosed to SACE and the NRC Staff on November 15, 2010[30];

c. Mollusk Survey of the Tennessee River Near [WBN] (Rhea County, Tennessee) (Nov. 2010) ("Mollusk Survey"), which TVA disclosed to SACE and the NRC Staff on Jamuary 18, 2011[31];

d. Discussion of the Results of the 2010 Mollusk Survey of the Tennessee River Near [WBN] (Rhea County, Tennessee) (Mar. 2011) ("Discussion of Mollusk Survey"), which TVA disclosed to SACE and the NRC Staff on March 15, 2011[32];

e. Aquatic Environmental Conditions in the Vicinity of [WBN] During Two Years of Operation, 1996-1997 (June 1998, Revised June 2010) ("Revised Aquatics Study"), which TVA disclosed to SACE and the NRC Staff on July 15, 2010[33];

f. Comparison of 2010 Peak Spawning Seasonal Densities of Ichthyoplankton at [WBN] at Tennessee River Mile 528 with Historical Densities

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30 *See* Att. 10, TVA, Analysis of Fish Species Occurrences in Chickamauga Reservoir – A Comparison of Historic and Recent Data (Oct. 2010); TVA's Tenth Supplemental Disclosures at 8 (Nov. 15, 2010), *available at* ADAMS Accession No. ML103190306.

31 *See* Att. 11, Third Rock Consultants, Mollusk Survey of the Tennessee River Near [WBN] (Rhea County, Tennessee) (October 28, 2010, Revised November 24, 2010); TVA's Twelfth Supplemental Disclosures at 9 (Jan. 18, 2011), *available at* ADAMS Accession No. ML110180334.

32 *See* Att. 12, TVA, Discussion of the Results of the 2010 Mollusk Survey of the Tennessee River Near [WBN] (Rhea County, Tennessee) (Mar. 2011); TVA's Fourteenth Supplemental Disclosures at 9 (Mar. 15, 2011), *available at* ADAMS Accession No. ML110740178.

33 *See* Att. 13, TVA, Aquatic Environmental Conditions in the Vicinity of [WBN] During Two Years of Operation, 1996-1997 (June 1998, Revised June 7, 2010); TVA's Sixth Supplemental Disclosures at 7 (July 15, 2010), *available at* ADAMS Accession No. ML101960302.

during 1996 and 1997 (Apr. 2011, Revised Nov. 2011) ("Peak Spawning Entrainment Study"), which TVA disclosed to SACE and the NRC Staff on April 15, 2011[34];

g. Fish Impingement at [WBN] Intake Pumping Station Cooling Water Intake Structure during March 2010 through March 2011 (Mar. 2011, Revised Apr. 2011) ("Impingement Study"), which TVA disclosed to SACE and the NRC Staff on May 16, 2011[35]; and

h. Hydrothermal Effects on the Ichthyoplankton from the [WBN] Supplemental Condenser Cooling Water Outfall in Upper Chickamauga Reservoir (Jan. 2011) ("Hydrothermal Study"), which TVA disclosed to SACE and the NRC Staff on February 15, 2011.[36]

11. SACE has not raised any concerns with respect to these studies with the NRC or this Board.[37]

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[34] *See* Att. 14, TVA, Comparison of 2010 Peak Spawning Seasonal Densities of Ichthyoplankton at [WBN] at [TRM] 528 with Historical Densities During 1996 and 1997 (Apr. 2011, Revised Nov. 2011); TVA's Fifteenth Supplemental Disclosures at 9 (Apr. 15, 2011), *available at* ADAMS Accession No. ML111050528. Although TVA disclosed a revised Peak Spawning Entrainment Study on November 15, 2011, the conclusions of that version were unchanged from that disclosed in April 2011. *See* TVA's Twenty-Second Supplemental Disclosures at 11 (Nov. 15, 2011), *available at* ADAMS Accession No. ML11319A200.

[35] *See* Att. 15, TVA, Fish Impingement at [WBN] [IPS] Cooling Water Intake Structure During March 2010 Through March 2011 (Mar. 2011, Revised Apr. 2011); TVA's Sixteenth Supplemental Disclosures at 11 (May 16, 2011). This was a revised version of the Impingement Study. TVA disclosed the initial version of the Impingement Study (Mar. 2011) to SACE and the NRC Staff on April 15, 2011. *See* TVA's Fifteenth Supplemental Disclosures at 10 (Apr. 15, 2011), *available at* ADAMS Accession No. ML111050528.

[36] *See* Att. 16, TVA, Hydrothermal Effects on the Ichthyoplankton from the [WBN] [SCCW] Outfall in Upper Chickamauga Reservoir (Jan. 2011); TVA's Thirteenth Supplemental Disclosures at 9 (Feb. 15, 2011), *available at* ADAMS Accession No. ML110460452.

[37] *See* Joint Affidavit ¶¶ 59, 67, 77, 84, 93, 99.

12. The NRC Staff's Draft SFES, dated October 31, 2011, concurs with TVA's findings in its aquatics studies.[38] Section IV, below, discusses the specific conclusions drawn by the Staff that are relevant to TVA's aquatic studies.

II. Description of the Proposed Project

A. General Information

13. The WBN site is located is located in Rhea County, Tennessee, on the west bank of the Tennessee River, in the upper Chickamauga Reservoir at Tennessee River Mile ("TRM") 528.[39]

14. The Tennessee River System is approximately 650 miles long and is comprised of riverine and lacustrine environments, created by numerous dams and locks on the system, most of which have been in place since the 1940s.[40] Chickamauga Dam, completed in 1940 at TRM 471, impounds Chickamauga Reservoir downstream of WBN.[41] Watts Bar Hydroelectric Dam impounds the Watts Bar Reservoir 1.9 miles upstream of WBN.[42]

15. The Tennessee River is also host to numerous industrial facilities.[43] For example, WBN is located approximately one mile downstream of the decommissioned Watts Bar Fossil Plant.[44]

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38 *See generally* Draft SFES.

39 *See* Final Supplemental Environmental Impact Statement, Completion and Operation of [WBN] Unit 2, at 1 (June 2007) ("2007 FSEIS"), *available at* ADAMS Accession No. ML11215A100.

40 Joint Affidavit ¶ 23.

41 Joint Affidavit ¶ 24.

42 Joint Affidavit ¶ 24.

43 Joint Affidavit ¶ 23.

16. TVA is the licensee and operator of the existing WBN Unit 1, a Westinghouse pressurized water reactor that began full commercial operation on May 27, 1996.[45]

17. WBN Unit 1 was originally designed to operate only in a closed cycle cooling mode via the Condenser Cooling Water ("CCW") system.[46] After TVA began operation of Unit 1, it determined that a supplemental cooling system would increase the efficiency of the plant.[47] Accordingly, TVA began to use a Supplemental Condenser Cooling Water ("SCCW") system in 1998.[48]

18. The present proceeding pertains to the OL for WBN Unit 2.[49] The added operation of WBN Unit 2 may result in minimal increased demands on that aquatic environment both for cooling water intake and cooling water discharge.[50]

B. WBN Cooling System Intake

19. WBN Unit 2 shares intake channels with Unit 1.[51] Operation of Unit 1 withdraws cooling water from CCW and SCCW intake channels.[52] Under dual unit operation, WBN will continue to draw cooling water from the CCW and SCCW intake channels.[53]

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44 Joint Affidavit ¶ 24.

45 Joint Affidavit ¶ 27.

46 Joint Affidavit ¶ 28.

47 Joint Affidavit ¶ 29.

48 Joint Affidavit ¶ 29.

49 *See supra* ¶¶ 4, 7-9.

50 *See, e.g.*, Joint Affidavit ¶¶ 27-44.

51 Joint Affidavit ¶ 35.

52 *See* Joint Affidavit ¶¶ 28-29.

53 *See* 2007 FSEIS at 26.

20. The SCCW system is gravity driven.[54] As a result, intake flow and velocity for the SCCW depends on the water level behind the Watts Bar Dam.[55]

21. Flow through the CCW is driven by the IPS, rather than gravity.[56] The IPS will draw more water at a higher flow rate under dual unit operation than for operation of Unit 1 alone.[57] CCW maximum intake velocities will not increase under dual unit operation because the intake will draw water through additional openings.[58]

22. Studies show that the hydraulic entrainment from dual unit operation will result in an additional entrained amount of 0.2% of the flow in the Chickamauga Reservoir.[59] The resulting total hydraulic entrainment represents approximately 0.5% of the flow in the Chickamauga Reservoir.[60] This increased hydraulic entrainment will result in a proportionate increase in entrainment of the ichthyoplankton present in the water column.[61]

23. Studies show that CCW flow rates resulting from dual unit operation will average 134 cubic feet per second ("cfs") at summer pool levels and 113 cfs at winter pool levels, an increase from those rates observed under operation of Unit 1 alone: 73 cfs and 68 cfs, respectively.[62] (The maximum intake velocities will not change under dual unit operation

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54 *See* 2007 FSEIS at 24; Joint Affidavit ¶ 36.

55 *See* 2007 FSEIS at 24; Joint Affidavit ¶¶ 34, 36.

56 *See* Joint Affidavit ¶¶ 36-37.

57 *See* Joint Affidavit ¶¶ 36-37.

58 Joint Affidavit ¶ 37.

59 Joint Affidavit ¶ 37.

60 Joint Affidavit ¶ 37.

61 Joint Affidavit ¶ 90.

62 Joint Affidavit ¶ 37.

because of the additional IPS openings available to accommodate increased flow.[63]) The increased flow rates in the CCW intake channel resulting from dual unit operation will result in a proportionate increase in the rates of fish impingement.[64]

C. WBN Cooling System Output

24. WBN Unit 2 shares cooling water discharge outfalls with Unit 1.[65]

25. The thermal discharge from WBN operation is bound by thermal limits established by TVA's NPDES permit.[66] The NPDES system establishes legally enforceable, aquatic health-based limits on hydrothermal discharges, in accordance with state and federal statutes.[67] The Tennessee Water Pollution Control Division ("TDEC") issued a new NPDES permit for the operation of WBN Units 1 and 2 on June 30, 2011, most recently revised on August 31, 2011.[68]

26. TVA's NPDES permit sets discharge limits for each of the WBN outfall points under operation of WBN Units 1 and 2 that are unchanged from the limits set for Unit 1 operation.[69]

27. For Outfall 101, the discharge point for blowdown water from the CCW system, the NPDES permit for operation of WBN Units 1 and 2 allows discharge only when the release

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63 Joint Affidavit ¶ 37.

64 *See* Joint Affidavit ¶ 97.

65 Joint Affidavit at ¶ 41.

66 Joint Affidavit at ¶ 28. *See, e.g.*, Att. 17, NPDES Permit No. TN0020168 (June 4, 2010).

67 *See* Att. 17; *see also generally* Tennessee Water Quality Control Act of 1977, T.C.A. 69-3-101 *et seq*.; Water Pollution Control Act, 33 U.S.C. 1251 *et seq*.

68 *See* Att. 18, NPDES Permit No. TN0020168 (Aug. 31, 2011); Joint Affidavit ¶ 30.

69 *See* Joint Affidavit ¶¶ 39-44. *Compare* Att. 17, *with* Att. 18.

from Watts Bar Dam is at least 3500 cfs, and specifies a discharge temperature limit of 35°C.[70] These requirements are unchanged from those set in TVA's NPDES permit for operation of Unit 1 alone.[71]

28. For Outfall 102, the discharge point for the CCW holding ponds, the NPDES permit for dual unit operation allows discharge only under emergency situations.[72] Even then, the NPDES permit limits the temperature of discharged water to 35°C and requires that TVA make every effort to use this outfall only when the flow of the receiving waters meets or exceeds 3500 cfs.[73] This condition is unchanged from that in the NPDES permit for WBN Unit 1.[74]

29. For Outfall 113, the discharge point for the SCCW system, the NPDES permit for operation of Units 1 and 2 specifies a discharge temperature limit based on the receiving water.[75] For example, the NPDES permit requires that the temperature rise at the edge of the mixing zone shall not exceed 3°C relative to an upstream control point.[76] The limits that apply to Outfall 113 in the current NPDES permit are unchanged from those established in the NPDES permit for WBN Unit 1 operation.[77]

30. Because the thermal discharge limits established by TVA's NPDES permit for dual unit operation are unchanged from those for Unit 1 operation, thermal impacts on the

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70 Joint Affidavit ¶ 39; *see also* Att. 18, at 1.

71 *Compare* Att. 17, at 1, *with* Att. 18, at 2.

72 *See* Joint Affidavit ¶ 42; Att. 18, at 4.

73 Joint Affidavit at ¶ 42; Att. 18, at 4.

74 *Compare* Att. 17, at 2-3, *with* Att. 18, at 4.

75 Joint Affidavit ¶ 44; Att. 18, at 7.

76 Joint Affidavit ¶ 44; Att. 18, at 7, 10-11.

77 *Compare* Att. 18, at 7, 10-11, *with* Att. 17, at 5, 7-8.

aquatic environment resulting from WBN operation will not be materially different under dual unit operation than they are for operation of Unit 1 alone.[78]

III. Description of TVA's Aquatics Studies

31. As noted in ¶ 10 above, TVA conducted a number of aquatics studies in direct response to the assertions made by SACE and its expert, Dr. Young, in Contention 7. Those studies, which are described in more detail below, collectively provide data on fish and mussel populations in the WBN vicinity, and the entrainment, impingement, and hydrothermal impacts on those species that result from operation of WBN Unit 1.[79] In addition, TVA conducted some of the studies to resolve alleged errors in TVA's original studies identified by SACE and Dr. Young.[80]

A. Comparison of Fish Species Occurrence and Trends in Reservoir Fish Assemblage Index Results in Chickamauga Reservoir Before and After WBN Unit 1 Operation (June 2010) ("RFAI Study")

32. In Contention 7, SACE and Dr. Young claimed that TVA relies on poor and outdated data about the health of the aquatic community in the WBN vicinity in lieu of recent monitoring studies.[81] Dr. Young challenged TVA's characterization of the health of the fish community in the WBN vicinity, which TVA based in part on measured RFAI data.[82] In

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78 *See* Joint Affidavit ¶¶ 41-44.

79 *See* Joint Affidavit ¶¶ 46, 47, 60, 68, 84, 93, 99.

80 *See* Joint Affidavit at ¶¶ 47 and 77.

81 *See* Petition at 33; Att. 9.

82 Declaration of Shawn Paul Young, Ph.D. at 6-8 (July 11, 2009) ("Young Affidavit"), *available at* ADAMS Accession No. ML093080675.

response to those allegations, TVA conducted this new study to explain RFAI methodology and evaluate the aquatic community in the WBN vicinity using that methodology.[83]

33. First, this study provides a detailed explanation of TVA's RFAI methodology.[84] TVA created the RFAI methodology based on industry standards for biological indices, including those approved by TDEC and the U.S. Environmental Protection Agency ("EPA"), for use in its Vital Signs monitoring program.[85] TVA has conducted fish sampling in the Chickamauga Reservoir every year since 1993, in support of this program.[86]

34. RFAI methodology uses twelve fish community metrics from four general categories: Species Richness and Composition; Trophic Composition; Abundance; and Fish Health.[87] For each metric, scores are given on a scale from 1 to 5, with a score of 5 indicating optimum health.[88] The resulting scores range from 12-60, broken down as follows: 12-21 ("Very Poor"), 22-31 ("Poor"), 32-40 ("Fair"), 41-50 ("Good"), or 51-60 ("Excellent").[89] RFAI scores have an intrinsic variability of ±3 points.[90]

35. RFAI methodology addresses all five attributes or characteristics of a Balanced Indigenous Population ("BIP"), which is required by the Clean Water Act.[91] If an RFAI score reaches 70% of the highest attainable score of 60 (*i.e.*, 42), or if fewer than half of the RFAI

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83 Joint Affidavit ¶ 47; Att. 9.

84 *See* Att. 9, at 1-3; Joint Affidavit ¶¶ 48-50.

85 Joint Affidavit ¶ 48.

86 Joint Affidavit ¶ 50.

87 Joint Affidavit ¶ 52.

88 Joint Affidavit ¶ 53.

89 Joint Affidavit ¶ 53.

90 Joint Affidavit ¶ 54.

91 Joint Affidavit ¶ 55.

metrics receive a low (1) or moderate (3) score, then normal community structure and function are considered to be present, indicating that BIP is maintained.[92]

36. Second, this study evaluates the health of the aquatic environment in the WBN vicinity based on recent fish surveys and the RFAI methodology.[93] The study found that RFAI scores from the site downstream of the WBN intake and thermal discharge have averaged 44 from 1996 to 2008 (*i.e.*, during operation of WBN Unit 1), indicating that the aquatic health of that area is "good" even during WBN operation.[94]

37. Third, this study compares the health of that environment as reflected in RFAI scores from before and after WBN operation.[95] Scores from every sample year (1993-2008) were at least 42, *i.e.*, 70% of the highest attainable score of 60.[96] As a result, the study concluded that both before and after WBN operation, BIP has been maintained.[97]

38. SACE has not challenged the methodology or findings of this study with this Board.[98]

B. Analysis of Fish Species Occurrences in Chickamauga Reservoir – A Comparison of Historic and Recent Data (Oct. 2010) ("Fish Species Occurrences Study")

39. SACE claimed in Contention 7 that TVA relies on inadequate and outdated data to form its conclusion that fish populations in the WBN vicinity are in good health, and has not

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92 Joint Affidavit ¶ 56.

93 *See* Att. 9, at 1-3; Joint Affidavit ¶¶ 48, 57.

94 Joint Affidavit ¶ 57.

95 *See* Att. 9 at 1-3; Joint Affidavit ¶¶ 48-50.

96 Joint Affidavit ¶ 57.

97 *See* Joint Affidavit ¶ 58.

98 *See* Joint Affidavit ¶ 59.

taken steps necessary to evaluate how effluent from WBN may affect fish communities.[99] In direct response, TVA conducted this study to analyze extensive historic and recent fish survey data from the WBN vicinity, and compare the current prevalence of fish species to historic (*i.e.*, pre-operational) values.[100]

40. This study uses the extensive fish survey data available for the WBN vicinity, dating back to 1947.[101] Because it also provides recent survey data for the fish populations in the WBN vicinity, this study inherently reflects the impact of the current operation of WBN Unit 1 on those populations.[102]

41. In analyzing the collective historical fish survey data for the Chickamauga Reservoir, this study takes into consideration the variations in survey methods employed over the past 60 years.[103] Variations in survey methodology preclude direct comparisons between historical and recent surveys.[104] This study also compared the results of fish sampling efforts in various Tennessee River reservoirs subject to similar conditions to understand widespread patterns and behavior of species in reservoir environments.[105]

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99 Petition at 33.

100 *See* Joint Affidavit ¶ 60; Att. 10.

101 Joint Affidavit at ¶ 61.

102 *See* Joint Affidavit ¶¶ 64-65, 67.

103 *See* Joint Affidavit ¶ 61.

104 *See* Joint Affidavit ¶¶ 64-65.

105 Joint Affidavit ¶ 62.

42. This study found that species occurrence and abundance in the Chickamauga Reservoir has changed from 1947 to 2009.[106] Many of these changes took place before operation of WBN Unit 1 began.[107]

43. One major cause of this change is impoundment of the Tennessee River, which began in the 1930s and has altered habitats required for various life stages of aquatic species.[108] Some of the species not found in recent surveys require unimpounded, free flowing riverine environments.[109]

44. The study found that another reason for the change in species diversity and abundance is that most species that have not been collected in recent times have historically never been caught frequently or in large numbers in Chickamauga Reservoir.[110]

45. Finally, the study found that changes in fish survey methods account for some of the changes in findings of species occurrence and abundance.[111] Certain survey methods, such as hoop nets, trap nets, and cove rotenone sampling, that were effective for targeting certain species, are no longer in use.[112]

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106 Joint Affidavit ¶ 64.

107 *See* Joint Affidavit ¶ 65.

108 *See* Joint Affidavit ¶¶ 64-65.

109 *See* Joint Affidavit ¶ 65.

110 *See* Joint Affidavit ¶¶ 64-65.

111 *See* Joint Affidavit ¶¶ 64-65.

112 Joint Affidavit ¶ 66.

46. As a result, this study concluded that there is no basis to support a finding that operation of WBN Unit 1 caused the observed changes in fish species and occurrence in the Chickamauga Reservoir.[113]

47. SACE has not challenged the methodology or findings of this study with this Board.[114]

C. Mollusk Survey of the Tennessee River Near [WBN] (Rhea County, Tennessee) (Oct. 28, 2010, Revised Nov. 24, 2010) ("Mollusk Survey"), and Discussion of the Results of the 2010 Mollusk Survey of the Tennessee River Near [WBN] (Rhea County, Tennessee) (Mar. 2011) ("Discussion of Mollusk Survey")

48. In Contention 7, SACE claimed that TVA relies on inadequate and outdated data to estimate the effects of WBN operation on mussels in the WBN vicinity.[115] In support, Dr. Young alleged that the mussel community in the WBN vicinity is not in good health, and that TVA has not given sufficient consideration of the impact of WBN operation on that community.[116]

49. To remedy those alleged deficiencies, TVA engaged an outside consultant to conduct a survey of the mussel community in the WBN vicinity in 2010.[117] The consultant conducted semi-quantitative and quantitative mollusk sampling in three sample areas at which TVA has previously conducted pre-operational and operational mollusk surveys.[118]

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113 *See* Joint Affidavit ¶¶ 65-66.

114 *See* Joint Affidavit ¶ 67.

115 Petition at 33.

116 *See* Young Affidavit at 8-10.

117 *See* Joint Affidavit at ¶ 68; Att. 11.

118 Joint Affidavit ¶ 69.

50. Because WBN Unit 1 was in operation in 2010 and had been in operation for more than a decade, this survey inherently reflects the impact of the operation of WBN Unit 1 on the mussel community in the WBN vicinity.[119]

51. The consultant provided the results in the Mollusk Survey.[120] TVA subsequently produced Discussion of Mollusk Survey, analyzing the results of the Mollusk Survey and comparing those results to preoperational (1983 to 1994) and operational (1996 to 1997) monitoring of the mollusk communities at WBN.[121]

52. These studies agree that the Chickamauga Reservoir in the WBN vicinity is not the ideal habitat for mussels.[122] Still, the 2010 survey found that the mussel community in the WBN vicinity is in substantially similar condition as it was near the end of the previous operational monitoring period (1996 to 1997), in both species composition and the number of mussels collected.[123] In addition, the 2010 survey collected juveniles of at least five mussel species, evidencing reproduction of mollusks in the WBN vicinity.[124]

53. As a result, this study concluded that there is no basis to support a finding that the relatively low densities of mussels in the WBN vicinity are the result of operation of WBN Unit 1.[125]

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119 *See, e.g.* Joint Affidavit ¶¶ 72-73.

120 *See* Att. 11.

121 *See* Att. 12**.**

122 *See* Joint Affidavit ¶ 73.

123 Joint Affidavit ¶ 72.

124 Joint Affidavit ¶ 72.

125 *See* Joint Affidavit ¶¶ 72-75.

54. SACE has not challenged the methodology or findings of this study with this Board.[126]

D. Aquatic Environmental Conditions in the Vicinity of Watts Bar Nuclear Plant During Two Years of Operation, 1996-1997 (June 1998, Revised June 2010) ("Revised Aquatics Study")

55. TVA completed the initial Aquatics Study in 1998, comparing pre-operational (1973 to 1979, 1982 to 1985) and operational (1996 to 1997) aquatic monitoring in the WBN vicinity.[127] The original study focused on the effects of WBN operation on fish (juveniles and adults), benthic macroinvertebrates, and water quality.[128] As part of the analysis of the effects on fish, the study estimated entrainment of ichthyoplankton and impingement of fish resulting from operation of WBN Unit 1.[129]

56. The original study concluded that ichthyoplankton were present in relatively low densities in the vicinity of the WBN intake, and that those that were present had passed through the turbines of the Watts Bar Dam.[130] The study also found that most spawning that occurs in Chickamauga Reservoir occurs downstream of the WBN intake.[131] In other words, relatively few ichthyoplankton were available to be entrained at the WBN intake.[132] The original study

126 *See* Joint Affidavit at ¶ 76.

127 Joint Affidavit ¶ 77.

128 Joint Affidavit ¶ 77.

129 Joint Affidavit ¶ 77.

130 Joint Affidavit ¶ 79.

131 Joint Affidavit ¶ 79.

132 Joint Affidavit ¶ 79.

concluded that the percent of ichthyoplankton entrained was very low, and that WBN entrainment has no impact on the fish populations in the WBN vicinity.[133]

57. TVA revised this study in direct response to concerns raised by SACE in Contention 7, and by Dr. Young in support of Contention 7, that TVA's methods for estimating entrainment were flawed.[134] Dr. Young claimed that TVA erroneously assumed that distribution of ichthyoplankton across the reservoir is uniform, and did not take into account variations in seasonal abundance of ichthyoplankton.[135] Dr. Young also alleged that TVA should estimate entrainment using actual intake water demand and river flow values.[136]

58. In response to Dr. Young's concerns, TVA revised the entrainment analysis to account for seasonality of ichthyoplankton occurrence and reservoir releases from Watts Bar Dam.[137] TVA also used actual intake water demand and reservoir flow values.[138]

59. After conducting the revised entrainment estimates, TVA found that its overall conclusions regarding entrainment were unchanged.[139] Estimated entrainment rates remained very low.[140] For samples collected in 1996, percent entrainment in the revised analysis was estimated to be 0.29% for fish eggs and 0.57% for fish larvae.[141] For samples collected in 1997,

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133 Joint Affidavit ¶ 80.

134 *See* Young Affidavit at 12-15; *see also* Joint Affidavit ¶ 81.

135 *See* Young Affidavit at 13-14; *see also* Joint Affidavit ¶ 81.

136 *See* Young Affidavit at 13-14.

137 Joint Affidavit ¶ 81.

138 Joint Affidavit ¶ 81.

139 *See* Joint Affidavit ¶ 82.

140 Joint Affidavit ¶ 82.

141 Joint Affidavit ¶ 82.

percent entrainment in the revised analysis was estimated to be 0.02% for fish eggs and 0.22% for fish larvae.[142]

60. TVA's experts concluded that these rates are "low" and therefore there is no impact to the ichthyoplankton populations of Chickamauga Reservoir as a result of operation of WBN Unit 1.[143]

61. SACE has not challenged the methodology or findings of this study with this Board.[144]

E. Comparison of 2010 Peak Spawning Seasonal Densities of Ichthyoplankton at [WBN] at Tennessee River Mile 528 with Historical Densities During 1996 and 1997 (Apr. 2011, Revised Nov. 2011) ("Peak Spawning Entrainment Study")

62. TVA conducted this study to respond to SACE and Dr. Young's concerns that TVA's methods for estimating entrainment were flawed, and that TVA should have taken direct measurements of entrainment.[145] TVA collected raw data on actual entrainment at WBN during Unit 1 operation from March 2010 through March 2011, to ensure that all of SACE and Dr. Young's concerns regarding entrainment estimates were addressed, and in direct response to requests from SACE and Dr. Young for recent *actual* entrainment monitoring at WBN during operation of WBN Unit 1.[146]

142 Joint Affidavit ¶ 82.

143 Joint Affidavit ¶ 82.

144 *See* Joint Affidavit at ¶ 83.

145 Joint Affidavit at ¶ 84; *see also* Petition at 33-34; Young Affidavit at 11-15.

146 *See* Joint Affidavit ¶ 84.

63. This study reports entrainment resulting from operation of WBN Unit 1, as measured during the peak spawning period of April through June, 2010.[147] TVA used this timeframe to address SACE and Dr. Young's concern that TVA account for the spawning patterns of fish species in the Chickamauga Reservoir and the high abundance of ichthyoplankton during certain times of year.[148]

64. This study concluded that measured entrainment rates at the WBN in 2010 were below one half of one percent of the ichthyoplankton population in the WBN vicinity, and consistent with those calculated for the same period during the first two years of operation of Unit 1, 1996 to 1997, when consistent calculation methods were applied.[149] Specifically, the study found that the percent of entrained eggs in 2010 (0.12%) was within the range for 1996 (0.2%) and 1997 (0.2%).[150] Likewise, the study found that the percent of entrained larvae in 2010 (0.40%) was within the range for 1996 (0.88%) and 1997 (0.22%).[151]

65. TVA's experts concluded that these entrainment rates are "very low," and are not adversely affecting the fish population in the WBN vicinity.[152]

66. The increased water intake demand for the CCW caused by dual unit operation will result in an estimated increase in hydraulic entrainment of approximately 0.2%.[153] This study found that ichthyoplankton entrainment will increase proportionately with hydraulic

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147 Joint Affidavit ¶ 84.

148 *See* Joint Affidavit ¶ 84.

149 *See* Joint Affidavit ¶ 87.

150 *See* Joint Affidavit ¶ 87.

151 *See* Joint Affidavit ¶ 87.

152 *See* Joint Affidavit ¶ 90.

153 Joint Affidavit ¶¶ 37, 90.

entrainment.[154] This increase will result in entrainment percentages that are still less than 1% of the ichthyoplankton population.[155] This study concluded that, as a result, dual unit operation will not result in a material change in entrainment impacts.[156]

67. SACE has not challenged the methodology or findings of this study with this Board.[157]

F. Fish Impingement at [WBN] Intake Pumping Station Cooling Water Intake Structure During March 2010 through March 2011 (Mar. 2011, Revised Apr. 2011) ("Impingement Study")

68. This study analyzes raw impingement data collected at the CCW intake during operation of WBN Unit 1 from March 2010 through March 2011.[158] TVA used this data, in combination with the existing recent SCCW impingement data, to estimate the annual impingement mortality of fish in the vicinity of WBN as the result of operation of WBN Unit 1, and to predict the impact from operation of Unit 2.[159] TVA conducted this study in response to allegations by SACE and Dr. Young that TVA's analysis of the effects of WBN operation on the aquatic community was deficient because TVA had not conducted recent studies of actual impingement at the CCW intake.[160]

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154 *See* Joint Affidavit ¶ 90.

155 Joint Affidavit ¶ 90.

156 Joint Affidavit ¶ 90.

157 Joint Affidavit ¶ 92.

158 Joint Affidavit ¶ 93; Att. 15.

159 Joint Affidavit ¶ 93.

160 *See* Joint Affidavit ¶ 93; Petition at 35; Young Affidavit at 15-16.

69. This study found that total impingement values in 1996 to 1997 (161) were less than those measured in 2010 to 2011 (13,573).[161] This study also found, however, that mortality resulting from a cold shock event dominated impingement mortality at WBN in 2010 to 2011.[162] Shad in the Southeastern United States, including the Chickamauga Reservoir, are susceptible to cold shock.[163] When temperatures fall below 50°F, they become lethargic and more susceptible to impingement.[164] The study found that the most significant impingement events observed at WBN in 2010 to 2011 were the result of cold shock.[165]

70. Excluding the cold shock event, this study found that fewer fish and number of species were impinged in 2010 to 2011, than in 1996 to 1997.[166] The EPA endorses an impingement modeling approach that excludes the effects of extreme environmental conditions.[167] The EPA also acknowledges the effects of cold shocks on shad.[168]

71. This study concludes that low numbers of impinged fish in both 1996-97 and 2010-11 indicate that impingement resulting from operation of WBN Unit 1 will not materially affect fish populations in the WBN vicinity.[169]

72. Dual unit operation will result in increased withdrawal of water through the CCW intake channel.[170] Impingement will likewise increase at a rate that is proportional to the

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161 Joint Affidavit ¶ 95.

162 *See* Joint Affidavit ¶ 95.

163 Joint Affidavit ¶ 95.

164 Joint Affidavit ¶ 95.

165 *See* Joint Affidavit ¶ 95.

166 Joint Affidavit ¶ 96.

167 *See* Joint Affidavit ¶ 96.

168 *See* Joint Affidavit ¶ 96.

169 Joint Affidavit ¶ 96.

increase in flow rate.[171] This study concluded that the impingement increase from dual unit operation would still be very small when compared to the effects of cold shock and winter kills on shad.[172] As a result, TVA's experts concluded that operation of Unit 2 will not result in material increases in impingement at WBN.[173]

73. SACE has not challenged the methodology or findings of this study with this Board.[174]

G. Hydrothermal Effects of the Ichthyoplankton from the Watts Bar Nuclear Plant Supplemental Condenser Cooling Water Outfall in Upper Chickamauga Reservoir (Jan. 2011) ("Hydrothermal Study")

74. This study analyzes the hydrothermal impacts of WBN operation, based on in-river testing in the vicinity of the WBN outfall during WBN operation in May and August, 2010.[175] TVA conducted this study in direct response to claims by SACE and Dr. Young that TVA should study the hydrothermal effects of operation of WBN Unit 1 on the aquatic environment in the WBN vicinity.[176] Dr. Young alleged that TVA does not provide data on spatial or temporal distribution of ichthyoplankton in relation to thermal mixing zones, does not evaluate the impact of discharge temperatures on ichthyoplankton, and does not account for impacts of variations in the size or temperature profile of the mixing zone.[177]

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170 *See* Joint Affidavit ¶¶ 37, 97.

171 Joint Affidavit ¶ 97.

172 *See* Joint Affidavit ¶ 97.

173 *See* Joint Affidavit ¶¶ 97-98.

174 Joint Affidavit ¶ 98.

175 Joint Affidavit ¶ 99; Att. 16.

176 *See* Joint Affidavit ¶ 99; Petition at 35-36; Young Affidavit at 16-19.

177 *See* Young Affidavit at 17-18.

75. In direct response to these claims, TVA designed this study to document the flow patterns and characteristics of the thermal plume from WBN, and track the thermal plume in conjunction with ichthyoplankton sampling.[178] This allowed TVA to understand the temporal and spatial distribution of ichthyoplankton and exposure rates to thermal discharges.[179]

76. TVA conducted this study in May and August, 2010, because those time frames represented extreme conditions: peak abundance of fish eggs and larvae, near maximum ambient water temperatures, and no release from the upstream Watts Bar Dam.[180]

77. This study found that, even under these extreme conditions, water temperatures did not approach the limits established by TVA's NPDES permit for operation of WBN Units 1 and 2.[181] Because discharge temperatures did not exceed those set in TVA's NPDES permit, this study concluded that there was no risk of thermal damage to ichthyoplankton from operation of WBN.[182]

78. Even if operation of WBN Units 1 and 2 causes effluent temperatures to rise above those measured even under extreme conditions for Unit 1, TVA is bound by its NPDES discharge limits.[183] Accordingly, dual unit operation does not pose any greater risk of thermal damage to the aquatic community in the WBN vicinity than does operation of Unit 1 alone.[184]

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178 Joint Affidavit ¶¶ 99, 101-104.

179 *See* Joint Affidavit ¶¶ 99, 104.

180 Joint Affidavit ¶ 100.

181 *See* Joint Affidavit ¶¶ 105-106.

182 *See* Joint Affidavit at ¶ 106.

183 Joint Affidavit ¶ 107; Att. 18.

184 *See* Joint Affidavit ¶¶ 107-109.

79. SACE has not challenged the methodology or findings of this study with this Board.[185]

IV. Overview of the Draft SFES Conclusions Regarding TVA's Aquatic Studies

80. As noted previously, the NRC Staff's Draft SFES concurs with the findings presented in TVA's aquatics studies.[186]

81. Specifically, the Staff concurred with TVA's findings regarding entrainment impacts, concluding in the Draft SFES that hydraulic entrainment would have a very minor impact on the aquatic biota in the vicinity of WBN.[187] The Staff agrees that existing levels of measured entrainment under Unit 1 operation are too low to be readily detected in the aquatic populations in the WBN vicinity, and the additional water withdrawn via the CCW intake will not be noticeable or furthermore destabilizing to the aquatic ecology in the WBN vicinity.[188] Moreover, the Staff concludes that the water withdrawn from the SCCW intake will actually *decrease* under dual unit operation.[189] In drawing these conclusions, the Staff relies in part on the Revised Aquatics Study and the Peak Spawning Entrainment Study.[190]

82. The Staff's conclusions regarding impingement impacts are similar. The Staff finds that measured levels of impingement under operation of WBN Unit 1 are low and impingement effects are too minor to be readily detected in aquatic populations in the WBN

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185 Joint Affidavit ¶ 109.

186 *Supra* ¶ 12; *see also generally* Draft SFES.

187 *See* Draft SFES at 4-32.

188 *See id*. at 4-31 to 4-32

189 *See id*. at 4-22 to 4-23.

190 *See id*. at 4-31 to 4-32.

vicinity.[191] The increased flow rates for the CCW intake under dual unit operation will not alter that conclusion, concludes the Staff, and the decreased flow rates for the SCCW intake will not increase impingement effects.[192] The Staff relied in part on the Impingement Study in drawing these conclusions.[193]

83. With respect to thermal impacts from operation of WBN Unit 2, the Staff concludes that this effect also will be undetectable and will not destabilize or noticeably alter the aquatic biota in the WBN vicinity.[194] The Staff based this conclusion in part on the Hydrothermal Study, as well as limits set by the NPDES permit.[195]

84. The Staff concludes in the Draft SFES that although the impoundments and industrial facilities have a significant cumulative impact on the aquatic biota in the WBN vicinity, "the overall impacts on aquatic biota, including Federally listed threatened and endangered species, from impingement and entrainment at the SCCW and IPS [*i.e.*, CCW] intakes and from thermal . . . discharges as a result of operating Unit 2 on the WBN site are SMALL."[196]

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191 *See id*. at 4-34.

192 *See id*. at 4-24 to 4-25, 4-34.

193 *See id*. at 4-33 to 4-34.

194 *See id*. at 4-37.

195 *See id*.

196 *Id*. at 4-78.

Respectfully submitted,

Signed (electronically) by Paul M. Bessette

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Counsel for TVA

Dated in Washington, D.C.
this 21st day of November, 2011

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

In the Matter of TENNESSEE VALLEY AUTHORITY (Watts Bar Nuclear Plant Unit 2)	Docket No. 50-391 November 21, 2011

JOINT AFFIDAVIT OF DENNIS SCOTT BAXTER, JOHN TRACY BAXTER, DR. CHARLES COE COUTANT, AND DR. PAUL NEIL HOPPING

TABLE OF CONTENTS

I. PERSONAL QUALIFICATIONS

1. [**Dennis Scott Baxter**] My name is Dennis Scott Baxter. I currently manage the Biological and Water Resources Team for the Tennessee Valley Authority's ("TVA") Environment and Technology Organization. I have 25 years of experience with TVA's Environmental Monitoring Program. I have conducted and coordinated multiple aquatic resource monitoring programs assessing environmental effects on aquatic resources throughout the Tennessee and Cumberland River Valleys. I have managed TVA's impingement and entrainment monitoring program, which was required for the recently rescinded EPA Section 316(b) Phase II rule, and which characterizes impingement and entrainment mortality at most of TVA Steam Electric Power plants. My current responsibilities include management of aquatic resource monitoring programs in support of TVA's Fossil and Nuclear Power Plant National Pollutant Discharge Elimination System ("NPDES") renewal process. These programs include entrainment and impingement mortality characterizations, as well as fish and benthic community assessments that use community assemblage indices and abiotic information, such as water quality and habitat characterization. In addition to my professional qualifications, I have presented scientific presentations at numerous professional meetings and fishing association functions.

2. [**D. Baxter**] For the environmental review of proposed Unit 2 at TVA's Watts Bar Nuclear site ("WBN"), I assisted in the preparation of the sections of aquatic community assessments and entrainment and impingement mortality estimates that pertain to EPA's Clean Water Act ("CWA") Sections 316(a) and (b).

3. [**D. Baxter**] Recently, I managed the aquatic monitoring program that updates the existing aquatic resource data of the WBN site. As part of that program, we conducted entrainment and impingement estimates and annual biological community assessments for fish and benthic macroinvertebrates to evaluate any adverse environmental impact from operation of WBN.

4. [**D. Baxter**] I began my career working at TVA's Aquatic Biology Laboratory in Norris, Tennessee, in 1986. I was a member of the Field Operations Staff who collected aquatic resource data for power plant compliance and TVA's Stewardship mission of managing the Tennessee Valley's resources to generating prosperity in the valley. I was a member of the team who processed the Sequoyah Nuclear Plant entrainment samples and was introduced to larval fish taxonomy. I have assisted with and conducted several environmental aquatic ecology assessments throughout the Tennessee Valley, such as Index of Biotic Integrity for streams and small rivers and Balanced Indigenous Community reservoir surveys that were being developed for the Tennessee Valley using EPA's guidance for Index of Biotic Integrity surveys. I have also written sections of NEPA Environmental Assessments and Impact Statements utilizing this data for nuclear power plants and other TVA actions.

5. [**D. Baxter**] With respect to this Joint Affidavit, I prepared those sections that pertain to the fish communities in the WBN vicinity and the various studies described in this affidavit regarding those communities. In particular, I helped revise the Aquatics Study and design the RFAI Study, Fish Species Occurrences Study, Impingement Study, and Peak Spawning Entrainment Study conducted in response to SACE's Contention 7. I also managed the conduct of the surveys themselves as well as the

resulting analyses and reports. Accordingly, I have helped prepare Sections V.A, V.B, V.D, V.E, and V.F of this Affidavit, as well as portions of the overview at Section III. A copy of my resume is attached to this Joint Affidavit as TVA Attachment 19.

6. [**John Tracy Baxter**] My name is John Tracy Baxter, Jr. I am currently Manager - Endangered Species Act Compliance at TVA. I have 21 years of experience with protected aquatic species monitoring, habitat assessment and recovery, and 13 years experience in assessing the environmental impacts of TVA projects and projects permitted by TVA on aquatic resources (including threatened and endangered species). These projects include several environmental assessments for new power generation facilities, facility up-rates, and re-licensing efforts.

7. [**J. Baxter**] For the environmental review in support of proposed WBN Unit 2, I assisted in the preparation of Chapter 3.2 - Aquatic Ecology, and Chapter 3.4 - Threatened and Endangered Species in TVA's 2007 FSEIS, "Completion and Operation of Watts Bar Nuclear Plant Unit 2, Rhea County, Tennessee" ("2007 SFEIS").[1]

8. [**J. Baxter**] Recently, I assisted with studies conducted in response to SACE Contention 7 regarding aquatic ecological impacts of WBN Unit 2. I assisted in developing the mollusk sampling plan for the study conducted in 2010, and prepared the "Discussion of Mollusk Survey," which compares the results of the consultant's

[1] Final Supplemental Environmental Impact Statement, Completion and Operation of [WBN] Unit 2, (June 2007), *available at* ADAMS Accession No. ML11215A100.

2010 mussel survey to data collected at three mussel beds previously monitored by TVA.

9. [**J. Baxter**] Prior to my current position, I was an Aquatic Zoologist for TVA (2000-2011). My job duties in that position involved maintaining a database of sensitive aquatic resources within the TVA Power Service Area, conducting monitoring studies for rare, threatened and endangered aquatic species, consultation with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act ("ESA"), and conducting aquatic ecology and threatened and endangered species impacts analyses of TVA projects, and third-party projects permitted by TVA, as part of TVA's ESA and NEPA compliance responsibilities. Upon graduation from college, I began my career as a consulting contractor to TVA, conducting field assessments, and preparing input for ESA and NEPA compliance activities.

10. [**J. Baxter**] With respect to this Joint Affidavit, I prepared those sections that pertain to the mollusk communities in the WBN vicinity and TVA's studies regarding those communities. In particular, I helped design the Mollusk Survey in response to SACE's Contention 7, provided direction to the consultant who conducted the survey, and managed and participated in the resulting analysis and report. I also assisted with the portions of the Revised Aquatics Study that pertain to mollusks. Accordingly, I have helped prepare Sections V.C and V.D of this Affidavit, as well as portions of the overview at Section III. A copy of my resume is attached to this Joint Affidavit as TVA Attachment 20.

11. [**Charles Coe Coutant, Ph.D.**] My name is Charles Coe Coutant. I am currently an individual consultant in aquatic ecology. I retired in October 2005, as a Distinguished

Research Scientist of aquatic ecology from Oak Ridge National Laboratory ("ORNL") in Oak Ridge, Tennessee. I have 52 years of experience with research on thermal discharges and aquatic ecology, much of it related to the energy industry. My Masters research was on the effect of a thermal effluent on the macroinvertebrate fauna of the Delaware River. My PhD research was on the effects of an impoundment on the plankton of a small Pennsylvania river. After receiving my PhD, I joined the Hanford Laboratories to conduct research on thermal effects of plutonium-production reactors on the aquatic life of the mid-Columbia River, with a focus on salmon. I was asked to join ORNL in 1970, to establish a national program in thermal-effects aquatic ecology that would develop biological criteria for siting, design and operation of thermal discharges from the anticipated surge in construction and operation of nuclear power plants. This program soon expanded to include other aspects of power plant cooling, including entrainment and impingement at intakes. Our research team of about 15 staff and many students conducted research, analysis, and modeling that resulted in numerous open-literature publications and guidelines for power plants.

12. [**Coutant**] I have assisted with or conducted several environmental assessments of temperature and other cooling-system effects on aquatic ecology. In 1972, I was asked by the U.S. National Academies to prepare the Heat and Temperature chapter for the revision of the national water quality criteria, in which I laid out the conceptual framework for water temperature standards that are still in use by EPA. I was an author of the 1977 EPA guidance manual for implementing Section 316(a) of the Clean Water Act. I was a founding advisor for the formation of the Electric Power Research Institute ("EPRI") in the 1970s, especially their programs in environmental

assessment. In the 1980s, I served on teams for the International Atomic Energy Agency ("IAEA") and UNESCO that developed international guidelines for environmental assessments of power plant cooling systems. I have written sections of NEPA Environmental Impact Statements for nuclear power plants and hydroelectric facilities. Both while employed at ORNL and since retirement, I have advised industry and regulators about resolving problems with thermal discharges, cooling-systems, and temperature criteria for aquatic life.

13. [**Coutant**] In addition to issues related to power plant cooling, I have been intimately involved with research and assessment of hydropower. I have participated in environmental impact assessments of several hydropower schemes for the Federal Energy Regulatory Commission, including adding hydropower to existing navigation dams on the Ohio River and a new power development on the Susitna River in Alaska. From 1989 to 2005, I served on a series of scientific advisory boards for the restoration of salmon in the Federal Columbia River Power System, including scientific evaluation of proposals for research, fish passage improvements and habitat enhancements, under the aegis of the Bonneville Power Administration and the Northwest Power and Conservation Council.

14. [**Coutant**] Recently, I assisted TVA in its responses to SACE Contention 7 related to aquatic ecological impacts of WBN Unit 2. As an outside reviewer in this context, I provided an objective peer review of the studies proposed and conducted by TVA. Peer review is a traditional and essential part of the scientific and assessment process. It involves consultation with another person with appropriate technical expertise to ensure that the study's purpose is adequately defined, a plan is adequately developed,

methods are appropriate, implementation satisfactory, and the reporting fair and thorough without unwarranted extrapolations beyond the data. Peer review is required by scientific journals before publication of research. Most governmental agencies now require or recommend peer review of programs and resulting reports.

15. [**Coutant**] I have also advised TVA in the conduct of certain updated studies deemed necessary by SACE, and I assisted with development of study plans that were responsive to the deficiencies alleged by SACE and its expert. Together with TVA staff, I reviewed assertions by SACE in Contention 7 and by Dr. Young in his supporting affidavit[2] to ensure that the points raised therein would be addressed by TVA in its planned studies and analyses. Plans for the field and assessment studies were discussed, prepared in written form by the most cognizant TVA staff, reviewed both internally and by myself, modified as needed, and approved for implementation. I reviewed the raw data as it was developed and commented on draft reports along with internal peer reviewers. I concur with the findings presented in each of the resulting reports, which are described herein at Section V.

16. [**Coutant**] With respect to this Joint Affidavit, I prepared those sections that pertain to aquatic survey methodology, particularly to the extent that the studies described herein were designed or revised to be responsive to concerns raised by SACE and its expert. I also assisted in the preparation of those sections that discuss the findings of these surveys. A copy of my resume is attached to this Joint Affidavit as TVA Attachment 21.

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[2] Declaration of Shawn Paul Young, PH.D. (July 11, 2009) ("Young Affidavit").

17. [**Paul Neil Hopping**] My name is Paul Neil Hopping. I currently work as a technical specialist in the River Operations business unit of TVA. Overall, I have 23 years of experience with TVA. In the first 7 years, I participated in the analysis and design of treatment systems for improving the quality of water in rivers located immediately downstream of TVA projects containing hydropower releases. In the past 16 years I have been responsible for assisting TVA in maintaining compliance with regulations concerning the flow and temperature of water entering and exiting thermal power plants owned and operated by the corporation.

18. [**Hopping**] With respect to the environmental review for WBN Unit 2, I participated in performing water quality analyses for the 2007 FSEIS. In particular, I was responsible for assisting with analyses related to the hydrothermal impact of the plant on the Tennessee River. I wrote the initial draft of the sections of the FSEIS that discuss these results. I also have assisted TVA in providing hydrothermal-related responses to requests for additional information ("RAIs") received from the U.S. Nuclear Regulatory Commission ("NRC").

19. [**Hopping**] Recently, I have assisted TVA in providing responses for SACE Contention 7, primarily in providing information about the historical and expected changes in the flow and temperature of the water entering and exiting the nuclear plant, and assisting with discussions related to the operation of the plant blowdown system and the supplemental condenser cooling water ("SCCW") system. I provided assistance in the field surveys that were conducted in the spring and summer of 2010, to evaluate the impact of the thermal effluent released to the Tennessee River from the WBN SCCW system. In these studies I was responsible for scheduling the

desired operating conditions of the nuclear plant and the river, and for collecting data and conducting measurements for water temperature and flow. Other recent, related experience includes participation in the environmental reviews for (hydrothermal aspects):

- Restart of Browns Ferry Nuclear Unit 1,
- Uprate of Browns Ferry Nuclear Units 2 and 3,
- License extensions for Browns Ferry Units 1, 2, and 3,
- Combined License Application for Bellefonte Units 3 and 4,
- Completion of a single unit at the Bellefonte Nuclear site, and
- License Extensions for of Sequoyah Nuclear Units 1 and 2, and
- Hydrothermal field surveys in support of NPDES permit renewals at the Browns Ferry, Sequoyah, and Watts Bar Nuclear Plants.

In addition, I also am responsible for assisting in the operation and maintenance of instrumentation systems that are used by TVA nuclear plants for monitoring compliance to regulatory limits for river water temperature, and the operation and maintenance of water temperature decision support systems that are used by TVA to help make day-to-day operating decisions in regard to thermal compliance.

20. [**Hopping**] I graduated from Purdue University with a Bachelor's Degree in 1975 and a Master's Degree in 1976, both in Civil Engineering. My primary emphasis of study was water resources engineering. Following graduation, I worked for about 7 years for a distinguished engineering firm in Chicago, Illinois (now Montgomery Watson Harza ("MWH")), where I was responsible for performing hydraulic analyses for a variety of water resources projects. In this role I became heavily involved in the

design of aeration devices. In 1988, I completed a PhD Degree in Civil and Environmental Engineering from the University of Wisconsin-Madison. My dissertation involved the development of numerical models for predicting the behavior of air/water mixtures in open channels, a topic beneficial to my initial responsibilities at TVA. Overall, my expertise includes the solution of problems in environmental fluid mechanics and thermodynamics; the flow in pumps, turbines, closed conduits, rivers, and reservoirs; and the flow of air/water mixtures and waterborne debris. Fundamental skills to understand and solve these problems include the development of mathematical models and design of field surveys and laboratory experiments.

21. [**Hopping**] With respect to this Joint Affidavit, I prepared those sections that pertain to the thermal effects of operation of WBN on the river in the vicinity of WBN. I helped design the Hydrothermal Study to respond to SACE's Contention 7. I also managed the survey and data collection associated with that study, as well as the resulting analysis. Accordingly, I have helped prepare Section V.G of this Affidavit, as well as portions of the overview at Section IV. A copy of my resume is attached to this Joint Affidavit as TVA Attachment 22.

II. PURPOSE OF THE AFFIDAVIT

22. [**All**] The purpose of this affidavit is to: (a) describe the existing aquatic environment at the WBN vicinity; (b) explain the intake and discharge systems and the corresponding cooling water demands and hydrothermal effects of the operation of WBN Unit 1, and how they will change under operation of both WBN Units 1 and 2; (c) describe the methodology and results of the various aquatic and thermal studies

conducted by TVA directly in response to SACE's Contention 7; and (d) demonstrate that any alleged deficiencies or omissions cited by SACE in Contention 7 have been addressed or cured by the various studies described herein.

III. OVERVIEW OF THE AQUATIC ENVIRONMENT IN THE WBN VICINITY

23. **[J. Baxter / Coutant]** The Tennessee River System is approximately 650 miles long and is comprised of riverine and lacustrine environments. The many dams on the system, most of which have been in place since the 1940s, create a series of reservoirs, affecting aquatic habitats required for fish feeding and reproduction. The Tennessee River is also host to numerous industrial facilities.

24. [**J. Baxter / Coutant**] Watts Bar Nuclear Plant ("WBN"), which includes Units 1 and 2, is located in Rhea County, Tennessee, on the west bank of the Tennessee River, in the upper Chickamauga Reservoir at Tennessee River Mile ("TRM") 528.[3] WBN is located approximately 1.9 miles downstream of Watts Bar Dam, which was completed in 1942 and impounds Watts Bar Reservoir. Located between Watts Bar Dam and WBN, approximately one mile upstream of WBN, is the Watts Bar Fossil Plant, now decommissioned. Chickamauga Dam, which was completed in 1940 and impounds Chickamauga Reservoir, is downstream of WBN at TRM 471.

25. [**J. Baxter / Coutant**] The reservoirs created by the many Tennessee River impoundments each have a unique environment, are subjected to a unique set of stressors or impacts, and are host to certain aquatic species. Although the river system as a whole may be "the single most biologically diverse river system for

[3] *See* 2007 FSEIS at 1.

aquatic organisms in the United States,"[4] each reservoir is not host to all species found in the entire system. Moreover, very few of the aquatic species endemic to the Tennessee River System are found in Tennessee River reservoirs, as these species prefer lotic or unimpounded environments.

26. [**J. Baxter / Coutant**] Likewise, although the Tennessee River System is host to a number of species listed for federal protection or candidates for listing, only a subset of those species are aquatic, and an even fewer number are found in reservoir environments. For example, SACE's expert, Dr. Young, noted, citing TVA's *Energy Vision 2020*, that the Tennessee River System is host to 100 species listed for federal protection and 380 species that are candidates for listing.[5] Yet only six federally-listed aquatic species (five mussels and one fish) and one mussel species proposed for listing are known from recent records to be found in the vicinity of WBN.[6] While all of these species have been found in the Chickamauga Reservoir, the reservoir is not the primary or preferred habitat for these species. Indeed, neither the U.S. Fish and Wildlife Service nor the National Oceanic and Atmospheric Administration has designated any critical habitat in the vicinity of the WBN site.[7] In short, although the entire mainstem Tennessee River system, encompassing a drainage area of approximately 41,000 square miles, is host to a number of species and habitats, the habitat of the Chickamauga Reservoir in the WBN vicinity is far more limited.

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4 Young Affidavit at 5.

5 Young Affidavit at 6.

6 *See* NUREG-0498, Supp. 2, Draft Final Environmental Statement Related to the Operation of [WBN] Unit 2, at 2-58 to 2-61 (Oct. 2011), *available at* ADAMS Accession No. ML112980199 ("Draft SFES"); *see also* Att. 23, Final Environmental Impact Statement Vol. 1, Ch. 4, TVA Natural Resource Plan: Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, and Virginia (2011).

7 *See* Draft SFES at 2-62.

IV. DESCRIPTION OF PHYSICAL EFFECTS OF OPERATION OF WBN UNITS 1 AND 2 ON THE AQUATIC ENVIRONMENT IN THE WBN VICINITY

27. [**All**] WBN Unit 1, a Westinghouse pressurized water reactor, began full commercial operation on May 27, 1996, and is designed for a net electrical output of 1160 megawatts ("MW") and a gross electrical output of 1218 mw. At the time WBN Unit 1 began operation, the surrounding aquatic environment had existed as a reservoir for more than five decades.

28. [**Hopping**] WBN Unit 1 was originally designed to operate solely in a closed cycle cooling mode via the Condenser Cooling Water ("CCW") system, which uses one cooling tower for heat dissipation. In closed cycle operation, nearly all of the blowdown from the cooling tower is discharged through multiport diffusers located on the bottom of the main channel of the Tennessee River at TRM 527.9.[8] Discharges from the diffusers are regulated by a National Pollution Discharge Elimination System ("NPDES") permit issued to TVA by the State of Tennessee.[9] The NPDES permit allows discharges from the diffusers only when the release from Watts Bar Dam is greater than or equal to 3500 cubic feet per second ("cfs"). For periods when the release from Watts Bar Dam is below 3500 cfs, the diffusers must be closed. To accommodate these periods, the blowdown is diverted and temporarily stored in a holding pond that is provided on the WBN site. Under normal operating conditions, water in the holding pond is ultimately discharged to the river through the

[8] *See* Att. 17, NPDES Permit No. TN0020168, at R-2 to R-4 (June 4, 2010).

[9] *See, e.g.*, *id*.

multiport diffusers, when the flow from Watts Bar Dam returns to levels at or above 3500 cfs.[10]

29. [**Hopping**] After TVA began operation of WBN Unit 1, evaluations revealed that a supplemental cooling system would increase the efficiency of the plant. Accordingly, in 1998, TVA applied to the State of Tennessee for a modification of the WBN NPDES permit to allow the use of a Supplemental Condenser Cooling Water ("SCCW") system.[11] The Tennessee Water Pollution Control Division approved that request on July 16, 1999, TVA notified the NRC of this change on August 10, 1999, and it began use of the SCCW system that year.[12] The SCCW system is purely supplemental, meaning that it can be removed from service without interrupting WBN operation, although in most cases, doing so would result in a lower power output from the plant. The SCCW is described in more detail in the following sections on cooling water intake and discharge.

30. [**Hopping**] In conjunction with its application for operation of WBN Unit 2, TVA applied to the State of Tennessee again to amend the WBN NPDES permit. The Tennessee Water Pollution Control Division approved that request and issued a new NPDES permit for the operation of WBN Units 1 and 2 on June 30, 2011, revised

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10 *See* Att. 17, at R-2 to R-4.

11 *See* Att. 24, Letter from P.L. Pace, TVA to NRC, [WBN] – [NPDES] Permit Number TN0020168, at 1 (Aug. 10, 1999).

12 *See id*.

again on August 31, 2011.[13] (TDEC subsequently corrected printing errors on several pages, and reissued those pages on October 11, 2011.)[14]

A. The Intake Systems

31. [**Hopping / D. Baxter**] Whether one unit is in service or both units, in closed mode operation (*i.e.*, without the SCCW system), all the raw water needed for WBN operation is obtained from the Chickamauga Reservoir by the plant intake pumping station ("IPS"). The IPS is located at TRM 528, approximately 1.9 miles downstream of Watts Bar Dam, and is connected to the reservoir by an artificial intake channel.[15] The IPS includes two pump bays, each with two gated openings, the four of which together create a gross flow area of approximately 360 ft^2 approaching the traveling water screens.[16] Outside of the gated openings, at the entrance of the IPS, the water resides in the intake channel as a free surface flow. At this location, the width of the intake openings is larger, and the height of the flow area depends on the pool level in Chickamauga Reservoir. Inside of the gated openings, the flow expands into an open wet well containing the traveling water screens. The height of the water in the wet well again depends on the pool level in Chickamauga Reservoir. The width of the flow, however, contracts to pass through the individual baskets of the traveling water screens. Furthermore, the overall area of flow through the traveling water screens is reduced by the size of the support members and wire mesh for the screens.

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13 *See* Att. 18, NPDES Permit No. TN0020168 (Aug. 31, 2011).

14 *See* Att. 25, V. Janjic, TDEC, to Travis Markum, TVA, NPDES Permit No. TN0020168 (Oct. 11, 2011).

15 *See* Att. 18, at R-2.

16 *See id*.

32. [**Hopping / D. Baxter**] For operation of WBN Unit 1 alone, the maximum average water velocity at the entrance of the IPS is approximately 0.17 feet per second ("fps") at summer pool levels and 0.18 fps at winter pool levels.[17] The maximum average velocity in the gated openings approaching the traveling water screens at the summer and winter levels is 0.40 and 0.37 fps, respectively.[18] The maximum average velocity through the traveling water screens is approximately 0.62 fps at summer pool levels and 0.67 fps at winter pool levels.[19] These values assume that all of the intake flow is drawn exclusively from only one of the two available IPS pump bays. In reality, TVA draws water from both bays, which results in lower intake velocities. Accordingly, the intake water velocities presented in this paragraph are conservative.

33. [**Hopping / D. Baxter**] The average volumetric flow rate at the IPS for operation of WBN Unit 1 is approximately 73 cubic feet per second ("cfs") at summer pool levels and 68 cfs at winter pool levels.[20] Because the long term average river flow is approximately 27,000 cfs, the IPS intake flow rate represents just 0.3% of the average flow past the plant.[21]

34. [**Hopping / D. Baxter**] As noted above, TVA supplemented the CCW system with the SCCW in 1999. The SCCW provides additional cooling water via gravity flow

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17 *See* Att. 15, Fish Impingement at [WBN] [IPS] Cooling Water Intake Structure During March 2010 Through March 2011, at 1 (Mar. 2011, Revised Apr. 2011).

The flow rates cited in this paragraph and throughout this section are described in TVA's revised Impingement Study, issued in April 2011. That version updates values provided in TVA's other studies and its FSEIS.

18 *See id*.

19 *See id*.

20 *See id*.

21 *See id*.

from an intake structure located at TRM 529.9, which is immediately upstream of Watts Bar Dam.[22] Because this system operates based on gravity flow, the amount of water entering the SCCW depends primarily on the elevation of the water at the intake point, that is, behind Watts Bar Dam. The average flow rate through the SCCW *intake* conduit is approximately 269 cfs.[23]

35. [**Hopping**] WBN Unit 2 shares the same intake structures with Unit 1. The additional operation of WBN Unit 2 in combination with Unit 1 will result in inconsequential changes on the demands of the cooling water intake system. Dr. Young claimed that TVA is inconsistent in its representation of the change of intake volume and flow rate that will result from combined operation of WBN Units 1 and 2.[24] In support, he cites to TVA's explanations in its 2007 FSEIS that water intake for dual operation would increase, but that the SCCW intake volume and flow rate will not change.[25] This is not an inconsistency; rather, as explained in the following paragraphs, both are correct.

36. [**Hopping**] Because the flow through the SCCW intake conduit is driven by gravity, the additional operation of WBN Unit 2 will not significantly affect SCCW intake volumes or flow rates. This is because, under dual unit operation, there will be no changes in the size of any of the SCCW conveyance structures (*e.g.*, intake or discharge conduits), or the water level at the entrance of the SCCW intake conduit (*i.e.*, water level in Watts Bar Reservoir). Because of the addition of flow through the

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22 *See* 2007 FSEIS at 21.

23 *See id.* at 137.

24 Young Affidavit at 11.

25 *See id*.

Unit 2 cooling tower, however, the water level in the Unit 2 cooling tower basin will be slightly higher under dual unit operation. This, in turn, will reduce the "head" difference between Watts Bar Reservoir and the Unit 2 cooling tower basin, and subsequently *reduce* the flow rate through the SCCW intake. To provide a conservative assessment of the environmental impact, the 2007 FSEIS for WBN Unit 2 assumed that the SCCW flow will remain unchanged, rather than be reduced, by the startup of the second unit. (The NRC Staff, on the other hand, in the Draft Final Environmental Statement (Related to the Operation of [WBN] Unit 2) ("SFES"), accounted for the reduced flow under dual unit operation.)[26] Because there will be no significant change (*i.e.*, increase) in the SCCW intake flow rate, there also will be no significant change in the SCCW intake velocity.

37. [**Hopping**] For the plant IPS, which uses the CCW intake channel, dual unit operation will change the average flow rate, but not the maximum intake velocities. This is because the IPS contains additional intake openings to accommodate additional intake flow that will result under dual unit operation. The following table[27] shows the changes in the maximum average CCW intake velocities and flow rates expected for dual unit operation:

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[26] *See* Draft SFES at 3-7.

[27] The referenced table depicts values established in TVA's Impingement Study. *See* Att. 15, at 1.

	Summer Pool (681 msl)		Winter Pool (677 msl)	
	Unit 1 Only	Units 1 and 2 Combined	Unit 1 Only	Units 1 and 2 Combined
Maximum Average Velocity at Entrance of IPS	0.17 fps	0.17 fps	0.18 fps	0.18 fps
Maximum Average Approach Velocity Entering Wet Well for Traveling Water Screens	0.40 fps	0.40 fps	0.37 fps	0.37 fps
Maximum Average Through-Screen Velocity	0.62 fps	0.62 fps	0.67 fps	0.67 fps
Maximum Average Flow rates	73 cfs	134 cfs	68 cfs	113 cfs
Percent Hydraulic Entrainment*	0.3%	0.5%	0.3%	0.4%

* Percent hydraulic entrainment is based on a long term average river flow past WBN of 27,000 cfs.

38. [**Hopping / Coutant**] Irrespective of the increase in flow rate over that for Unit 1 operation alone, the increased demands on the water source are *de minimis*. In fact, on an average annual basis, this represents a change of only a few tenths of one percent in the amount of water from the Chickamauga Reservoir that is diverted to the WBN. The percent hydraulic entrainment under dual unit operation, at most about 0.5%, is still ten times smaller than EPA's performance standard of 5%, which EPA established in its 2001 rulemaking implementing Section 316(b) of the Clean Water Act for new facilities that use water from rivers, streams, lakes, and reservoirs for cooling purposes.[28]

[28] *See* National Pollutant Discharge Elimination System: Regulations Addressing Cooling Water Intake Structures for New Facilities, 66 Fed. Reg. 65,256, 65,277 (Dec. 18, 2001); 40 C.F.R. § 125.84.

In addition, this performance standard has also been cited by the NRC in its Final Environmental Impact Statement ("FEIS") for the Vogtle Early Site Permit. *See* Att. 26, NUREG-1872, Final Environmental Impact Statement for an Early Site Permit (ESP) at the Vogtle Electric Generating Plant Site § 5.4.2, at 5-

B. Discharges and Outfalls

39. [**Hopping**] For closed mode operation, makeup water for the CCW system enters the plant via the IPS, described above, and heat is intermittently dissipated to the Tennessee River by the cooling tower blowdown system. Blowdown water is returned to the Tennessee River through multiport bottom diffusers, which are located 2.0 miles below Watts Bar Dam at TRM 527.9.[29] This discharge point is identified as Outfall 101 in TVA's NPDES permit.[30] As emphasized above, blowdown may only be discharged when the release from the Watts Bar Dam is at least 3500 cfs, to ensure adequate dilution of the plant discharge.[31] When the release from Watts Bar Dam drops below 3500 cfs, the release through the multiport diffuser is suspended and the blowdown water is temporarily stored in the holding pond.[32]

40. [**Hopping**] The diffuser system consists of two pipes extending into the main channel of the Tennessee River.[33] The hourly temperature of the discharge from Outfall 101 varies, from approximately 17°C in January to approximately 35°C in July, depending on river flow conditions and WBN operating conditions.[34]

41. [**Hopping**] WBN Unit 2 shares discharge outfalls with Unit 1. The NPDES permit for operation of WBN Units 1 and 2 specifies a daily average discharge temperature

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30 (Aug. 2008) (also noting, with respect to through-screen velocity, that EPA determined that species and life stages evaluated in various studies could endure a velocity of 1.0 fps).

29 *See* Att. 18, at R-3.

30 *See id.* at 1.

31 *See id.* at 2.

32 *See id.* at R-3.

33 *See* Att. 13, Aquatic Environmental Conditions in the Vicinity of [WBN] During Two Years of Operation, 1996-1997, at 4 (June 1998, Revised June 7, 2010).

34 *See id*.

limit of 35°C for Outfall 101.[35] This limit is unchanged from the NPDES permit for WBN Unit 1.[36] Although the operation of Unit 2 will result in the discharge of additional heat from Outfall 101, the NPDES temperature limit of 35°C must still be met and, therefore, the thermal discharge for dual unit operation will not adversely impact the aquatic environment.

42. [**Hopping**] Under normal operating conditions, the aforementioned holding ponds discharge water via the diffuser system described above. The holding ponds also contain an emergency overflow weir that is available to deliver water to a local channel, which is connected to the Tennessee River at TRM 527.2.[37] TVA's NPDES permit allows use of this outfall, which it identifies as Outfall 102, only under emergency situations.[38] Even then, the NPDES permit limits the temperature of discharged waters to 35°C and requires that TVA make every effort to use this outfall only when the flow of the receiving waters meets or exceeds 3500 cfs.[39] Again, these permit conditions are unchanged from the NPDES permit for WBN Unit 1.[40] Since Unit 1 began operation in 1996, WBN has never experienced an unexpected recordable discharge from the holding ponds to the Tennessee River.

43. [**Hopping**] The SCCW system relies on an additional discharge point. The inflow from the SCCW mixes with CCW flow within WBN, but because the SCCW inflow

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35 *See* Att. 18, at 1.

36 *See* Att. 2, History of Watts Bar Unit 2 Reactivation at 1 (Apr. 1, 2011), http://www.nrc.gov/infofinder/reactor/wb/watts-bar/history.html (pagination is from PDF printout).

37 *See* Att. 18, at R-3.

38 *See id.* at 4.

39 *See id.* at R-12.

40 *See* Att 17 at 2-3.

exceeds the capacity of the blowdown conduits and Outfall 101 diffusers, the SCCW system includes a separate discharge structure to provide releases to Chickamauga Reservoir at TRM 529.2, which is approximately 0.7 miles downstream of Watts Bar Dam and 1.2 miles upstream of WBN.[41] This discharge structure includes the CCW outfall for the now decommissioned Watts Bar Fossil Plant. The discharge structure is capable of releasing roughly the same amount of flow that the SCCW intake structure accepts. The average flow through the SCCW outfall is approximately 200 cfs, and the maximum flow, by design, is not expected to exceed about 365 cfs.[42] Because the SCCW system operates based on gravity flow, the amount of water entering and exiting the SCCW system depends primarily on the elevation of the water behind Watts Bar Dam, which will not be affected by the additional operation of WBN Unit 2.

44. [**Hopping**] The SCCW discharge structure is identified as Outfall 113 in the WBN NPDES permit.[43] The NPDES permit for operation of WBN Units 1 and 2 specifies a discharge temperature limit for Outfall 113 based on protection of the aquatic environment in the receiving water.[44] The permit states that for the edge of the mixing zone for the outfall, the maximum temperature shall not exceed 30.5°C, except when the upstream temperature approaches or exceeds this value by natural causes.[45] The permit also specifies that the temperature rise at the edge of the mixing

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41 *See* Att. 18, at R-4.

42 *See* 2007 FSEIS at 24. Note that this is smaller than the average *intake* flow through the SCCW, as a result of evaporation.

43 *See* Att. 18, at 7.

44 *See id.*

45 *See id.* at 7, 10-11.

zone shall not exceed 3°C relative to an upstream control point,[46] and that the temperature rate of change for waters outside the mixing zone not exceed 2°C per hour.[47] The NPDES permit also limits the temperature in the receiving stream bottom at the SCCW outlet to 33.5°C.[48] This value historically has not been approached. These permit conditions are again unchanged from those in the NPDES permit for operation of Unit 1.[49] Accordingly, although operation of Unit 2 will likely result in the discharge of additional heat from Outfall 113, the NPDES temperature limits must still be met and, therefore, thermal discharge for dual unit operation will not adversely impact the aquatic environment.

V. DESCRIPTION OF THE STUDIES AND ANALYSES CONDUCTED BY TVA DIRECTLY IN RESPONSE TO SACE'S CONTENTION 7

45. [**All**] In Contention 7, SACE claimed that TVA's conclusion regarding the cumulative impacts of operation of WBN Unit 2 on aquatic ecology is not adequately supported.[50] SACE alleged that TVA's aquatic studies were deficient or outdated, and charged that TVA "understates the potential impacts of the coolant intake system (*i.e.*, entrainment and impingement) and the thermal impacts of the coolant discharge system on fish and benthic organisms, by relying on poor and outdated data, distorted interpretations of data, and assumptions and extrapolations in lieu of recent monitoring studies."[51] In support of SACE's contention, Dr. Young identified certain

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46 *See id*.

47 *See id*.

48 *See id.* at 7.

49 *See* Att. 17 at 5, 7-8.

50 *See* Petition at 31.

51 *See id.* at 33.

alleged deficiencies in TVA's fish and mussel data, and proposed ways in which TVA should evaluate the effect of Unit 1 operation on fish and mussel communities.[52] Specifically, Dr. Young questioned whether TVA accurately characterized the health of the aquatic environment, and cited values from TVA's Vital Signs monitoring program and fish species occurrences surveys.[53] He also raised concerns with TVA's entrainment and impingement estimates, and stated that TVA should undertake additional *actual* entrainment and impingement monitoring.[54] Finally, Dr. Young claimed that TVA should conduct hydrothermal studies to model the thermal effects of WBN operation on the aquatic community, and identified certain elements of such a study that he believed to be important.[55]

46. [**All**] We reviewed all of the concerns raised by SACE in Contention 7 and Dr. Young's supporting Affidavit regarding the alleged deficiencies in TVA's aquatics studies. In direct response to those concerns, we assisted TVA in the design, coordination, and conduct of a series of aquatic and hydrothermal studies to address the specific issues raised by SACE and Dr. Young. In some cases, TVA revised or corrected an existing study to address alleged problems identified by Dr. Young. In other cases, TVA designed and conducted entirely new studies to address Dr. Young's claims that TVA relied on deficient or outdated information. In this section, we describe the purpose, methodology, and findings of each of these studies, and how

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52 *See* Young Affidavit at 6-19.

53 *See* Young Affidavit at 6-8.

54 *See* Young Affidavit at 10-16.

55 *See* Young Affidavit at 16-19.

these studies resolve or cure all of the alleged deficiencies in TVA's aquatics studies identified by SACE and Dr. Young.

A. Comparison of Fish Species Occurrence and Trends in Reservoir Fish Assemblage Index Results in Chickamauga Reservoir Before and After WBN Unit 1 Operation (June 2010) ("RFAI Study")

47. [**D. Baxter / Coutant**] In his 2009 Affidavit in support of SACE's Contention 7, Dr. Young challenged TVA's assertions that the fish community health in the WBN vicinity is "good."[56] Specifically, Dr. Young challenged the conclusions that TVA drew from Reservoir Fish Assemblage Index ("RFAI") data, which TVA provided in its 2007 FSEIS.[57] Dr. Young alleged that the health of the fish community was *not* good, and for support compared a pre-operational (1993) RFAI score of 52 to an operational (2005) RFAI score of 42.[58] In 2010, TVA conducted a new study to respond to the issues raised by Dr. Young, as well as the more general claim in SACE's Contention 7 that TVA relies on poor and outdated data in lieu of recent monitoring studies.[59] In particular, this new study: (1) provides a detailed explanation of RFAI methodology and its application to fish community evaluation; (2) compares fish community structure of Chickamauga Reservoir before and after operation of WBN Unit 1 using RFAI data; and (3) compares temporal differences in RFAI scores at the site within the WBN thermal discharge area and at other monitoring sites within Chickamauga Reservoir from 1993 to 2008.[60]

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56 *See* Young Affidavit at 6-8; 2007 FSEIS at 55, Tbl. C-3.

57 *See* Young Affidavit at 6.

58 *See* Young Affidavit at 6 (*citing* 2007 FSEIS Tbl. C-3).

59 *See* Att.9, Comparison of Fish Species Occurrence and Trends in Reservoir Fish Assemblage Index Results in Chickamauga Reservoir Before and After [WBN] Unit 1 Operation (June 2010); Petition at 33.

60 *See* Att. 9, at 1.

i. Summary of Methodology

48. [**D. Baxter / Coutant**] RFAI methodology was implemented at WBN beginning in 1993, as a part of TVA's Vital Signs monitoring program.[61] The Vital Signs program, which began in 1990, was initiated by TVA in the Tennessee River System in order to evaluate ecological health conditions in major Tennessee River reservoirs.[62] The RFAI is one of five indicators used in the Vital Signs program.[63] TVA designed this index based on industry standards for biological indices, and the Tennessee Department of Environmental Conservation ("TDEC") and the EPA deem this type of survey method appropriate for reservoirs like Chickamauga, as evidenced by TDEC's and EPA's ongoing acceptance of TVA's use of this index.

49. [**D. Baxter / Coutant**] Reservoirs are typically divided into three zones for Vital Signs monitoring: inflow, transition, and forebay.[64] The inflow zone is in the upper reaches of the reservoir and is riverine in nature.[65] The transition zone is the area where water velocity decreases due to larger cross sectional area.[66] The forebay is the lacustrine area near the dam.[67]

50. [**D. Baxter / Coutant**] To support the Vital Signs monitoring program, TVA has conducted fish sampling in the Chickamauga Reservoir each year, beginning in 1993. TVA has conducted fish sampling in the Chickamauga Reservoir inflow zone, TRM

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61 *See id*.

62 *See id*.

63 *See id*.

64 *See id*. at 3.

65 *See id*.

66 *See id*.

67 *See id*.

529.0 to 526.3, which is immediately downstream of Watts Bar Dam and in the vicinity of WBN thermal discharge.[68] Because the WBN thermal discharge is in the inflow zone, no upstream data are available as controls or for comparison.[69] Nevertheless, TVA has also conducted fish sampling upstream of Watts Bar Dam at TRM 531, in order to document any notable changes in Tennessee River ecological conditions.[70] Because Watts Bar Dam is between these two sampling sites, values derived from the upstream sampling site cannot be used for direct comparison with values derived from the sampling site in the WBN vicinity.[71] TVA has also conducted sampling far downstream of WBN in the Chickamauga Reservoir, at TRM 490.5, 482.0, and 472.3.[72] These sites are also not appropriate for direct comparison with the WBN site because of their distance from the site and because they represent transition and forebay zones, but they do provide a useful reflection of long term changes in the Tennessee River ecology.

51. [**D. Baxter / Coutant**] TVA conducted sampling in the WBN vicinity by boat electro-fishing.[73] Fish collected were identified by species, counted, and examined for anomalies such as disease, deformations, or hybridization.[74] The resulting data

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68 *See id.* at 3-4.

69 *See id.* at 4.

70 *See id*.

71 *See id.*

72 *See id.* at 4, Tbl. 4.

73 *Id.* at 4.

74 *Id.* at 5.

were analyzed using RFAI methodology, which, as noted previously, is consistent with reservoir survey methodology approved by TDEC and EPA.[75]

52. [**D. Baxter / Coutant**] RFAI methodology uses 12 fish community metrics from four general categories: Species Richness and Composition; Trophic Composition; Abundance; and Fish Health.[76] Together, these 12 metrics provide a balanced evaluation of fish community integrity. The individual metrics are shown below, grouped by category:

Species Richness and Composition

i. Total number of indigenous species: Greater numbers of indigenous species are considered representative of healthier aquatic ecosystems. As conditions degrade, numbers of species at an area decline.

ii. Number of centrarchid species: Sunfish species (excluding black basses) are invertivores and a high diversity of this group is indicative of reduced siltation and suitable sediment quality in littoral areas.

iii. Number of benthic invertivore species: Due to the special dietary requirements of this species group and the limitations of their food source in degraded environments, numbers of benthic invertivore species increase with better environmental quality.

iv. Number of intolerant species: This group is made up of species that are particularly intolerant of physical, chemical, and thermal habitat degradation. Higher numbers of intolerant species suggest the presence of fewer environmental stressors.

v. Percentage of tolerant individuals (excluding Young-of-Year): This metric signifies poorer water quality with increasing proportions of individuals tolerant of degraded conditions.

vi. Percent dominance by one species: Ecological quality is considered reduced if one species inordinately dominates the resident fish community.

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75 *See id*.

76 *See id.* at 5-6.

vii. Percentage of non-indigenous species: This metric is based on the assumption that non-indigenous species reduce the quality of resident fish communities.

viii. Number of top carnivore species: Higher diversity of piscivores is indicative of the availability of diverse and plentiful forage species and the presence of suitable habitat.

Trophic Composition

ix. Percentage of individuals as top carnivores: A measure of the functional aspect of top carnivores, which feed on major planktivore populations.

x. Percentage of individuals as omnivores: Omnivores are less sensitive to environmental stresses due to their ability to vary their diets. As trophic links are disrupted due to degraded conditions, specialist species such as insectivores decline, while opportunistic omnivorous species increase in relative abundance.

Abundance

xi. Average number per run (number of individuals): This metric is based upon the assumption that high quality fish assemblages support large numbers of individuals.

Fish Health

xii. Percentage of individuals with anomalies: Incidence of diseases, lesions, tumors, external parasites, deformities, blindness, and natural hybridization are noted for all fish measured, with higher incidence indicating less favorable environmental conditions.[77]

53. [**D. Baxter / Coutant**] For each metric, scores are given on a scale from 1 to 5, with a score of 5 indicating optimum health.[78] Because there are 12 metrics, RFAI scores range from 12 to 60.[79] The aquatic community health is indicated by the following ranges of scores: 12-21 ("Very Poor"), 22-31 ("Poor"), 32-40 ("Fair"), 41-50 ("Good"), or 51-60 ("Excellent"). The scoring criteria ranges were developed from

[77] *See id.* at 5-6

[78] *See id.* at 6-7.

[79] *See id.* at 8.

datasets collected in all Tennessee River reservoirs from 1993 to 2002, and therefore reflect expected or baseline values for Tennessee River reservoirs.[80]

54. [**D. Baxter / Coutant**] RFAI scores have an intrinsic variability of ±3 points.[81] This variability comes from various sources, including annual variations in air temperature and stream flow; variations in pollutant loadings from nonpoint sources; changes in habitat, such as extent and density of aquatic vegetation; natural population cycles and movements of the species being measured.[82] Another source of variability arises from the fact that nearly any practical measurement, lethal or non-lethal, of a biological community is a sample rather than a measurement of the entire population.[83] Therefore, as long as the RFAI score is within a 6-point range of the previous year's score (*i.e.*, ±3 for each score), there is no certainty that any real change has taken place beyond method variability.[84]

55. [**D. Baxter / Coutant**] RFAI methodology addresses all four attributes or characteristics of a Balanced Indigenous Population ("BIP"), which is required by the Clean Water Act.[85] Those attributes are: (i) diversity, (ii) capacity to sustain itself through cyclic seasonal changes, (iii) presence of necessary food chain species, and (iv) lack of domination by pollution tolerant species.[86] RFAI methodology also addresses other considerations for a BIP that are set forth in the implementing

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80 *See id.* at 7-8.

81 *Id.* at 10.

82 *Id*.

83 *Id*.

84 *Id*.

85 *See* 33 U.S.C. § 1326(a); 40 C.F.R. § 125.71(c).

86 *See* 40 C.F.R. § 125.71(c).

regulations for the Clean Water Act.[87] Accordingly, TVA can employ the RFAI results to determine maintenance of a BIP, that is, to determine whether the community is adversely affected by WBN. There are generally two approaches for this evaluation. The first is "absolute," in that it compares the RFAI scores and individual metrics to predetermined values.[88] The other is "relative," in that it compares RFAI scores attained downstream to the upstream control site.[89] Because in this case the upstream control site is above the Watts Bar Dam (*i.e.*, not within the Chickamauga Reservoir), the "relative" approach does not apply, and RFAI scores must be compared to predetermined values (*i.e.*, the scoring criteria identified above).

56. [**D. Baxter / Coutant**] In using the "absolute" approach, TVA uses two criteria to ensure a conservative screening of BIP. If an RFAI score reaches 70% (conservatively adjusted upward to include sample variability) of the highest attainable score of 60, or if fewer than half of the RFAI metrics receive a low (1) or moderate (3) score, then normal community structure and function are considered to be present, indicating that BIP is maintained.[90] Because 70% of 60 is 42, a score of 42 or higher is automatically considered to have BIP.[91] RFAI scores below 42 require a more in-depth look to see if BIP exists. For example, TVA determines whether one of the causes of variability is present and is artificially depressing the score, or whether fewer than half of the RFAI metrics received a low or moderate

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87 *See* 40 C.F.R. pt. 125, subpt. H, Criteria for Determining Alternative Effluent Limitations Under Section 316(a) of the Act.

88 Att. 9, at 8.

89 *Id*.

90 *Id.* at 8-9.

91 *See id.* at 9.

score. TVA may also find that if the previous year's score is not different by more than six points (*i.e.*, the range of RFAI variability), then BIP is maintained.

ii. Summary of Findings

57. [**D. Baxter / Coutant**] RFAI scores from the site downstream of the WBN thermal discharge have averaged 44 from 1996 to 2008, indicating that the aquatic health of that area is "good," even during WBN operation.[92] (Recall that scores ranging from 41 to 50 indicate "good" health.) Scores from every sample year (1993 to 2008) were at least 42, *i.e.*, 70% of the highest attainable score of 60, and it was determined that in every case, BIP had been maintained.[93] In addition, from one year to another, scores never changed by more than six points.[94] Accordingly, long term trends in RFAI scores indicate that overall fish community health, diversity, and structure has not declined in the vicinity of the WBN or throughout the Chickamauga Reservoir as a result of WBN operation.

58. [**D. Baxter / Coutant**] These long-term trends are a more reliable indication of reservoir health than are year-to-year variations. Consider Dr. Young's statement that the RFAI score declined from 1993 (52) to 2005 (42), for the area in the WBN vicinity.[95] Superficially, these data indicate decline. Dr. Young could have just as well cited, however, the change in RFAI scores in this same area from 1996 (42) to 2002 (48), which suggests an improvement in aquatic health.[96] In fact, there is a natural variation in fish communities that is seen throughout Tennessee River

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92 *See id.* Tbl. 4.

93 *See id*. at 9.

94 *See id.* Tbl. 4.

95 *See* Young Affidavit at 6-7.

96 *See* Att. 9, Tbl. 4.

reservoirs. RFAI scores regularly fluctuate over time. For example, TRM 490.5 (Chickamauga transition zone) – an area not affected by WBN thermal discharge – also exhibited these natural fluctuations. From 1993 to 1995, the RFAI score at TRM 490.5 dropped from 51 (1993) to 40 (1994) and then increased to 48 (1995).[97] From 2002 to 2004, the score dropped from 51 (2002) to 42 (2003) and then increased to 49 (2004).[98] Although scores naturally fluctuate, the area in the vicinity of WBN discharge has never scored below the "good" range, and BIP has been met every operational sample year. This long-term trend indicates that operation of WBN Unit 1 has not adversely affected overall fish community health, diversity, and structure in the Chickamauga Reservoir.

59. [**D. Baxter / Coutant**] In sum, this new study addresses concerns raised by Dr. Young and SACE that TVA relied on poor and outdated data, and inappropriately concluded that RFAI data support a finding that the aquatic community in the WBN vicinity is in "good" health. In response to claims that TVA relied on poor data, this study explains RFAI methodology, which is consistent with biological indices approved by TDEC and EPA. In response to claims that TVA relied on outdated data, this study reports pre-operational and operational RFAI values measured through 2008. Finally, in response to claims that TVA drew inappropriate conclusions based on RFAI scores, this study shows that although RFAI values fluctuate from year to year, long term trends irrefutably demonstrate maintenance of a BIP and "good" aquatic health in the WBN vicinity. TVA disclosed this study to

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97 *See id*.

98 *See id*.

SACE on July 15, 2010, and SACE and Dr. Young have not challenged the results of this study.[99] Accordingly, this study resolves issues regarding RFAI scores and the health of the aquatic community in the WBN vicinity raised in Contention 7.

B. Analysis of Fish Species Occurrences in Chickamauga Reservoir – A Comparison of Historic and Recent Data (Oct. 2010) ("Fish Species Occurrences Study")

60. [**D. Baxter / Coutant**] In Contention 7, SACE claims that TVA relies on inadequate and outdated data to form its conclusion that fish populations in the WBN vicinity are in good health, and has not taken steps necessary to evaluate how effluent from WBN may affect fish communities.[100] SACE also alleges that the fish community in the WBN vicinity is not in good health.[101] In support of this assertion, Dr. Young cited data from fish species occurrence surveys provided by TVA in its 1978 FEIS and 2007 FSEIS.[102] TVA specifically designed and conducted this new fish species occurrences study to respond to these claims by SACE and Dr. Young, relying on the results of the extensive fish sampling efforts conducted by TVA in Chickamauga Reservoir from 1947 to 2009.[103] This new study examines temporal changes in the fish species occurrences in Chickamauga Reservoir during this time period, with particular attention to differences between data obtained before and after operation of WBN Unit 1.[104]

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99 *See* TVA's Sixth Supplemental Disclosures at 8 (July 15, 2010), *available at* ADAMS Accession No. ML101960302.

100 *See* Petition at 33.

101 *See id.* at 32-33.

102 *See* Young Affidavit 7-8.

103 *See* Att. 10, Analysis of Fish Species Occurrences in Chickamauga Reservoir – A Comparison of Historic and Recent Data at 1 (Oct. 2010).

104 *See generally* Att. 10.

i. Summary of Methodology

61. [**D. Baxter / Coutant**] TVA has fish survey data for the Chickamauga Reservoir as far back as 1947 available for use to evaluate long term trends in fish species occurrences and the impact of operation of WBN on fish populations.[105] Different methods have been used to survey fish populations in Chickamauga Reservoir over the past 60 years, however, which must be considered in any long-term evaluation.[106] The following methods were among those used:

- Cove rotenone sampling (blocking off a cove in a reservoir and killing fish with a chemical to assess species occurrence and abundance) was conducted from 1947 to 1999 in Chickamauga Reservoir.[107]
- Gill nets were used from 1971 to 1994, and continue to be used in routine reservoir fisheries monitoring at various stations throughout Chickamauga Reservoir.[108]
- Hoop nets were used from 1977 to 1985.[109]
- Trap nets were used from 1971 to 1978.[110]
- Boat electro-fishing was conducted from 1977-1985 and 1991; from 1993 onwards, boat electro-fishing continues to be used in routine reservoir fisheries monitoring at various stations throughout Chickamauga Reservoir.[111]
- Fish impingement mortality sampling was conducted at various intervals and at various locations, including Sequoyah Nuclear Plant and WBN's CCW and SCCW intakes.[112]

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105 *See id.* at 1.

106 *See generally id.* at 1.

107 *See id.* at 4-5.

108 *See id.* at 5-6.

109 *See id.* at 6.

110 *See id*.

111 *See id.* at 7.

112 *See id*.

Accordingly, in analyzing the historical fish sampling data to prepare this report, consideration was given to these changes in sampling methodology, which may yield inconsistent results.[113]

62. [**D. Baxter / Coutant**] TVA compared the results of these extensive fish sampling efforts in the Chickamauga Reservoir to examine temporal changes in fish species occurrences.[114] In addition, TVA compared this data to data from similar areas in other mainstream Tennessee River reservoirs subject to similar conditions in order to understand widespread patterns across the Tennessee River system.[115] TVA also found it useful to compare data on certain species across different reservoirs to determine how these species perform in reservoirs generally.

63. [**D. Baxter / Coutant**] Dr. Young took issue with TVA's comparison of the WBN vicinity with other aquatic communities that he asserts are in "serious decline."[116] Accepting, *arguendo*, Dr. Young's characterization of other Tennessee River reservoir fish populations as being in a "serious decline," the comparison of those populations against the populations in the Chickamauga Reservoir does not render TVA's analysis unreasonable or inadequate. NEPA requires an analysis of the proposed action's impact on the subject ecosystem.[117] Analysis of the Chickamauga ecosystem in its present condition, and comparison with similar ecosystems subjected to similar industrial impacts, is therefore entirely appropriate. Indeed, EPA guidance

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113 *See generally id*.

114 *See id.* at 1.

115 *See id.* at 18-19.

116 Young Affidavit at 7.

117 *See* 40 C.F.R. § 1508.7.

on NEPA cumulative impacts analyses states that such analyses may make use of "a reference ecosystem that is *comparable* to the project area."[118]

ii. Summary of Findings

64. [**D. Baxter / Coutant**] TVA's review of extensive species occurrence data found that species occurrence and abundance in the Chickamauga Reservoir has changed over the period from 1947 to 2009.[119] TVA's analysis of the survey results found three reasons for this change. First, impoundment of the Tennessee River, which began in the 1930s and eliminated or reduced habitats required for life history aspects such as reproduction and feeding, is the major limiting factor for many of these species.[120] Second, most species that have not been collected in recent times have historically never been caught frequently or in large numbers in Chickamauga Reservoir.[121] Third, changes in survey methods account for some of the changes in findings of species occurrence and abundance.[122]

65. [**D. Baxter / Coutant**] Specifically, this study found that although certain aquatic species have not been found in the Chickamauga Reservoir in recent years, these species were rarely caught in the area historically and appear to be affected by impoundment of the Tennessee River System, rather than operation of WBN.[123] Of the 83 valid species records obtained during TVA fish sampling in Chickamauga

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118 Att. 27, EPA-315-R-99-002, Consideration of Cumulative Impacts in EPA Review of NEPA Documents at 16 (May 1999), *available at* http://www.epa.gov/compliance/resources/policies/nepa/cumulative.pdf (emphasis added).

119 *See* Att. 10, at 17-19.

120 *See id.* at 19, 21.

121 *See id*. at 21

122 *See id.* at 19.

123 *See id*.

Reservoir from 1947 to 2009, six have not been encountered in Chickamauga Reservoir since the 1970s (*i.e.*, before operation of WBN), four have not been encountered since the 1980s (*i.e.*, before operation of WBN), and 16 have not been encountered since the 1990s (*i.e.*, partially before operation of WBN).[124] Of those not encountered in the 1990s, five are non-native.[125] Twenty one native species have not been collected from 2000 to 2009.[126] Of those, five are most adapted to medium or large free-flowing rivers, one is catadromous and has been severely affected by the series of dams that impede its migration, and five are not as susceptible to current collection methods or they occur only sporadically throughout the upper Tennessee River system.[127] Furthermore, ten of the 21 native species not collected during recent times have only been collected in rotenone or impingement samples, indicating that current sampling methods are not effective in documenting the presence of these species.[128] As a result, although fish population surveys conducted over the last 60 years document a change in species occurrence, there is no basis on which to conclude that the change was the result of the relatively recent operation of WBN Unit 1.

66. [**D. Baxter / Coutant**] Indeed, changes in fish species occurrences cannot be assumed to be the result of operation of WBN Unit 1. In his Affidavit in support of Contention 7, Dr. Young compared sampling period 1991 to 1996 with sampling period 1970 to 1973, and concluded that the number of species of freshwater fish

124 *Id.* at 20.

125 *Id*.

126 *Id*.

127 *Id*.

128 *Id*.

declined 24%.[129] Although it appears that Dr. Young misinterpreted the data, even if taken as true, Dr. Young's comparison cannot support a conclusion that operation of WBN Unit 1 has resulted in a decrease of fish species. As an initial matter, WBN Unit 1 did not begin full operation until May 1996, which represents the very tail end of the timeframe referenced by Dr. Young. Therefore, his comparison, at least as it relates to operation of WBN Unit 1, is inherently flawed. Furthermore, survey frequencies, methodologies, and locations differed between these collection times and prohibit direct comparisons.[130] For example, certain sampling methods, such as trap nets, boat electrofishing, and cove rotenone that were used in the period of 1970 to 1973 were no longer employed or were not consistently employed in the later period of 1991 to 1996.[131] Therefore, even if this downward trend in data existed as recognized by Dr. Young, it would not be an indication of the effects of operation of WBN Unit 1. Furthermore, any actual decline in fish species occurrence, if one exists, likely represents the effects of impoundment of the Tennessee River decades before operation of WBN, given that many native species do not thrive in reservoir environments.

67. [**D. Baxter / Coutant**] TVA conducted this study in order to respond to claims by SACE and Dr. Young that TVA relies on poor and outdated data to draw conclusion about the health of fish populations in the WBN communities, and that TVA has not attempted to evaluate the impact of WBN operation on fish communities. This study analyzes extensive historic and recent data about fish species in the WBN vicinity,

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129 *See* Young Affidavit at 7.

130 *See* Att. 10, at 2-4.

131 *See id.* at 1-3.

including data from before and after WBN operation, to understand the impact of WBN operation on the fish community. TVA disclosed this study to SACE on November 15, 2010, and SACE has not challenged the methodology or results of this study.[132] Accordingly, this study resolves Contention 7 to the extent that the contention claims that TVA relies on outdated data for fish community health and has not attempted to evaluate the impact of WBN operation on the fish community.

C. Mollusk Survey of the Tennessee River Near [WBN] (Rhea County, Tennessee) (Oct. 28, 2010, Revised Nov. 24, 2010) ("Mollusk Survey"), *and* Results and Discussion of the Results of the 2010 Mollusk Survey of the Tennessee River Near [WBN] (Rhea County, Tennessee) (Mar. 2011) ("Discussion of Mollusk Survey")

68. [**J. Baxter / Coutant**] In Contention 7, SACE claimed that TVA relies on inadequate and outdated data to estimate the effects of operation of WBN Unit 2 on the mussel community in the vicinity of WBN.[133] In support of Contention 7, Dr. Young alleged that the mussel community in the WBN vicinity is not in good health, and that TVA has not given adequate consideration to the impact of WBN on that allegedly fragile community.[134] In direct response to these concerns, TVA designed an operational mollusk survey to be conducted by an outside consultant. In 2010, the consultant conducted the survey and described the survey methodology and results in the report, "Mollusk Survey of the Tennessee River Near [WBN] (Rhea County, Tennessee)," ("Mollusk Survey").[135] In "Results and Discussion of the Results of the 2010 Mollusk Survey of the Tennessee River Near [WBN] (Rhea County, Tennessee)"

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132 *See* TVA's Tenth Supplemental Disclosures at 8 (Nov. 15, 2010), *available at* ADAMS Accession No. ML103190306.

133 *See* Petition at 33.

134 *See* Young Affidavit at 8-10.

135 *See* Att. 11, Third Rock Consultants, Mollusk Survey of the Tennessee River Near [WBN] (RheaCounty, Tennessee) (Oct. 28, 2010, Revised Nov. 24, 2010).

("Discussion of Mollusk Survey"), TVA compared the results of the consultant's 2010 mussel survey to data collected at three mussel beds previously monitored by TVA.[136] The previous data includes preoperational (1983 to 1994) and operational (1996 to 1997) monitoring in the vicinity of WBN.[137]

i. Summary of Methodology

69. [**J. Baxter / Coutant**] In response to Contention 7, TVA directed the conduct of semi-quantitative and quantitative mollusk sampling from September 28 to 30, 2010, at the three sample areas that were previously subjected to pre-operational and operational monitoring.[138] A total of 120 semi-quantitative and 40 quantitative samples were collected during this 2010 period.[139] Semi-quantitative sampling involved timed collections of mussels by divers along transects on the reservoir bottom.[140] Quantitative sampling, on the other hand, involved whole-substrate excavations by divers.[141] The substrate was then sieved on the boat and mussels present in the substrate were recorded.[142] Methods varied from those used from 1983 to 1997, in which only semi-quantitative sampling (timed collection by SCUBA divers) was conducted.[143] In 2010, TVA employed quantitative sampling methods

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136 *See* Att. 12, TVA, Discussion of the Results of the 2010 Mollusk Survey of the Tennessee River Near [WBN] (Rhea County, Tennessee) (Mar. 2011).

137 *See id.* at 1.

138 *See id.* at 2.

139 *See* Att. 11, at 3.

140 *See id*.

141 *See id*.

142 *See id*.

143 *See* Att. 12, at 2.

because that methodology is more repeatable and controllable than the timed collection methods.[144]

70. [**J. Baxter / Coutant**] TVA's survey also involved sampling of an experimental boulder field, which TVA had previously constructed one mile downstream from Watts Bar Dam (near the WBN intake channel) in an attempt to cultivate young mussels and provide refuge from the effects of Watts Bar Dam.[145] TVA determined from sampling efforts, however, that flows from the Watts Bar Dam were too heavy for the boulder field to be successful.[146] Because the experimental boulder field was created to respond to the effects of the Watts Bar Dam on the mussel community (as opposed to operation of WBN Unit 1), it was not given further treatment in the Discussion of Mollusk Survey, which focuses instead on the effects of WBN discharges.

71. [**J. Baxter / Coutant**] In analyzing the 2010 mollusk survey data, TVA did not specifically take into account varying thermal discharge plumes under different river flows.[147] This factor was not considered because, as evidenced in TVA's Hydrothermal Study, described below, the thermal plume hovers at the top of the water column and does not affect benthic organisms such as mussels.[148] Moreover, TVA's NPDES permit for the SCCW discharge point limits the temperature at the

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144 *See id*.

145 *See* Att. 11, at 3.

146 *See* Att. 12, at 2.

147 *See id.* at 3.

148 *See* Att. 16, Hydrothermal Effects on the Ichthyoplankton from the [WBN] [SCCW] Outfall in Upper Chickamauga Reservoir at 8 (Jan. 2011).

receiving stream bottom to a value that is healthy for aquatic organisms such as mussels.[149]

ii. Summary of Findings

72. [**J. Baxter / Coutant**] The survey results demonstrated that the current mussel community adjacent to WBN is stable and that some species are reproducing, even though the reservoir environment is not the optimal habitat for many of the species of riverine mollusks documented in the area.[150] The mussel community in the WBN vicinity is in substantially similar condition as it was near the end of the previous operational monitoring period (1996 to 1997), in both species composition and the number of mussels collected.[151] Moreover, at least five mussel species collected showed recent recruitment.[152] The collection of these juveniles is significant. Because quantitative and semi-quantitative sampling methods are not effective in collecting juveniles, the collection of even a few juveniles suggests the presence of many more. Accordingly, these results indicate that operation of WBN Unit 1 has not had a long-term adverse effect on mussel populations and reproduction.

73. [**J. Baxter / Coutant**] Although the mussel population in the WBN vicinity is stable and is not adversely affected by the operation of WBN Unit 1, the reservoir environment is not the ideal habitat for several of the riverine mussels that are part of this community. We do not disagree with Dr. Young's assertion that the mussel

149 *See* Att. 18, at 7.

150 *See* Att. 12, at 1.

151 *See id*.

152 *See id.* at 2-3.

community in the WBN vicinity is not "excellent."[153] But the same is true for mussel communities in other Tennessee River reservoirs and tailwaters. The mussel community in the WBN vicinity is affected by the fragmentation of the river system and conversion of the river from free-flowing into a regulated system of reservoirs and tailwater reaches, however, and not operation of WBN Unit 1.

74. [**J. Baxter / Coutant**] As an aside, in citing TVA's "excellent" rating in his Affidavit, Dr. Young erroneously extrapolated TVA's characterization of the Reservoir Benthic Macroinvertebrate Index ("RBMI") for the benthic macroinvertebrate community in the WBN vicinity, to the freshwater mussel community specifically.[154] Sampling methods employed for determination of that index value are not effective for freshwater mussels, and the index value is not intended to represent freshwater mussels alone. Specifically, the sampling methodology of the RBMI involves taking a series of 0.1 m^2 Ponar dredge grab samples along transects running perpendicular to the river flow. This sample methodology is not generally effective in collecting bivalve mollusks and is not used to assess mollusk community composition or health.

75. [**J. Baxter / Coutant**] Because the reservoir environment is not ideal for riverine freshwater mussels, some mussel species are present in low densities in the WBN vicinity. Some such species that have been collected historically were not found in 2010 surveys.[155] It is reasonable to conclude that these species may still be present in the same low densities observed in previous sampling and were simply not collected

153 *See* Young Affidavit at 8.

154 *See* Young Affidavit at 8.

155 *See* Att. 12, at 2-3.

in subsequent sampling. For example, TVA collected a single sheepnose mussel in 2010.[156] Prior to this collection, this species was only found in 1983 (2 individuals), 1992 (1 individual), and 1994 (1 individual).[157] Because such species are present in the WBN vicinity in very low numbers, and given the limited selectivity of TVA's sampling methods, there is no trend that suggests that these low densities are the result of operation of WBN Unit 1.[158]

76. [**J. Baxter / Coutant**] In summary, TVA directed the conduct of additional mollusk sampling, and compared that data to pre-operational and operational mollusk data previously obtained by TVA, in order to respond to claims by SACE and Dr. Young that TVA relies on inadequate and outdated data regarding the impact of WBN operation on the mollusk community in the WBN vicinity. TVA disclosed the Mollusk Survey to SACE on January 18, 2011, and Discussion of Mollusk Survey to SACE on March 15, 2011, and SACE has not raised any concerns with the methodology or results of those studies.[159] As a result, these studies resolve the portions of Contention 7 that pertain to the impacts of WBN on the benthic macroinvertebrate community.

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156 *Id*. at 3.

157 *Id*.

158 *See id*.

159 *See* TVA's Twelfth Supplemental Disclosures at 9 (Jan. 18, 2011), *available at* ADAMS Accession No. ML110180334; TVA's Fourteenth Supplemental Disclosures at 9 (Mar. 15, 2011), available at ADAMS Accession No. ML110740178.

D. Aquatic Environmental Conditions in the Vicinity of Watts Bar Nuclear Plant During Two Years of Operation, 1996-1997 (June 1998, Revised June 2010) ("Revised Aquatics Study")

77. [**D. Baxter / J. Baxter / Coutant**] This study was originally conducted in June 1998, to compare aquatic monitoring conducted at WBN from 1973 to 1979, 1982 to 1985 (*i.e.*, preoperational monitoring), and 1990 to 1997 (*i.e.*, operational monitoring).[160] The focus of the original study was on detection of significant effects of the first two years of operation of WBN Unit 1 on juvenile and adult fish, benthic macroinvertebrate communities, native mussel fauna, and various water quality parameters.[161] The study also sought to estimate ichthyoplankton entrainment and fish impingement resulting from operation of WBN Unit 1.[162] In June 2010, TVA revised certain elements of the entrainment analysis from the original study to address concerns with TVA's entrainment estimates identified by Dr. Young in his July 11, 2009 Affidavit supporting SACE's petition to intervene.[163]

i. Summary of Original Study Methodology and Findings for Estimating Entrainment

78. [**D. Baxter / Coutant**] TVA's entrainment estimates in the original study were based on ichthyoplankton samples collected in the reservoir and intake channel.[164] TVA conducted pre-operational and operational sampling of fish eggs and larvae in the Chickamauga Reservoir by collecting samples from five locations on a transect across the reservoir during both day and night.[165] Because the sample area was immediately

160 *See* Att. 13, at 1-3.

161 *See id.* at IV.

162 *See id.*

163 *See* Young Affidavit at 12-15.

164 *See* Att, 13, at 5-7.

165 *See id.* at 5.

downstream of the Watts Bar Dam and therefore subject to significant mixing, the densities recorded at the five stations were averaged and extrapolated across the 24-hour flow value.[166] Pre-operational sampling for ichthyoplankton in the cooling water intake channel was conducted from the intake pump building to the mouth of the intake channel.[167] Operational sampling of ichthyoplankton in the cooling water intake channel was conducted from the trash boom to the mouth of the intake channel.[168] TVA analyzed ichthyoplankton samples from the reservoir and intake channel to identify species present in the WBN vicinity, and species abundance and age.[169]

79. [**D. Baxter / Coutant**] As a result of this analysis, TVA found that there were few taxa at relatively low densities in the WBN vicinity.[170] Eggs and larvae passing WBN were primarily spawned in Watts Bar Reservoir and had passed through the turbines at Watts Bar Dam before entering the waters in the WBN vicinity.[171] Very few eggs or larvae of species known to spawn in tailwaters (*i.e.*, in waters characteristic of those in the WBN vicinity) were collected, indicating that most of the spawning that occurs in Chickamauga Reservoir occurred downstream of WBN in more riverine environments.[172] In other words, because the WBN intake channel is

166 *See id*. at 7.

167 *See id.* at 6.

168 *See id*.

169 *See id.* at 6-7.

170 *See id.* at 56.

171 *See id.*

172 *See id*.

located in the tailwater immediately downstream of the Watts Bar Dam, relatively few ichthyoplankton were vulnerable to entrainment in WBN.

80. [**D. Baxter / Coutant**] TVA estimated entrainment using the total estimated transport of fish eggs and larvae past WBN, and the average hydraulic entrainment for WBN based on mean annual flow rates.[173] The proportion of the Tennessee River flow entrained by WBN (*i.e.*, hydraulic entrainment) was calculated to be 0.6%,[174] which is very low. Percent entrainment of fish larvae passing WBN was therefore also estimated to be very low, supporting the conclusion that WBN entrainment has no impact to the ichthyoplankton populations in the vicinity of WBN or the fish community in the Chickamauga Reservoir.[175]

ii. 2010 Revisions and Findings for Entrainment Estimates

81. [**D. Baxter / Coutant**] In July 2010, TVA revised the original study in direct response to issues involving TVA's entrainment modeling identified by Dr. Young.[176] Specifically, Dr. Young claimed that TVA erroneously assumed that distribution of ichthyoplankton across the reservoir is uniform, and failed to take into account variations in seasonal abundance of ichthyoplankton.[177] Based on the concerns raised by Dr. Young, original fish and egg density values and CCW intake and river flow data for 1996 and 1997 used to calculate percent entrainment were re-evaluated based on the seasonality of ichthyoplankton occurrence and reservoir releases from Watts Bar Dam.[178] TVA also revised the entrainment analysis using *actual* intake water

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173 *See id.* at 8, 13.

174 *See id.* at 56.

175 *See id*.

demand and reservoir river flow values for each sample period, to more accurately estimate percent entrainment.[179]

82. [**D. Baxter / Coutant**] The revisions to this study confirm that the conclusions of the original report remain valid.[180] Estimated average hydraulic entrainment by WBN, which was derived from *measured* intake volumes and reservoir flow at WBN during the study years (1996 and 1997), remained very low (0.6%).[181] Estimated percent entrainment of ichthyoplankton, which was derived from actual reservoir flow and WBN intake values, and which accounted for seasonality of ichthyoplankton occurrence, also remained very low. For samples collected in 1996, percent entrainment was estimated to be 0.29% for fish eggs and 0.57% for fish larvae.[182] For samples collected in 1997, percent entrainment was estimated to be 0.02% for fish eggs and 0.22% for fish larvae.[183] Total transport of fish eggs and larvae was estimated to be 1.09×10^8 and 1.63×10^8, respectively, in 1996, and 1.20×10^8 and 4.2×10^8, respectively, in 1997.[184] Accordingly, estimated total entrainment in 1996

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176 Young Affidavit at 11-15.

177 *See* Young Affidavit at 13-14.

178 *See* Att. 13, at II.

179 *See id*. In addition, TVA removed data on day and night ichthyoplankton densities because diel densities were variable and no trend was apparent. *See id.* TVA also revised certain tables within the study to reflect these changes. *See id.*

180 *See id.* at II.

181 *See id.* at 13. The 0.6% hydraulic entrainment rate measured in the mid-1990's differs from that measured in the most recent studies (0.3%, *see* ¶ 36), due to changes in the average reservoir flow past WBN, which depends upon the amount of annual rainfall that occurs upstream of Watts Bar Dam. The average flow past the plant will continue to vary with the average annual rainfall upstream of the Watts Bar Dam.

182 *See id*.

183 *See id*.

184 *See id*.

was 2.05 x 10^4 for fish eggs and 1.4 x 10^6 for fish larvae.[185] In 1997, estimated total entrainment was 1.94 x 10^4 for fish eggs and 9.29 x 10^5 for fish larvae.[186] Overall, these very low entrainment percentages for ichthyoplankton and minimal hydraulic entrainment demonstrate that there is no impact to the ichthyoplankton populations of Chickamauga Reservoir from the operation of WBN Unit 1.[187]

83. [**D. Baxter / Coutant**] The changes made to TVA's 1998 Aquatics Study in 2010 resolved a number of the issues Dr. Young raised in his Affidavit with respect to the results of TVA's entrainment estimates.[188] TVA disclosed this revised report to SACE on July 15, 2010, and SACE did not raise any additional concerns with TVA's methodology for estimating entrainment.[189] Accordingly, this revised study resolves many of the issues regarding TVA's methodology for estimating entrainment raised in Contention 7.

E. Comparison of 2010 Peak Spawning Seasonal Densities of Ichthyoplankton at [WBN] at Tennessee River Mile 528 with Historical Densities During 1996 and 1997 (Apr. 2011, Revised Nov. 2011) ("Peak Spawning Entrainment Study")

84. [**D. Baxter / Coutant**] In Contention 7, SACE claims that TVA's conclusions regarding entrainment effects are in error because of flaws in the approach employed by TVA for estimating entrainment, and because, at base, TVA has not taken direct

185 *See id*.

186 *See id.* at 13-14.

187 *See id.* at 14.

188 Dr. Young also challenged TVA's failure to measure *actual* entrainment at the WBN CCW intake. *See* Young Affidavit at 11-15. In response to this challenge, TVA conducted actual entrainment monitoring, discussed in Section V.E, below.

189 *See* TVA's Sixth Supplemental Disclosures at 7.

measurements of entrainment.[190] Likewise, Dr. Young raises a number of concerns with TVA's entrainment modeling, and concludes that TVA should update and correct these estimates by conducting an actual entrainment study at WBN.[191] In direct response to SACE and Dr. Young's concerns regarding TVA's entrainment *estimates*, TVA revised its Aquatics Study, discussed in Section V.D above, adjusting its methodology to conform to Dr. Young's recommendations.[192] To ensure that all of SACE and Dr. Young's concerns regarding entrainment estimates were addressed, and in direct response to requests from SACE and Dr. Young for *actual* entrainment monitoring at WBN during operation of WBN Unit 1, TVA also monitored *actual* entrainment at WBN from March 2010 through March 2011.[193] TVA used the results to determine taxonomic composition, densities, and entrainment mortality at WBN from Unit 1 operation.[194] TVA subsequently completed the Peak Spawning Entrainment Study, focusing on entrainment data from the April through June 2010 timeframe, because that is the peak spawning period in the WBN vicinity, and because SACE and Dr. Young requested that TVA account for the spawning patterns of fish species in the Chickamauga Reservoir and the high abundance of ichthyoplankton during certain times of year.[195]

i. Summary of Methodology

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190 *See* Petition at 33-34.

191 *See* Young Affidavit at 11-15.

192 *See supra* § V.D.

193 *See* Att. 14, Comparison of 2010 Peak Spawning Seasonal Densities of Ichthyoplankton at [WBN] at [TRM] 528 with Historical Densities During 1996 and 1997 (Apr. 2011, Revised Nov. 2011).

194 *See generally id*.

195 *See generally id*.; *see also* Petition at 35; Young Affidavit at 14.

85. [**D. Baxter / Coutant**] In TVA's 2010 entrainment survey, TVA collected ichthyoplankton samples both day and at night on a weekly basis.[196] Samples were collected at the following locations: (a) five stations along a transect across the river channel positioned at Tennessee River Mile ("TRM") 528.4, which is perpendicular to river flow just upstream of the CCW intake channel; and (b) four stations within the IPS canal located at TRM 528.[197] In other words, TVA measured the number of organisms drifting past the facility and the number of organisms actually entrained, in response to Dr. Young's suggestion that this method would allow for a more accurate evaluation of adverse impacts.[198]

86. [**D. Baxter / Coutant**] TVA took ichthyoplankton samples using a beam net of set dimensions, towed upstream at a speed of 1.0 m/s for ten minutes.[199] The volume of water filtered through the net in a ten minute sample was 150 m^3.[200] Water temperature was recorded using a mercury thermometer calibrated to the tenth degree.[201] The sampling procedures employed in 2010 were the same as those used during the 1996 and 1997 surveys, except that the 1996-97 surveys were conducted on a biweekly – rather than weekly – basis.[202] Laboratory analysis in 2010 also followed the same procedures used in 1996 and 1997.[203] Larval fish were identified

196 *See* Att.14, at 1.

197 *Id*.

198 *See* Young Affidavit at 13.

199 *See* Att. 14, at 1.

200 *See id*.

201 *See id*.

202 *See id*.

203 *See id*.

to the lowest possible taxon, counted, and measured to the nearest millimeter total length.[204] Taxonomic decisions were based on a consistent set of literature.[205]

ii. Summary of Findings

87. [**D. Baxter / Coutant**] Analysis of the data demonstrated that entrainment percentages for both fish eggs and larvae during April through June 2010, were low and were within the range of those calculated for the same period in 1996 and 1997.[206] During this same period in 1996, the seasonal entrainment for eggs was 0.29% and for larvae 0.57%.[207] Over the same period in 1997, the seasonal entrainment for eggs was 0.02% and for larvae 0.22%.[208] Seasonal entrainment estimates for the 1996-97 period were calculated by averaging the percent entrained values from each week.[209] In the same period in 2010, seasonal entrainment was 0.12% for eggs and 0.40% for larvae.[210] For this period, however, a more precise calculation method was employed than was used in 1996-97. Seasonal entrainment estimates in 2010 were calculated by dividing the total number of estimated entrained individuals by the total number of estimated transported individuals.[211] In other words, the average was calculated one time from the raw data, rather than by averaging all weekly averages. We cannot directly compare 2010 percent entrainment estimates with 1996 and 1997 estimates until we apply a consistent

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204 *See id*.

205 *See id*.

206 *See id.* at 4.

207 *See id.* at Tbl. 7. "Seasonal" entrainment represents total entrainment for the entire season.

208 *See id*.

209 *See id*.

210 *See id*.

211 *See id*.

calculation method. Applying the 2010 method to the 1996 data, we find that the seasonal entrainment for eggs and larvae was 0.2% and 0.88%, respectively, as shown in the following table:

1996-Eggs								
		Intake			Reservoir			
Date	Sample Period	Density/ 1,000 m^3	Water Demand m^3/d	Estimated Number Entrained	Density/ 1,000 m^3	River Flow m^3/d	Estimated Number Transported	Percent Entrained
		D_i	Q_i		D_r	Q_r		
April 8	1	17.1	1.27E+05	2.18E+03	382.2	2.04E+07	7.80E+06	0.03%
April 22	2	108.9	7.10E+04	7.73E+03	1527.5	6.29E+07	9.61E+07	0.01%
May 6	3	58.8	1.62E+05	9.54E+03	25.7	2.41E+07	6.17E+05	1.55%
May 20	4	0.0	1.54E+05	0.00E+00	83.6	4.36E+07	3.64E+06	T (0%)
June 3	5	8.8	1.17E+05	1.03E+03	9.5	8.20E+07	7.80E+05	0.13%
June 17	6	0.0	2.26E+05	0.00E+00	7.0	6.94E+07	4.84E+05	T (0%)
			Total:	2.05E+04		**Total:**	1.09E+08	**0.02%**

1996-Larvae								
		Intake			Reservoir			
Date	Sample Period	Density/ 1,000 m^3	Water Demand m^3/d	Estimated Number Entrained	Density/ 1,000 m^3	River Flow m^3/d	Estimated Number Transported	Percent Entrained
		D_i	Q_i		D_r	Q_r		
April 8	1	0.0	1.27E+05	0.00E+00	1.4	2.04E+07	2.93E+04	T (0%)
April 22	2	0.0	7.10E+04	0.00E+00	22.1	6.29E+07	1.39E+06	T (0%)
May 6	3	294.1	1.62E+05	4.77E+04	426.2	2.41E+07	1.03E+07	0.47%
May 20	4	1348.2	1.54E+05	2.08E+05	594.2	4.36E+07	2.59E+07	0.80%
June 3	5	5575.2	1.17E+05	6.51E+05	1065.3	8.20E+07	8.73E+07	0.75%
June 17	6	2354.0	2.26E+05	5.32E+05	550.6	6.94E+07	3.82E+07	1.39%
			Total:	1.44E+06		**Total:**	1.63E+08	**0.88%**

. Applying the 2010 method to the 1997 data, we find that the seasonal entrainment for eggs and larvae was 0.2% and 0.22%, respectively, as shown in the following table:

1997-Eggs								
		Intake			Reservoir			
			Water	Estimated		River	Estimated	
Date	Sample Period	Density/ 1,000 m^3	Demand m^3/d	Number Entrained	Density/ 1,000 m^3	Flow m^3/d	Number Transported	Percent Entrained
		D_i	Q_i		D_r	Q_r		
March 21	1	177.0	1.03E+05	1.82E+04	1069.8	1.09E+08	1.17E+08	0.02%
April 14	2	0.0	1.24E+05	0.00E+00	16.0	2.38E+07	3.80E+05	T (0%)
April 28	3	0.0	1.01E+05	0.00E+00	10.5	5.43E+07	5.72E+05	T (0%)
May 15	4	0.0	1.04E+05	0.00E+00	0.7	4.96E+07	3.35E+04	T (0%)
May 27	5	0.0	1.10E+05	0.00E+00	2.7	4.63E+07	1.25E+05	T (0%)
June 9	6	0.0	1.19E+05	0.00E+00	0.0	7.49E+07	0.00E+00	T (0%)
June 23	7	9.1	1.23E+05	1.12E+03	18.1	9.99E+07	1.81E+06	0.06%
			Total:	1.94E+04		**Total:**	1.20E+08	**0.02%**

1997-Larvae								
		Intake			Reservoir			
			Water	Estimated		River	Estimated	
Date	Sample Period	Density/ 1,000 m^3	Demand m^3/d	Number Entrained	Density/ 1,000 m^3	Flow m^3/d	Number Transported	Percent Entrained
		D_i	Q_i		D_r	Q_r		
March 21	1	35.4	1.03E+05	3.65E+03	52.1	1.09E+08	5.70E+06	0.06%
April 14	2	232.1	1.24E+05	2.89E+04	318.5	2.38E+07	7.59E+06	0.38%
April 28	3	427.4	1.01E+05	4.30E+04	1115.3	5.43E+07	6.05E+07	0.07%
May 15	4	1822.0	1.04E+05	1.89E+05	1688.9	4.96E+07	8.37E+07	0.23%
May 27	5	625.0	1.10E+05	6.88E+04	550.0	4.63E+07	2.55E+07	0.27%
June 9	6	2260.4	1.19E+05	2.70E+05	1032.2	7.49E+07	7.74E+07	0.35%
June 23	7	2645.5	1.23E+05	3.25E+05	1600.0	9.99E+07	1.60E+08	0.20%
			Total:	9.28E+05		**Total:**	4.20E+08	**0.22%**

A table summarizing seasonal entrainment values in 1996, 1997, and 2010, calculated using the 2010 method, is provided below:

Year	Percent Entrained Eggs	Percent Entrained Larvae
1996	0.2	0.88
1997	0.2	0.22
2010	0.12	0.40

The above table confirms that low entrainment percentages for both fish eggs and larvae during April through June 2010, were within the range of the low entrainment percentages calculated for the same period in 1996 and 1997

88. [**D. Baxter / Coutant**] The above averages for 2010 reflect one abnormal entrainment event. During the week of June 21, 2010, entrainment was measured to be 8.65%.[212] Although still a low entrainment percentage generally, this represents a departure from average entrainment measured at WBN. Laboratory analyses indicated that the intake samples collected during the week of June 21, 2010, contained a high number of sunfish larvae relative to the reservoir samples. The higher composition of sunfish larvae in the intake basin was likely a result of resident populations using this area for spawning and nursery habitat. The shape of the intake canal, the higher proportion of shoreline area (*i.e.*, preferred habitat), and the lower flow rate in the intake canal as compared to the adjacent reservoir area, artificially concentrate sunfish larvae in the intake canal. The resulting abundance of sunfish larvae in the intake canal is higher than would be expected in the adjacent reservoir. Nevertheless, this isolated occurrence would not have an effect on the sunfish population in upper Chickamauga Reservoir. Sunfish larvae were not restricted to the IPS canal but were collected in reservoir samples as well. TVA has also conducted sunfish sampling at multiple stations throughout the Chickamauga Reservoir from 1993 to 2010, and throughout this period has seen consistent trends in sunfish abundance throughout the reservoir. On the whole, during a majority of the past decade, sunfish populations have increased throughout Chickamauga Reservoir. These results suggest that sunfish are not affected by operation of WBN Unit 1.

89. [**D. Baxter / Coutant**] Although the entrainment percentages were similar for the monitoring periods in 1996 to 1997, and for 2010, the fish egg densities were lower in

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212 *See id*.

2010.[213] (Fish larvae densities in 2010, were consistent with those during the same periods in 1996 and 1997.[214]) This is likely to be the result of a temporary fluctuation in the fish spawning rate, and the impact of the preexisting Watts Bar Dam, through which these organisms must pass before they reach the CCW intake channel. This conclusion is supported by the finding in 1996 to 1997 that nearly 100% of eggs collected were mutilated and unidentifiable, due to turbine passage through Watts Bar Dam.[215] Moreover, the peak ichthyoplankton density recorded in the 2010 survey occurred on a day when there was no turbine flow through Watts Bar Dam.[216] Passage through Watts Bar Dam appears to be the dominant factor in the health of fish eggs in Chickamauga Reservoir. There is no evidence to suggest that fish egg densities were affected by operation of WBN Unit 1.

90. [**D. Baxter / Coutant**] The increased water intake demand for the CCW caused by dual unit operation will result in an estimated increase in entrainment that is proportional to the 0.2% anticipated increase in hydraulic entrainment. Because entrainment percentages are very low, this increase will result in entrainment percentages that are less than 1%, *i.e.*, still very low. In other words, dual unit operation will not result in a material change in entrainment impacts.

91. [**D. Baxter / Coutant**] In conclusion, consistent entrainment percentages in 1996, 1997, and 2010, indicate relatively few fish eggs and larvae are being entrained by the IPS relative to numbers passing the plant. These percentages suggest that most

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213 *See id.* Tbl. 3.

214 *See id*.

215 *See id.* at 3.

216 *See id*. at 4.

reproduction and larval drift is occurring outside of the influence of the IPS. If most fish eggs and larvae occurring in the vicinity of the plant are passing by and not being entrained, WBN is not adversely impacting fish communities in the vicinity of WBN and a balanced indigenous population would be maintained in Chickamauga Reservoir.

92. [**D. Baxter / Coutant**] TVA conducted actual entrainment monitoring at WBN from March 2010 to March 2011, in direct response to concerns raised by SACE and Dr. Young regarding TVA's methodology for estimating entrainment, and TVA's lack of actual entrainment data. TVA disclosed these surveys to SACE on April 15, 2011, and SACE has not challenged TVA's methodology or findings.[217] As a result, TVA's entrainment study resolves the portion of Contention 7 that pertains to entrainment impacts from WBN.

F. Fish Impingement at [WBN] Intake Pumping Station Cooling Water Intake Structure During March 2010 through March 2011 (Mar. 2011) ("Impingement Study")

93. [**D. Baxter / Coutant**] In Contention 7, SACE questioned TVA's analysis of the effects of WBN operation on the aquatic community because TVA had not conducted recent studies of actual impingement at the CCW intake.[218] In support, Dr. Young claimed that TVA should have updated its historic data on which it relies for its conclusions about impingement at the Unit 1 CCW intake.[219] He also explained that

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217 *See* TVA's Fifteenth Supplemental Disclosures at 10 (Apr. 15, 2011), *available at* ADAMS Accession No. ML111050528. Although TVA disclosed a revised Peak Spawning Entrainment Study on November 15, 2011, the conclusions of that version were unchanged from that disclosed in April 2011. *See* TVA's Twenty-Second Supplemental Disclosures at 11 (Nov. 15, 2011), *available at* ADAMS Accession No. ML11319A200.

218 *See* Petition at 35.

219 *See* Young Affidavit at 15.

TVA could not use impingement at the SCCW to estimate impingement at the CCW because of the different conditions at the two intake points: the SCCW intake point is in the forebay above Watts Bar Dam, while the CCW intake point is in the tailwater below the Dam.[220] In direct response to SACE and Dr. Young's assertions, TVA monitored actual impingement at the CCW intake screens from March 2010 through March 2011.[221] TVA used the resulting data, in combination with the existing recent SCCW impingement data, to estimate the annual impingement mortality of fish in the vicinity of WBN as the result of operation of WBN Unit 1, and to predict the impact from operation of Unit 2.[222]

i. Summary of Methodology

94. [**D. Baxter / Coutant**] In conducting the 2010 study, TVA used the same testing parameters that were employed in TVA's impingement monitoring conducted in 1996 and 1997.[223] In fact, Quality Assurance ("QA") / Quality Control ("QC") controls were used to ensure that the same methods for impingement sampling that were used in 1996 and 1997, were employed in 2010.[224] In both surveys, impinged fish were collected after regular 24-hour weekly screen washes.[225] Impinged fish were identified, separated into length classes, enumerated, and weighed.[226] Any fish that were collected alive were returned to the reservoir after processing.[227] Fish that

220 *See* Young Affidavit at 15-16.

221 *See* Att. 15.

222 *See id.* at 1.

223 *See id.* at 2.

224 *See id*.

225 *See id*.

226 *See id*.

227 *See id*.

appeared to be dead for more than 24 hours were not included in the sample, in order to exclude fish mortalities due to upstream causes.[228] Data recorded by one member of the team was checked and verified by another for quality control.[229] Estimated weekly and annual impingement rates were calculated by extrapolating impingement rates from the 24-hour samples.[230]

ii. Summary of Findings

95. [**D. Baxter / Coutant**] Total impingement values in 1996 to 1997, were less than those in 2010.[231] Estimated total annual impingement for 2010 to 2011, was 13,573, while estimated total annual impingement for 1996 to 1997, was 161.[232] Most of this increase, however, was due to the spike in numbers of impinged shad during the winter weather months of January through March, 2011.[233] Water temperatures measured during this period showed significantly cooler temperatures, when compared to temperatures measured during the corresponding months in 1996 to 1997.[234] Shad are noticeably affected by temperature, and become lethargic and moribund when temperatures fall below 50°F, making them more susceptible to impingement.[235] Such cold shocks are a well established phenomenon among shad in

228 *See id*.

229 *See id*.

230 *See id*.

231 *See id.* at 3.

232 *See id*.

233 *See id*.

234 *See id*.

235 *See id*.

the Southeastern United States.[236] It was these cold shocks that led to the increased impingement mortality, and not operation of WBN Unit 1.

96. [**D. Baxter / Coutant**] The EPA endorses an impingement modeling approach that excludes the effects of extreme environmental conditions from impingement results. For example, in its proposed regulations under Section 316(b) of the Clean Water Act published on April 20, 2011, the EPA recommended that for facilities measuring impingement mortality, "naturally moribund fish and invasive species would be excluded from the totals for both impingement and impingement mortality."[237] Moreover, the EPA has noted the effects of cold water kills on shad in its Technical Development Document for the Final Section 316(b) Phase III Rule, the EPA's guidance document for its cooling water intake regulations applicable to certain offshore oil and gas extraction facilities.[238] That guidance document uses examples of impingement studies from operating power plants, including some commercial nuclear facilities.[239] In discussing those impingement results, the EPA identified and separately accounted for natural mortality events resulting from temperature extremes.[240] Accordingly, excluding natural mortality from the cold shock events, TVA's impingement study found that fewer fish and numbers of species were impinged in 2010 to 2011, than in 1996 to 1997.[241] Low numbers of impinged fish

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236 *See id*.

237 National Pollutant Discharge Elimination System—Cooling Water Intake Structures at Existing Facilities and Phase I Facilities, 76 Fed. Reg. 22,174, 22,257 (Apr. 20, 2011).

238 *See* Att. 28, EPA-821-R-06-003, Technical Development Document for the Final Section 316(b) Phase III Rule, Ch. 8, § 2.1, *available at* http://water.epa.gov/lawsregs/lawsguidance/cwa/316b/phase3/index.cfm#finaltdd.

239 *See* Att. 28, § 2.1.1.

240 *See id*.

(excluding cold shock events) in both 1996 to 1997, and 2010 to 2011, suggest no adverse long term effects of the WBN CCW intake from Unit 1 operation on fish populations in the Chickamauga Reservoir.

97. [**D. Baxter / Coutant**] As discussed in Section IV above, operation of WBN Unit 2 in conjunction with Unit 1 would cause WBN to withdraw additional water through the CCW intake channel.[242] It can be assumed, therefore, that impingement would increase proportionally to flow rates due to the addition of Unit 2. In other words, the resulting impingement values would increase by the ratio of 73 to 134 at summer pool levels of the Chickamauga Reservoir, and by the ratio of 68 to 113 at winter pool levels.[243] Given the effects of cold shock and winter kills on shad, observed during winter 2011 impingement monitoring, we expect that impingement at the IPS will be driven more by winter conditions than by the projected increase in flow values.

98. [**D. Baxter / Coutant**] In sum, TVA monitored actual impingement at the CCW intake for one year, in direct response to SACE's claim that TVA inappropriately relies on historical information about impingement impacts at the CCW intake, and inappropriately extrapolated impingement data at the SCCW to the entire facility. Based on these impingement surveys, TVA found that impingement mortality at the WBN is dominated by natural mortality events. Impingement from operation of WBN Unit 1 is relatively minor, and under dual unit operation, will increase only proportionally to the marginal increases in intake flow rates. TVA disclosed this

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241 *See* Att. 15, at 3.

242 *Supra* ¶ 37.

243 *See supra* ¶ 37 (showing that flow rates at the CCW intake are projected to increase from 73 cfs to 134 cfs at summer pool levels, and from 68 cfs to 113 cfs at winter pool levels).

study to SACE on May 16, 2011, and SACE has not challenged the methodology or results of these studies.[244] As a result, this study resolves the aspect of Contention 7 that pertains to TVA's impingement monitoring.

G. Hydrothermal Effects of the Ichthyoplankton from the Watts Bar Nuclear Plant Supplemental Condenser Cooling Water Outfall in Upper Chickamauga Reservoir (Jan. 2011) ("Hydrothermal Study")

99. [**Hopping / Coutant**] In Contention 7, SACE asserted that TVA should study the thermal effects of operation of WBN Unit 1 on the aquatic environment in the WBN vicinity.[245] Dr. Young also claimed that TVA does not provide data on spatial or temporal distribution of ichthyoplankton in relation to thermal mixing zones, does not evaluate the impact of discharge temperatures on ichthyoplankton, and does not account for impacts of variations in the size or temperature profile of the mixing zone.[246] In direct response, TVA conducted two new hydrothermal surveys in the vicinity of WBN.[247] TVA recorded water temperatures upstream and downstream of the SCCW discharge in order to characterize the behavior of the SCCW discharge and model variations in the thermal plume.[248] The thermal plume was tracked and measured in conjunction with daytime and nighttime ichthyoplankton sampling to describe temporal

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244 *See* TVA's Sixteenth Supplemental Disclosures at 11. This was a revised version of the Impingement Study. TVA disclosed the initial version of the Impingement Study (March 2011) to SACE and the NRC Staff on April 15, 2011. *See* TVA's Fifteenth Supplemental Disclosures at 10.

245 *See* Petition at 35-36; *see also* Young Affidavit at 16-19.

246 *See* Young Affidavit at 17-18.

247 *See* Att. 16 at 1.

248 *See id*.

and spatial distribution of fish eggs and larvae and exposure rates to the thermal plume.[249]

i. Summary of Methodology

100. [**Hopping / Coutant**] TVA conducted its hydrothermal surveys during May and August 2010, when conditions would typify an operating extreme for the aquatic wildlife in the reservoir.[250] Such conditions include thermal discharge from WBN when Unit 1 is operating at a full load, and when there is no release of ambient water from the upstream Watts Bar Dam. These timeframes were also strategically chosen based on the life stage of aquatic fauna. May is the month of peak abundance of fish eggs and larvae in the WBN area.[251] August is the month of maximum ambient water temperature in the reservoir, and the time when most fish eggs have hatched and larvae are mature.[252]

101. [**Hopping / Coutant**] TVA also designed the May and August 2010 surveys in part to collect water temperature data that would allow TVA to characterize the spatial extent of the SCCW thermal plume.[253] Even though TVA previously performed field surveys and modeling of the spatial behavior of the thermal effluent from the SCCW system,[254] TVA conducted the additional 2010 surveys in response to claims by SACE and its expert that TVA's previous studies did not provide data on variations in the size and temperature profile of the thermal mixing zone.[255] Multiple

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249 *See id*.

250 *See id*.

251 *See id*.

252 *See id.* at 1, 7.

253 *See id.* at 1-2.

254 *See* 2007 FSEIS at 123 (references TVA 1998e, TVA 1999b, and TVA 2001).

255 *See* Petition at 35-36; Young Affidavit at 17.

drogue releases were made during the daytime and nighttime data collection periods, to capture the flow patterns over low-flow periods.[256] The drogues were equipped with GPS units to track the movement of the water in the surface layer of the reservoir, where most of the mixing of SCCW discharge occurs.[257] The hydrothermal surveys collected temperature data from multiple depths at thirteen fixed monitoring stations along river transects at locations across the river channel from the SCCW outfall, upstream from the SCCW outfall, and downstream of the SCCW outfall. The position of each station was determined by GPS.[258]

102. [**Hopping / Coutant**] Samples collected at the reservoir transect upstream of the IPS also represent densities of ichthyoplankton drifting over the diffuser discharge point. Although Dr. Young claimed that TVA did not account for thermal impacts at the diffuser discharge point,[259] separate samples at the diffuser discharge point were not necessary because the discharge is intermittent and the impact of diffuser discharge is an order of magnitude smaller than the impact of SCCW discharge. In other words, the thermal impacts from the SCCW discharge point bound the impacts from the CCW discharge point. Moreover, during extreme conditions produced by periods of no flow from Watts Bar Dam, TVA's NPDES permit prohibits releases to the reservoir from the diffuser. In fact, to ensure compliance with the WBN NPDES permit, when the release from the dam drops below 3500 cfs, the diffusers at WBN

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256 *See* Att. 16, at 1-2.

257 *See id*.

258 *See id.*at 2.

259 *See* Young Affidavit at 17.

are automatically closed by a system that is linked to the flow measurement at Watts Bar Dam.

103. **[D. Baxter / Coutant]** TVA also designed the May and August 2010 surveys to record the ichthyoplankton distribution in the thermal plumes.[260] TVA did this in response to claims by SACE and its expert that TVA's analyses did not include data on what species would be drifting through thermal mixing zones.[261] Dr. Young claimed that TVA "should have coupled modeling of the thermal discharge plumes under different river flows with ichthyoplankton and mussel distributions to determine effects on the different species across time and space."[262] In response, TVA estimated ichthyoplankton abundance, distribution, and taxonomic composition by collecting samples at a transect below Watts Bar Dam at TRM 528.[263] The samples were taken both day and night, in order to accurately estimate average densities for each 24-hour sample period, and were drawn along each shoreline and toward the bottom at mid-channel.[264] Samples were also collected upstream of the dam at TRM 530.2.[265] TVA also collected data in the weeks before and after the hydrothermal surveys to determine if the May and August surveys represented the seasonal larval density and the seasonal maximum temperatures.[266] Larval fish and egg exposure rates were compared to thermal limit data to evaluate species potentially

260 *See* Att. 16, at 2-3.

261 *See* Petition at 35; Young Affidavit at 17.

262 *See* Young Affidavit at 17.

263 *See* Att. 16, at 2.

264 *See id*.

265 *See id*.

266 *See id*.

affected.[267] In this way, TVA's study also responded to SACE and Dr. Young's request that TVA provide data on the effects of high temperatures on fish eggs and larvae.[268]

104. [**Hopping / Coutant / D. Baxter**] Results from the hydrothermal surveys show the pattern of water movement, river temperature data, lists of fish and ichthyoplankton collected near WBN in May and August 2010, and the densities of ichthyoplankton collected during normal and no flow conditions.[269] TVA provided this latter data (in Tables 3 to18 of the Hydrothermal Study) in order to illustrate the maximum number of ichthyofauna that would be exposed to the SCCW system and to compare densities during normal and no flow conditions of Watts Bar Dam.[270]

ii. Summary of Findings

105. [**Hopping / Coutant**] TVA was able to characterize the thermal plume using the data collected in the hydrothermal studies. The May and August 2010 surveys of SCCW discharge demonstrate that when there is no release from the Watts Bar Dam, the thermal plume remains primarily in the upper portion of the water column and spreads across the river, such that a large portion of the plume is exposed to surface evaporation and cooling.[271] This result contrasts with observations under normal releases from Watts Bar Dam, wherein the thermal plume tends to reside and mix with the flow in the right-hand side of the reservoir (the WBN side of the

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267 *See id*.

268 *See* Petition at 35-36; Young Affidavit at 17-18.

269 *See generally*, Att. 16.

270 *See id.*at 5-8, Tbls. 3-18.

271 *See id.* at 8.

reservoir).[272] The maximum water temperatures that were measured in May and August (23.8°C and 28.2°C, respectively) represent extreme temperature conditions, and yet were still lower than the NPDES limit of 30.5°C.[273]

106. [**Hopping / Coutant / D Baxter**] Although the hydrothermal surveys were conducted under extreme temperature conditions, the results demonstrated maximum temperatures below the NPDES criteria.[274] Because NPDES criteria were developed and approved by the State of Tennessee to provide protection for aquatic resources, these results demonstrate that there is no risk of thermal damage to ichthyoplankton even during no-flow conditions from the Watts Bar Dam. This is true for both the high-density ichthyoplankton season and the season with the highest river temperatures.

107. [**Hopping / Coutant**] Although dual unit operation may cause effluent temperatures to increase, TVA is bound by its NPDES discharge limits to maintain certain temperatures determined to be safe for aquatic organisms.[275] Even if dual unit operation caused effluent temperatures to approach the WBN NPDES temperature limits, TVA can avoid exceeding these limits through operational measures. For example, the SCCW system includes a bypass conduit that allows the cooler water in the supply conduit to mix with and dilute the warmer water in the discharge conduit, before it enters the reservoir via the SCCW outfall. Also, if conditions are so extreme that flow through the bypass conduit cannot safely attenuate the river temperature,

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272 *See id*.

273 *See id*.

274 *See id*.

275 *See generally* Att. 18.

then the SCCW system can be totally removed from service. To date, TVA has successfully implemented this strategy without exceeding any of the NPDES temperature limits for the SCCW system.

108. [**Hopping / Coutant**] As a final note, Dr. Young claims that TVA's acknowledgment of the need to move mussels in the vicinity of the SCCW discharge means that proposed operation of WBN Unit 2 will result in thermal impacts harmful to the environment.[276] This is not the case. TVA relocated mussels in this vicinity in anticipation of the addition of the SCCW discharge point in 1998, and before any surveys of the effect of that outfall were conducted. Indeed, as demonstrated in the preceding paragraphs, subsequent surveys showed that thermal discharge from this outfall has not exceeded the aquatic health-based limits established by the NPDES permit.

109. [**Hopping / Coutant**] In sum, TVA conducted hydrothermal studies for the thermal mixing zones and spatial-temporal distribution of ichthyoplankton in thermal mixing zones, in direct response to concerns raised by SACE and Dr. Young that TVA should study the thermal effects of operation of WBN Unit 1 on the aquatic environment in the WBN vicinity. TVA designed the studies to respond to the specific deficiencies in thermal studies alleged by Dr. Young. TVA disclosed the resulting Hydrothermal Study to SACE on February 15, 2011, and SACE has not raised any concerns regarding the methodology or results of this study.[277] As a result,

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276 *See* Young Affidavit at 16.

277 *See* TVA's Thirteenth Supplemental Disclosures at 9 (Feb. 15, 2011), *available at* ADAMS Accession No. ML110460452.

this study resolves the portion of Contention 7 that pertains to thermal impacts of operation of WBN.

VI. CONCLUSION

110. [**All**] Based on the information provided in these studies, and to the best of our professional knowledge and belief, we conclude that TVA has addressed all of the errors and deficiencies with TVA's aquatics studies identified by SACE in Contention 7 and in Dr. Young's supporting Affidavit.

[**All**] I declare under penalty of perjury that the foregoing is true and correct.

Executed the 21st day of November, 2011.

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