Attachment 1
to

NRC Staff's Answer to
Entergy's Motion to Dismiss Contention RK-EC-8
(Endangered and Threatened Species) as Moot (Aug. 6, 2013)

NUREG-1437, Supplement 38, Vol. 4 (June 2013)

(Excerpted)

PART 2 of 3

2.0 IMPINGEMENT AND ENTRAINMENT DATA CORRECTIONS

2.1 Corrections to Section 4.1.2, "Entrainment of Fish and Shellfish in Early Lifestages," and Its Related Appendices

In a letter to the NRC dated March 29, 2011 (Entergy 2011b; AKRF 2011b), Entergy provided new information supplementing the entrainment and impingement field data that it had previously provided to the NRC for its aquatic resource impact assessment. This new information appears in "Technical Review of FSEIS for Indian Point Nuclear Generating Unit Nos. 2 and 3" (AKRF 2011b). In its technical review, AKRF (2011b) stated that the units of the entrainment catch densities provided by Entergy are expressed as the number caught per 1,000 cubic meters (m^3). Because Entergy did not originally provide the units used in the FSEIS to assess impacts, the NRC staff believed the units to be the number caught per m^3 based on historical documents provided by Entergy, comments by Entergy and its consultants on the draft SEIS, and phone conversations among Entergy, Entergy's consultants, and the NRC staff. Thus, the entrainment losses the FSEIS reported for each of the representative important species (RIS) used in the NRC staff's analysis are too large by a factor of 1,000.

In the FSEIS, the NRC staff estimated the number entrained for a given week as the product of the mean density entrained and the combined weekly flow for IP2 and IP3. The error in the entrainment catch density directly affects Figure 4–3 in Section 4.1.2, and the error is repeated in Figure H–5 in Appendix H. In these figures, the total number entrained on the right axis should be in units of numbers × 10^8 instead of numbers × 10^{11}. The corrected Figures 4–3 and H–5 appear below. In addition, these changes affect two portions of text in the FSEIS.

Lines 2 and 3 of page 4-14 in the FSEIS are corrected as follows:

> The total number of identified fish entrained has decreased at a rate of 187 ~~billion~~ million fish per year since 1984.

Lines 1–3 of page H-22 in the FSEIS are corrected as follows:

> Linear regression (n=6; p<0.01) indicated that the number of identified fish entrained decreased at a rate of 187 ~~billion~~ million fish per year, a result consistent with the decrease observed in the number of fish impinged.

The change in units of the entrainment catch densities also affects the 75th percentile of the number of each life stage entrained and the annual estimate of the number entrained presented in Tables I–39 and I–42 of Appendix I. In Table I–39, the units should be numbers × 10^3 instead of numbers × 10^6. In Table I–42, the units should be numbers in the thousands instead of numbers in the millions. The corrected tables appear below.

Figure 4–3 on page 4-15 in the FSEIS is corrected as follows:

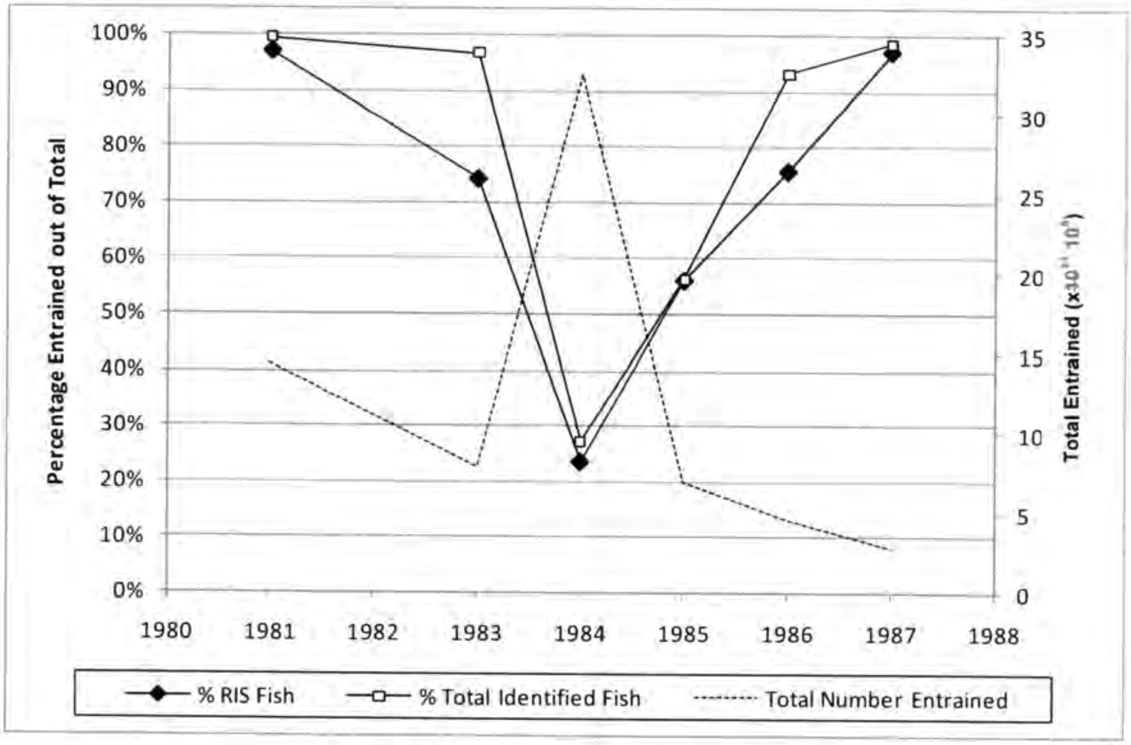

Figure 4–3. Percentage of entrainment composed of RIS fish and total identified fish relative to the estimated total entrainment at IP2 and IP3 combined (data from Entergy 2007b)

Figure H–5 on page H-23 in the FSEIS is identical to Figure 4–3 in the FSEIS and is corrected as follows:

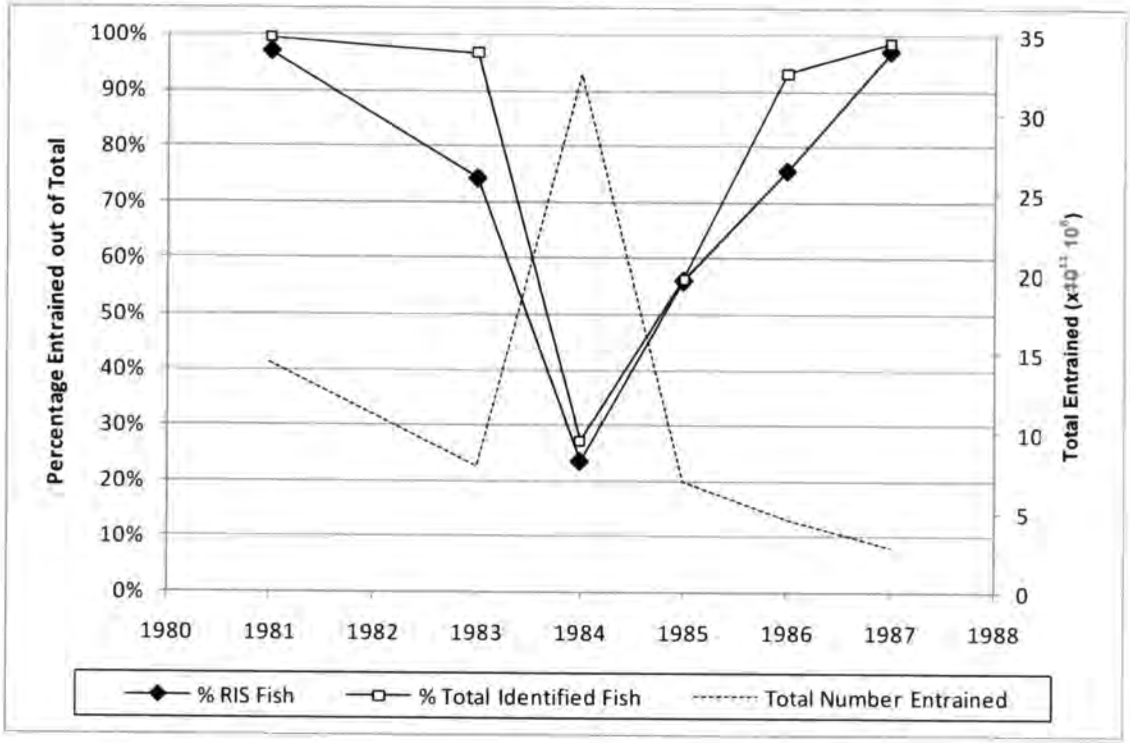

Figure H–5. Percentage of entrainment composed of RIS fish and total identified fish relative to the estimated total entrainment at IP2 and IP3 combined (data from Entergy 2007b)

Table I–39 on page I-54 in the FSEIS is corrected as follows:

Table I-39. Percentage of Each Life Stage Entrained by Season and the Contribution of Major Taxa Represented in the Samples.

Calculations are based on the 75th percentile over years (1981 and 1983–1987) of each season's number of fish entrained. No entrainment sampling occurred in October–December.

Life Stage	Season 1 Jan–Mar	Season 2 Apr–Jun	Season 3 Jul–Sep	75th Percentile over Years
EGG	3%	20%	78%	210,801× ~~10^6~~ 10^3
Rainbow Smelt	99%	2%	0%	
Bay Anchovy	0%	92%	100%	
White Perch	0%	4%	<1%	
Alosa species	1%	2%	0%	
YOLK–SAC LARVA	8%	89%	3%	23,140× ~~10^6~~ 10^3
Atlantic Tomcod	100%	0%	0%	
Herring Family	0%	91%	<1%	
Bay Anchovy	0%	2%	94%	
Striped Bass	0%	5%	1%	
Hogchoker	0%	0%	3%	
POST YOLK–SAC LARVA	<1%	52%	48%	618,393× ~~10^6~~ 10^3
Atlantic Tomcod	100%	<1%	0%	
Alosa species	0%	37%	<1%	
Bay Anchovy	0%	11%	58%	
Anchovy Family	0%	2%	39%	
White Perch	0%	12%	1%	
Striped Bass	0%	17%	1%	
Herring Family	0%	20%	<1%	
JUVENILE	2%	44%	54%	10,989× ~~10^6~~ 10^3
White Perch	96%	10%	10%	
Atlantic Tomcod	0%	67%	2%	
Weakfish	0%	1%	50%	
Bay Anchovy	0%	1%	17%	
Rainbow Smelt	0%	9%	3%	
Striped Bass	0%	6%	5%	
Anchovy Family	0%	1%	4%	
Alosa species	0%	2%	2%	
White Catfish	4%	<1%	0%	
Blueback Herring	0%	<1%	3%	
UNDETERMINED STAGE	10%	77%	13%	4,469× ~~10^6~~ 10^3
Atlantic Tomcod	100%	<1%	0%	
Morone species	0%	88%	2%	
Bay Anchovy	0%	9%	83%	
Anchovy Family	0%	0%	10%	
Alosa species	0%	0%	4%	

The title of Table I–42 on page I-58 of the FSEIS is corrected as follows:

Table I–42 Annual Estimated Number of RIS Entrained at IP2 and IP3 (~~millions~~ thousands of fish)

The contents of the table remain accurate and, therefore, are not duplicated in this supplement.

2.2 Corrections to Section 4.1.3, "Combined Effects of Impingement and Entrainment," and Its Related Appendices

In a letter to the NRC dated March 29, 2011, Entergy (2011b) provided new information (in AKRF 2011b) regarding the units associated with the catch density data from the Long River Survey (LRS) and the Fall Shoals Survey (FSS) that Entergy (2007) had previously submitted to the NRC for its aquatic resource impact assessment. In AKRF's (2011b) technical review, the units of the catch densities are expressed as the number caught per 1,000 m^3. Entergy did not provide the units for these densities when it originally submitted the data to the NRC. The NRC staff based the units it used in the FSEIS to assess impacts (i.e., number caught per m^3) on information in the mathematical construction of these measures provided in Central Hudson Gas and Electric Corporation (CHGEC) et al. (1999). Thus, the NRC staff overestimated the annual standing crop from the LRS and FSS in the FSEIS for each of the representative important species (RIS) by a factor of 1,000. The NRC staff then used the estimates of the annual standing crop and the estimated entrainment losses to estimate a conditional entrainment mortality rate (EMR), a parameter in the models used in the strength-of-connection (SOC) analysis.

The NRC staff described the calculation of the standing crop from the LRS and FSS in Appendix I, Section I.2.2, of the FSEIS. The NRC staff estimated the LRS and FSS weekly standing crop as the weekly density of fish caught multiplied by the IP2 and IP3 region river volume. The error in the density units for the LRS and FSS produced incorrect estimates of the combined standing crop used in the denominator of the estimated EMR in the FSEIS. The NRC staff also used entrainment losses as input to the numerator and the denominator of the EMR estimates. Because both the numerator and the denominator of the estimated EMR were too large by a factor of 1,000, only those estimates for two RIS (spottail shiner (*Notropis hudsonius*) and white catfish (*Ameiurus catus*)), in which the Beach Seine Survey (BSS) contributed more of the standing crop, were seriously affected. For the remaining RIS, to which the BSS contributed little, the errors in units largely cancelled because of the construction of the EMR as a ratio of the number entrained (which was 1,000 times too large) to the number at risk (number in the river plus the number entrained, both of which were 1,000 times too large). The amount and direction of change in the EMR depends on the relative contributions from the three sampling programs—BSS, FSS, and LRS.

The NRC staff used the EMR in its assessment of the SOC and, ultimately, to determine the final weight-of-evidence (WOE) assessment of the combined effects of impingement and entrainment from IP2 and IP3. The unit of measure error affects the staff's conclusion of High SOC for spottail shiner, but not the conclusion of Low SOC for white catfish. The NRC staff reran the SOC Monte Carlo simulations using the corrected EMRs, and, based on the corrected data, now finds a Low SOC for the spottail shiner. Further, based on the WOE assessment of the combined effects of impingement and entrainment from IP2 and IP3, the NRC staff concludes that the impacts of impingement and entrainment on the spottail shiner are SMALL rather than LARGE.

The changes to the SOC analysis affect FSEIS Table 4–4 (presented below) and several lines of text in Section 4.1.3.3. However, Section 4.1.3.5 is not affected by these changes.

Lines 41–43 on page 4-20 of the FSEIS are corrected as follows:

> Based on the WOE assessment (Table 4–4), the NRC staff concludes that impacts to American shad, Atlantic menhaden, Atlantic sturgeon, Atlantic tomcod, bay anchovy, bluefish, gizzard shad, shortnose sturgeon, **spottail shiner**, striped bass, white catfish, and blue crab are SMALL.

Lines 1–3 on page 4-21 of the FSEIS are corrected as follows:

> The NRC staff concludes that impacts to alewife, rainbow smelt, and weakfish are MODERATE. The staff concludes that impacts to blueback herring, hogchoker, ~~spottail shiner,~~ and white perch are LARGE.

Lines 30–41 on page 4-21 of the FSEIS are removed as follows:

> ~~*Spottail Shiner*~~
>
> ~~**The NRC staff concludes that a Large impact is present for YOY spottail shiner because a detectible population decline occurred in the river-wide (1 of 3) and river segment (1 of 1) data sets, and the strength of connection with the IP2 and IP3 cooling system is high. The habitat for the spottail shiner includes small streams, lakes, and large rivers, including the Hudson. This species feeds primarily on aquatic insect larvae, zooplankton, benthic invertebrates, and fish eggs and larvae, and is the prey of striped bass. Spottail shiners spawn from May to June or July (typically later for the northern populations) over sandy bottoms and stream mouths (Smith 1985; Marcy et al. 2005); water chestnut (Trapa natans) beds provide important spawning habitat (CHGEC 1999). Individuals older than 3 years are rare, although some individuals may live 4 or 5 years (Marcy et al. 2005). Spottail shiner is not a marine or anadromous species, so coastal population trend data are not available.**~~

Table 4–4 on page 4-23 of the FSEIS is corrected as follows:

Table 4–4. Impingement and Entrainment Impact Summary for Hudson River YOY RIS

Species	Population Trend Line of Evidence	Strength of Connection Line of Evidence	Impacts of IP2 and IP3 Cooling Systems on YOY RIS
Alewife	Variable	High	Moderate
American Shad	Detected Decline	Low	Small
Atlantic Menhaden	Unresolved[(a)]	Low[(b)]	Small
Atlantic Sturgeon	Unresolved[(a)]	Low[(b)]	Small
Atlantic Tomcod	Detected Decline	Low	Small
Bay Anchovy	Undetected Decline	High	Small
Blueback Herring	Detected Decline	High	Large
Bluefish	Detected Decline	Low	Small
Gizzard Shad	Unresolved[(a)]	Low[(b)]	Small
Hogchoker	Detected Decline	High	Large
Rainbow Smelt	Variable	High	Moderate–Large[(c)]
Shortnose Sturgeon	Unresolved[(a)]	Low[(b)]	Small
Spottail Shiner	Detected Decline	~~High~~ **Low**	~~Large~~ **Small**
Striped Bass	Undetected Decline	High	Small
Weakfish	Variable	High	Moderate
White Catfish	Variable	Low	Small
White Perch	Detected Decline	High	Large
Blue Crab	Unresolved[(a)]	Low[(b)]	Small

(a) Population trend could not be established because of a lack of river survey data.

(b) Monte Carlo simulation could not be conducted because of the low rate of entrainment and impingement; a Low Strength of connection was concluded.

(c) Section 4.1.3.3 provides supplemental information.

Because of the new information regarding the units of the data for entrainment density and the density of fish caught during the LRS and FSS, the NRC staff corrected the estimates of EMR for American shad (*Alosa sapidissima*), bay anchovy (*Anchoa mitchilli*), hogchoker (*Trinectes maculates*), white catfish, and white perch (*Morone americana*) reported in Appendices H and I. The staff's conclusions of the SOC for these RIS, however, remain unchanged. These changes affect several lines of text in Sections H.1.3.2 and H.1.3.3 and Tables H–16 and H–17, as described below.

Lines 11–12 on page H-47 in Section H.1.3.2 of the FSEIS are corrected as follows:

> The results of this analysis indicated a High strength of connection for ~~nine~~ **eight** species (Table H–16).

Lines 15–16 on page H-47 in Section H.1.3.2 of the FSEIS are corrected as follows:

> For ~~four~~ **five** RIS, the strength of connection was Low (minimal evidence of connection).

Lines 5–10 on page H-49 in Section H.1.3.3 of the FSEIS are corrected as follows:

> Based on the WOE assessment (Table H–17), the NRC staff concludes that the impact levels are Small for ~~eleven~~ **12** species: American shad, Atlantic menhaden, Atlantic sturgeon, Atlantic tomcod, bay anchovy, bluefish, gizzard shad, shortnose sturgeon, **spottail shiner**, striped bass, white catfish, and blue crab. Further, the staff concludes that the impacts are Moderate for three species: alewife, rainbow smelt, and weakfish. Finally, the staff concludes that

the impacts are Large for ~~four~~ three species: blueback herring, hogchoker, ~~spottail shiner;~~ and white perch.

Lines 26–38 on page H-50 in Section H.1.3.3 of the FSEIS are removed as follows:

~~*Spottail Shiner*~~

~~The NRC staff concludes that a Large impact is present for YOY spottail shiner because a detectible population decline occurred in the river-wide (1 of 3) and river segment (1 of 1) data sets, and there was a high strength of connection with the IP2 and IP3 cooling system. The habitat for the spottail shiner includes small streams, lakes, and large rivers, including the Hudson. This species feeds primarily on aquatic insect larvae, zooplankton, benthic invertebrates, and fish eggs and larvae, and is the prey of striped bass. Spottail shiners spawn from May to June or July (typically later for the northern populations) over sandy bottoms and stream mouths (Smith 1985; Marcy et al. 2005); water chestnut (Trapa natans) beds provide important spawning habitat (CHGEC 1999). Individuals older than 3 years are rare, but there is evidence of individuals living four or five years (Marcy et al. 2005). Coastal population trend data were not available for this species.~~

Table H–16 on page H-48 of the FSEIS is corrected as follows:

Table H–16. Weight of Evidence for the Strength–of–Connection Line of Evidence for YOY RIS Based on the Monte Carlo Simulation

RIS	Strength of Connection	RIS	Strength of Connection
Alewife	High	Hogchoker	High
American Shad	Low	Rainbow Smelt	High
Atlantic Menhaden	Cannot be Modeled[a]	Shortnose Sturgeon	Cannot be Modeled[a]
Atlantic Sturgeon	Cannot be Modeled[a]	Spottail Shiner	~~High~~ Low
Atlantic Tomcod	Low	Striped Bass	High
Bay Anchovy	High	Weakfish	High
Blueback Herring	High	White Catfish	Low
Bluefish	Low	White Perch	High
Gizzard Shad	Cannot be Modeled[a]	Blue Crab	Cannot be Modeled[a]

[a] Estimates for model parameters were unavailable or information was lacking. Strength of connection assumed to be Low based on review of impingement and entrainment data.

Table H–17 on page H-49 of the FSEIS is corrected as follows:

Table H–17. Impingement and Entrainment Impact Summary for Hudson River YOY RIS

Species	Population Trend Line of Evidence	Strength of Connection Line of Evidence	Impacts of IP2 and IP3 Cooling Systems on YOY RIS
Alewife	Variable	High	Moderate
American Shad	Detected Decline	Low	Small
Atlantic Menhaden	Unresolved[a]	Low[b]	Small
Atlantic Sturgeon	Unresolved[a]	Low[b]	Small
Atlantic Tomcod	Detected Decline	Low	Small
Bay Anchovy	Undetected Decline	High	Small
Blueback Herring	Detected Decline	High	Large
Bluefish	Detected Decline	Low	Small
Gizzard Shad	Unresolved[a]	Low[b]	Small
Hogchoker	Detected Decline	High	Large
Rainbow Smelt	Variable	High	Moderate–Large[c]
Shortnose Sturgeon	Unresolved[a]	Low[b]	Small
Spottail Shiner	Detected Decline	~~High~~ Low	~~Large~~ Small
Striped Bass	Undetected Decline	High	Small
Weakfish	Variable	High	Moderate
White Catfish	Variable	Low	Small
White Perch	Detected Decline	High	Large
Blue Crab	Unresolved[a]	Low[b]	Small

[a] Population Line of Evidence could not be established using WOE; therefore, population Line of Evidence could range from small to large.

[b] Strength of connection could not be established using Monte Carlo simulation; therefore, strength of connection was based on the rate of entrainment and impingement.

[c] Section 4.1.3.3 provides supplemental information.

In addition to Tables I–39 and I–42, presented earlier, the new information about the units of measure affects tables in Appendix I. The corrected Table I–40, Table I–41, Table I–43, Table I–46, and Table I–47 in Appendix I of the FSEIS appear on the following pages.

Table I–40 on page I-56 of the FSEIS is corrected as follows:

Table I–40. Method for Estimating Taxon-Specific Entrainment Mortality Rate (EMR) Based on River Segment 4 Standing Crop for the Strength of Connection Analysis

Property of Method		Number Entrained	River Segment 4 Standing Crop
Input Data	Variables	Mean density organisms entrained by IP2 and IP3 (# per 1000 m^3) Volume of cooling water withdrawn by IP2 and IP3 (1000 m^3/min)	LRS density (by life stage) FSS density of YOY (# per 1000 m^3) BSS density of YOY (# per haul) River Segment 4 volume (m^3) River Segment 4 shorezone surface area (m^2)
	Frequency	Per week of sampling	Per week of sampling
Summary Statistics	Seasonal (Year specific)	Sum of weekly estimates of number of organisms entrained by IP2 and IP3	Sum of weekly standing crop estimates
	Annual	Sum of Season 1, 1986, with each year's totals from Season 2 and Season 3	Sum of seasonal standing crop estimates for River Segment 4
	EMR	$\frac{\text{75th Percentile Annual Number Entrained}}{\text{75th Percentile (Annual Number Entrained + Annual Standing Crop)}}$	
	Units of numerator and denominator of EMR	# of organisms	
Years of Data		1981 and 1983–1987	1981 and 1983–1987
Life Stages		Eggs, Larvae, and Juveniles	Eggs, Larvae, and Juveniles (YOY)
Taxonomic Substitutions		Alewife, blueback herring, and unidentified alosids treated collectively as river herring	
		Unidentified anchovy spp. (species, plural) allocated to bay anchovy Unidentified *Morone* spp. allocated proportionally to striped bass and white perch	

The title of **Table I–41 on page I-57** of the FSEIS is corrected as follows:

Table I–41. Estimated Annual Standing Crop of Eggs, Larvae, and Juvenile RIS Within River Segment 4 (~~millions~~thousands of fish)

The contents of the table remain accurate and, therefore, are not duplicated in this supplement.

Table I–43 on page I-59 of the FSEIS is corrected as follows:

Table I–43. Estimate of the River Segment 4 Entrainment Mortality Rate (EMR) and the 95 Percent Confidence Limits for the Riverwide Entrainment CMR (1974–1997)

Taxa	75th Percentile Annual Number Entrained (number x ~~10^9~~ 10^6)	75th Percentile of Number at Risk (number x ~~10^9~~ 10^6)	EMR	Riverwide CMR for Entrainment at IP2 and IP3	
				Lower 95% Confidence Limit	Upper 95% Confidence Limit
Alewife and Blueback Herring	94.9	1003	0.095	0.00747	0.0324
American Shad	0.357	~~8.43~~ 9.26	~~0.042~~ 0.039	0	0.016696
Atlantic Menhaden	0	NA	NA	Not Modeled	
Atlantic Sturgeon	0	NA	NA	Not Modeled	
Atlantic Tomcod	7.65	210	0.036	0.152	0.234
Bay Anchovy	439	~~2064~~ 2065	~~0.213~~ 0.212	0.0925	0.140
Bluefish	0.00291	1.13	0.003	Not Modeled	
Gizzard Shad	0	NA	NA	Not Modeled	
Hogchoker	1.87	~~4.83~~ 4.84	~~0.386~~ 0.385	Not Modeled	
Rainbow Smelt	7.07	27.4	0.258	Not Modeled	
Shortnose Sturgeon	0	NA	NA	Not Modeled	
Spottail Shiner	0.00295	~~0.00838~~ 0.0937	~~0.352~~ 0.031	0.0802	0.104
Striped Bass	71.4	676	0.106	0.181	0.276
Weakfish	3.90	7.17	0.544	Not Modeled	
White Catfish	0.00965	~~0.0848~~ 0.0388	~~0.114~~ 0.249	Not Modeled	
White Perch	63.5	~~840~~ 841	~~0.076~~ 0.075	0.0568	0.108

Table I–46 on page I-61 of the FSEIS is corrected as follows:

Table I–46. Parameter Values Used in the Monte Carlo Simulation

RIS	Survey Used	Linear Slope (*r*)	Upper 95% Confidence Limit of the Slope	Error Mean Square from Regression	CV of Density Data (1979-1990)	EMR	IMR
Alewife	BSS	-0.030	-0.014	0.570	1.245	0.095	0.0020
American Shad	BSS	-0.069	-0.059	0.350	0.744	~~0.042~~ 0.39	0.0005
Atlantic Tomcod	FSS	-0.040	-0.026	0.490	1.035	0.036	0.0300
Bay Anchovy	FSS	-0.075	-0.061	0.505	0.598	~~0.213~~ 0.212	0.0040
Blueback Herring	BSS	-0.024	-0.009	0.530	1.488	0.095	0.0040
Bluefish	BSS	-0.038	-0.022	0.580	0.692	0.003	0.0005
Hogchoker	FSS	-0.034	-0.018	0.580	1.679	~~0.386~~ 0.385	0.0005
Rainbow Smelt	FSS	0.012	0.041	0.576	1.452	0.258	0.0005
Spottail Shiner	BSS	-0.017	-0.005	0.430	1.293	~~0.352~~ 0.031	0.0070
Striped Bass	BSS	0.040	0.052	0.420	0.528	0.106	0.0080
Weakfish	FSS	-0.047	-0.031	0.560	1.085	0.544	0.0005
White Catfish	FSS	0.007	0.010	0.100	3.520	~~0.114~~ 0.249	0.0005
White Perch	BSS	-0.062	-0.045	0.610	0.848	~~0.076~~ 0.075	0.0320

Table I–47 on page I-63 of the FSEIS is corrected as follows:

Table I–47. Quartiles of the Relative Difference in Cumulative Abundance and Conclusions for the Strength-of-Connection from the Monte Carlo Simulation

Taxa	Number of Years	$N_0 = 1000$			$N_0 = 1 \times 10^8$			Strength of Connection Conclusion
		Median	Q1	Q3	Median	Q1	Q3	
Alewife	20	0.33	0.11	0.59	0.32	0.06	0.55	High
	27	0.36	0.15	0.56	0.33	0.14	0.53	
American Shad	20	~~0.07~~ 0.08	~~-0.04~~ -0.03	~~0.18~~ 0.20	~~0.09~~ 0.08	~~-0.02~~ -0.03	~~0.20~~ 0.19	Low
	27	~~0.08~~ 0.07	-0.01	~~0.16~~ 0.15	~~0.08~~ 0.07	~~0.00~~ -0.01	0.16	
Atlantic Tomcod	20	0.14	-0.04	0.32	0.17	-0.01	0.38	Low
	27	0.18	0.04	0.32	0.18	0.02	0.33	
Bay Anchovy	20	~~0.21~~ 0.19	~~0.09~~ 0.08	~~0.32~~ 0.31	0.20	0.08	0.31	High
	27	~~0.18~~ 0.19	0.10	~~0.26~~ 0.28	0.18	~~0.10~~ 0.09	~~0.27~~ 0.28	
Blueback Herring	20	0.30	0.02	0.60	0.28	0.02	0.60	High
	27	0.43	0.16	0.67	0.40	0.14	0.64	
Bluefish	20	0.13	-0.04	0.29	0.14	-0.03	0.30	Low
	27	0.14	0.02	0.29	0.16	0.01	0.30	
Hogchoker	20	~~0.71~~ 0.72	~~0.39~~ 0.37	~~1.05~~ 1.06	~~0.74~~ 0.76	~~0.41~~ 0.42	~~1.10~~ 1.09	High
	27	~~0.81~~ 0.76	~~0.53~~ 0.50	~~1.10~~ 1.09	~~0.77~~ 0.84	~~0.46~~ 0.56	~~1.06~~ 1.13	
Rainbow Smelt	20	0.77	0.33	1.25	0.81	0.35	1.34	High
	27	0.93	0.52	1.38	1.03	0.63	1.46	
Spottail Shiner	20	~~0.59~~ 0.20	~~0.33~~ -0.07	~~0.88~~ 0.43	~~0.58~~ 0.18	~~0.23~~ -0.06	~~0.90~~ 0.42	~~High~~ Low
	27	~~0.61~~ 0.22	~~0.36~~ 0.01	~~0.88~~ 0.42	~~0.62~~ 0.23	~~0.35~~ 0.01	~~0.87~~ 0.46	
Striped Bass	20	0.45	0.09	0.76	0.45	0.12	0.78	High
	27	0.62	0.27	1.02	0.66	0.31	1.01	
Weakfish	20	0.62	0.39	0.87	0.66	0.42	0.90	High
	27	0.63	0.43	0.84	0.64	0.43	0.83	
White Catfish	20	~~0.19~~ 0.40	~~-0.36~~ -0.20	~~0.76~~ 0.98	~~0.05~~ 0.37	~~-0.46~~ -0.18	~~0.66~~ 1.00	Low
	27	~~0.08~~ 0.39	~~-0.41~~ -0.15	~~0.58~~ 0.91	~~0.09~~ 0.37	~~-0.43~~ -0.19	~~0.58~~ 0.99	
White Perch	20	~~0.16~~ 0.18	~~0.01~~ 0.03	~~0.32~~ 0.35	~~0.20~~ 0.19	~~0.04~~ 0.03	~~0.35~~ 0.34	High
	27	~~0.18~~ 0.19	~~0.06~~ 0.07	~~0.31~~ 0.30	~~0.20~~ 0.17	~~0.07~~ 0.06	~~0.31~~ 0.30	

3.0 ASSESSMENT OF THERMAL IMPACTS

In the FSEIS, the NRC staff concluded that the potential impacts of the cooling water discharge from IP2 and IP3 on aquatic species could range from SMALL to LARGE because the staff did not have enough information to quantify the extent and magnitude of the IP2 and IP3 thermal plume. Since publication of the FSEIS, the NRC has obtained additional information from Entergy regarding the thermal plume that enables the staff to make a more informed conclusion regarding thermal impacts.

In January 2011, Entergy submitted to the NYSDEC a preliminary report on a triaxial plume study (Swanson et al 2011a) as part of its SPDES permit renewal application. Entergy undertook this study in response to the NYSDEC's 2010 Notice of Denial (NYSDEC 2010), which noted that Entergy's previous thermal study (Swanson et al. 2010) did not directly address the period of highest river temperatures, and as such, would require additional confirmatory monitoring to determine whether any modeled results accurately show compliance with thermal standards. The NYSDEC provided Entergy with comments on the new Swanson et al. (2011a) study in March 2011. Within the same month, Mendelsohn et al. (2011) and Swanson et al. (2011b) prepared responses to the NYSDEC staff's review of the study. In a letter dated May 16, 2011, NYSDEC (2011) notified NYSDEC Judges M.E. Villa and D.P. O'Connell that it had finished reviewing the data and information contained in both the study and the response to NYSDEC's comments and that, based on this information and applicable regulations, the NYSDEC staff had determined the following:

> ...a thermal mixing zone in the Hudson River near Indian Point not to exceed a maximum of seventy-five (75) acres in total size during any time of a given year (6 NYCRR §704.3) will provide reasonable assurance of compliance with water quality standards and criteria for thermal discharges set forth in 6 NYCRR §§704.1 and 704.2, respectively.

Based on Swanson et al.'s (2011a) triaxial thermal plume study, Mendelsohn et al.'s (2011) and Swanson et al.'s (2011b) responses to NYSDEC staff comments on the study, and NYSDEC staff's (2011) conclusions regarding the study, the NRC staff has revised its discussion of and conclusions regarding thermal impacts to aquatic species, which appear in Section 4.1.4 of the FSEIS.

Lines 16–26 on page 4-30 in Section 4.1.4.3 of the FSEIS are changed as follows:

> ~~Entergy has been engaged in discussions with the NYSDEC concerning the thermal impacts of IP2 and IP3 cooling water system operation. As a result of those discussions, the NRC staff notes that Entergy recently performed a triaxial thermal study of the Hudson River from September 9 to November 1 of 2009 (Entergy 2010). Given the months involved in this study, the study period did not include days with the highest average annual water temperature. Entergy has indicated that it will perform modeling of the river based on its field data in order to determine whether the power plant is in compliance with conditions of its permit; it also indicated that it may conduct additional monitoring in 2010. The NYSDEC, in its recent Notice of Denial of Water Quality Certification, indicated that additional verification of any modeled results would be necessary (NYSDEC 2010). Entergy did conduct additional studies in 2010. This issue continues to be subject to NYSDEC authority and review.~~

In February 2010, Entergy submitted to NYSDEC a preliminary report (Swanson et al. 2010) on a triaxial thermal study of the Hudson River performed during the period of September 9 to November 1, 2009. Because the study did not directly address the period of highest river temperatures, the NYSDEC directed Entergy to perform additional confirmatory monitoring to determine whether any modeled results accurately show compliance with thermal standards (NYSDEC 2010). In January 2011, Entergy submitted to the NYSDEC a new triaxial plume study (Swanson et al. 2011a).

In the new study, Swanson et al. (2011a) reported that the extent and shape of the thermal plume varied greatly, primarily in response to tidal currents. For example, the plume (illustrated as a 4°F (2.2°C) temperature increase or ΔT isotherm in Figure 5–6 of Swanson et al. 2011a) generally followed the eastern shore of the Hudson River and extended northward from IP2 and IP3 during flood tide and southward from IP2 and IP3 during ebb tide. Depending on tides, the plume can be reasonably easily identified and can reach a portion of the near-shore bottom or be largely confined to the surface of the river.

Temperature measurements reported by Swanson et al. (2011a) generally show that the warmest water in the thermal plume is close to the surface, and plume temperatures tend to decrease with depth. A cross-river survey conducted in front of IP2 and IP3 captured one such incident during spring tide on July 13, 2010 (Figure 3–28 in Swanson et al. 2011a). Across most of the river, water temperatures were close to 82°F (28°C), often with warmer temperatures near the surface and cooler temperatures near the bottom. The IP2 and IP3 thermal plume at that point was clearly defined and extended about 1,000 feet (ft) (300 meters (m)) from shore on a cross-river transect of about 3800 ft (1150 m) (interpreted from the figure). Surface water temperatures in the plume reached about 85°F (29°C). Maximum river depth along the measured transect is approximately 50 ft (15 m).

A temperature contour plot at a cross-river transect at IP2 and IP3 illustrates a similar condition on July 11, 2010, during slack before flood tide (Figure 1–10 in Swanson et al. 2011b). Here, the thermal plume is evident to about 2,000 ft (600 m) from the eastern shore (the location of the IP2 and IP3 discharge) and extends to a depth of about 35 ft (11 m) along the eastern shore. The river here is more than 4,500 ft (1,400 m) wide. Bottom temperatures above 82°F (28°C) were confined to about the first 250 ft (76 m) from shore. In that small area, bottom water temperatures might also exceed 86°F (30°C); elsewhere, bottom water temperatures were about 80°F (27°C). The NRC staff notes, however, that these limited-area conditions would not last long, as they would change with the tidal cycle.

In response to NYSDEC's review of the IP2 and IP3 thermal studies (Swanson et al. 2011a), Mendelsohn et al. (2011) modeled the maximum area and width of the thermal plume (defined by the 4°F (2.2°C) ΔT isotherms) in the Hudson River. Mendelsohn et al. (2011) reported that for four cross-river transects near IP2 and IP3, the maximum cross-river area of the plume would not exceed 12.3 percent of the river cross-

> section, and the maximum cross-river width of the plume would not exceed 28.6 percent of the river width (Table 3–1 in Mendelsohn et al. 2011).
>
> Swanson et al. (2011a) concluded that IP2 and IP3 are in compliance with NYSDEC water quality standards set forth at 6 NYCRR Part 704.

After line 43 on page 4-31 of Section 4.1.4.4 of the FSEIS, the following text is to be added:

> In response to the NYSDEC's 2010 Notice of Denial (NYSDEC 2010), Entergy submitted a new triaxial plume study (Swanson et al. 2011a) to the NYSDEC in January 2011. NYSDEC provided Entergy with comments on the new study (Swanson et al. 2011a) in March 2011. Within the same month, Mendelsohn et al. (2011) and Swanson et al. (2011b) prepared responses to the NYSDEC staff's review of the study. In a May 2011 letter (NYSDEC 2011), NYSDEC staff notified NYSDEC Judges M.E. Villa and D.P. O'Connell that NYSDEC staff had finished reviewing the data and information contained in both the study and the response to NYSDEC's comments and that, based on this information and applicable regulations, NYSDEC staff had determined the following:
>
>> a thermal mixing zone in the Hudson River near Indian Point not to exceed a maximum of seventy-five (75) acres in total size during any time of a given year (6 NYCRR §704.3) will provide reasonable assurance of compliance with water quality standards and criteria for thermal discharges set forth in 6 NYCRR §704.1 and 704.2, respectively.

Lines 2–26 on page 4-32 in Section 4.1.4.5 of the FSEIS are corrected as follows:

> ~~In the absence of a completed thermal study proposed by NYSDEC (or an alternative proposed by Entergy and accepted by NYSDEC), existing information must be used to determine the appropriate thermal impact level to sensitive life stages of important aquatic species. Since NYSDEC modeling in the FEIS (NYSDEC 2003a) indicates that discharges from IP2 and IP3 could raise water temperatures to a level greater than that permitted by water quality criteria that are a component of existing NYSDEC permits, the staff must conclude that adverse impacts are possible. Cold water fish species such as Atlantic tomcod and rainbow smelt may be particularly vulnerable to temperature changes caused by thermal discharges. The population of both species has declined, and rainbow smelt may have been extirpated from the Hudson River. The NYSDEC's issuance of a SPDES permit provides a basis to conclude that the thermal impacts of IP2 and IP3 discharges could meet applicable regulatory temperature criteria. The NYSDEC's recent pronouncements and its ongoing re-examination of this issue create uncertainty, and this issue is currently being addressed in NYSDEC administrative proceedings. Accordingly, in the absence of specific studies, and in the absence of results sufficient to make a determination of a specific level of impact, the NRC staff concludes that thermal impacts from IP2 and IP3 potentially could range from SMALL to LARGE depending on the extent and magnitude of the~~

> ~~thermal plume, the sensitivity of various aquatic species and life stages likely to encounter the thermal plume, and the probability of an encounter occurring that could result in lethal or sublethal effects. This range of impact levels expresses the uncertainty accruing from the current lack of studies and data. Either additional thermal studies or modeling and verification of Entergy's 2009 thermal study might generate data to further refine or modify this impact level. For the purposes of this Final SEIS, the NRC staff concludes that the impact level could range from SMALL to LARGE. This conclusion is meant to satisfy NRC's NEPA obligations and is not intended to prejudice any determination the NYSDEC may reach in response to new studies and information submitted to it by Entergy.~~
>
> NRC regulations for license renewal environmental reviews establish the primary role of the U.S. Environmental Protection Agency (EPA) (or States, when applicable) in water quality regulations as they relate to impacts on aquatic species. As such, the assessment of impacts from heat shock is within the purview of the responsible government agency. In the case of IP2 and IP3, NYSDEC is the responsible agency.
>
> NYSDEC regulations at 6 NYCRR Part 704 establish specific standards that apply to thermal discharges within the State of New York. The standards are set to "assure the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife in and on the body of water" to which heated water is discharged (6 NYCRR 704.1(a)). Section 4.1.4.4 of this FSEIS supplement describes the thermal plume studies (Swanson et al. 2010, 2011a) that Entergy submitted to NYSDEC and NYSDEC's (2011) conclusions regarding these studies. NYSDEC concluded that the results of the thermal plume studies provide reasonable assurance that the IP2 and IP3 discharge is in compliance with NYSDEC's water quality standards and criteria for thermal discharges.
>
> Based on Entergy's thermal plume studies and NYSDEC's conclusions, the NRC staff concludes that the impacts from heat shock to aquatic resources of the lower Hudson River would be SMALL.

This change in the NRC staff's conclusion regarding thermal impacts (heat shock) also affects the Abstract, Executive Summary, Alternatives, and Summary sections of the FSEIS. The NRC staff has revised parts of these sections, as described below.

Line 37 on page iii through line 2 on page iv of the FSEIS Abstract are changed as follows:

> Overall effects from entrainment and impingement are likely to be MODERATE, and impacts from heat shock are likely to be SMALL. ~~Impacts from heat shock potentially range from SMALL to LARGE depending on the conclusions of thermal studies proposed by the New York State Department of Environmental Conservation (NYSDEC).~~

Lines 33–39 on page xviii of the FSEIS Executive Summary are changed as follows:

> The NRC staff concludes that the potential environmental effects for most of these issues are of SMALL significance in the context of the standards set forth in the GEIS with ~~three~~ two exceptions—entrainment~~,~~ and impingement~~, and heat shock from the facility's heated discharge~~. The NRC staff jointly

> assessed the impacts of entrainment and impingement to be MODERATE based on NRC's analysis of representative important species. ~~Impacts from heat shock potentially range from SMALL to LARGE depending on the conclusions of thermal studies conducted by Entergy and submitted to the NYSDEC.~~

Line 43 on page 8-8 through line 3 on page 8-9 of Section 8.1.1.2 are changed as follows:

> Because the closed-cycle cooling system discharges a smaller volume of water, and because the water is cooler than in a once-through system, the extent of thermal impacts ~~– which could range from SMALL to LARGE for the current once-through system, given uncertainty in the facility's thermal impacts –~~ **would remain SMALL** ~~be reduced. Thus, the effects of thermal shock also decline.~~

Lines 35–40 on page 9-4 of Section 9.1 are changed as follows:

> The NRC staff concludes that the potential environmental effects for ~~9~~ **10** of the 12 categorized issues are of SMALL significance in the context of the standards set forth in the GEIS. The NRC staff concludes that the combined impacts from impingement and entrainment (each a separate issue) are MODERATE. ~~Impacts from heat shock could range from SMALL to LARGE, based on the large uncertainties discussed in Chapter 4~~.

Lines 8–13 on page 9-5 of Section 9.1 are changed as follows:

For issues of MODERATE ~~or LARGE~~ significance (i.e., issues related to aquatic ecology), mitigation measures are addressed both in Chapter 4 and in Chapter 8 as alternatives based on determinations in the draft New York State Department of Environmental Conservation (NYSDEC) State Pollutant Discharge Elimination System (SPDES) permit proceeding, Clean Water Act Section 401 proceeding, and in draft policy statements published by the State.