Biological Assessment

Indian Point Nuclear Generating Plant, Unit Nos. 2 and 3
License Renewal

December 2010

Docket Nos. 50-247 and 50-286

U.S. Nuclear Regulatory Commission
Rockville, Maryland

Revised Biological Assessment of the Potential Effects on Federally Listed Endangered or Threatened Species from the Proposed Renewal of Indian Point Nuclear Generating Plant, Unit Nos. 2 and 3

Introduction and Purpose

The U.S. Nuclear Regulatory Commission (NRC) staff prepared this biological assessment (BA) to support the supplemental environmental impact statement (SEIS) for the renewal of the operating licenses for Indian Point Nuclear Generating Unit Nos. 2 and 3 (IP2 and IP3), located on the shore of the Hudson River in the village of Buchanan, in upper Westchester County, New York. The current 40-year licenses expire in 2013 (IP2) and 2015 (IP3). The proposed license renewal for which this BA has been prepared would extend the operating licenses to 2033 and 2035 for IP2 and IP3, respectively.

The NRC is required to prepare the SEIS as part of its review of a license renewal application. The SEIS supplements NUREG-1437, Volumes 1 and 2, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants (GEIS)," (NRC 1996, 1999)[1] for the license renewal of commercial nuclear power plants. The SEIS covers specific issues, such as the potential impact on endangered and threatened species, that are of concern at IP2 and IP3 and that could not be addressed on a generic basis in the GEIS. The NRC staff published the draft SEIS in December 2008 (NRC 2008) and published the final SEIS on December 3, 2010 (NRC 2010).

Pursuant to Section 7 of the Endangered Species Act of 1973 (ESA), as amended, the NRC staff requested, in a letter dated August 16, 2007 (NRC 2007), that the National Marine Fisheries Service (NMFS) provide information on Federally listed endangered or threatened species, as well as on proposed or candidate species, and on any designated critical habitats that may occur in the vicinity of IP2 and IP3. In its response, dated October 4, 2007 (NMFS 2007), NMFS expressed concern that the continued operation of IP2 and IP3 could have an impact on the shortnose sturgeon (*Acipenser brevirostrum*), an endangered species that occurs in the Hudson River. NMFS also noted that a related species that also occurs in the Hudson River, the Atlantic sturgeon (*Acipenser oxyrinchus*), is a candidate species for which NMFS has proposed listing as endangered. The NRC staff has corresponded with NMFS regarding the Atlantic sturgeon, and requests that NMFS address Atlantic sturgeon to the extent appropriate (NMFS 2010).

Under Section 7, the NRC is responsible for providing information on the potential impact that the continued operation of IP2 and IP3 could have on the Federally listed species, the shortnose sturgeon. In addition, the NRC has prepared information regarding the potential impact on important species, including the Atlantic sturgeon; this information can be found in Chapters 2 and 4 of the SEIS (NRC 2010).

The NRC staff relied on data originally supplied by the applicant, Entergy Nuclear Operations, Inc. (Entergy) in preparing the BA for IP2 and IP3 in the draft SEIS (Entergy 2007b) but

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[a] The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the "GEIS" include the GEIS and its Addendum 1.

subsequently questioned the impingement data supplied by Entergy. The NRC staff sought, and Entergy later submitted revised impingement data (Entergy 2009). Mathematical errors in the original data submitted to the NRC (Entergy 2007b) apparently resulted in overestimates of the take of shortnose sturgeon that the NRC staff presented in the previous BA. The NRC staff found that the differences in the original (Entergy 2007b) and revised (Entergy 2009) data were of sufficient magnitude to possibly affect the staff's conclusions and has issued this revised biological assessment based on the revised data.

Proposed Action

The current proposed action considered in the SEIS is the renewal of the operating licenses for IP2 and IP3 for an additional 20-year term beyond the period of the existing licenses. The applicant has indicated that it may replace reactor vessel heads and control rod drive mechanisms during the period of extended operation. (For a description of these activities and potential environmental effects, see Chapter 3 of the SEIS.) If the NRC grants the operating license renewals, the applicant can operate and maintain the nuclear units, the cooling systems, and the transmission lines and corridors as they are now until 2033 and 2035.

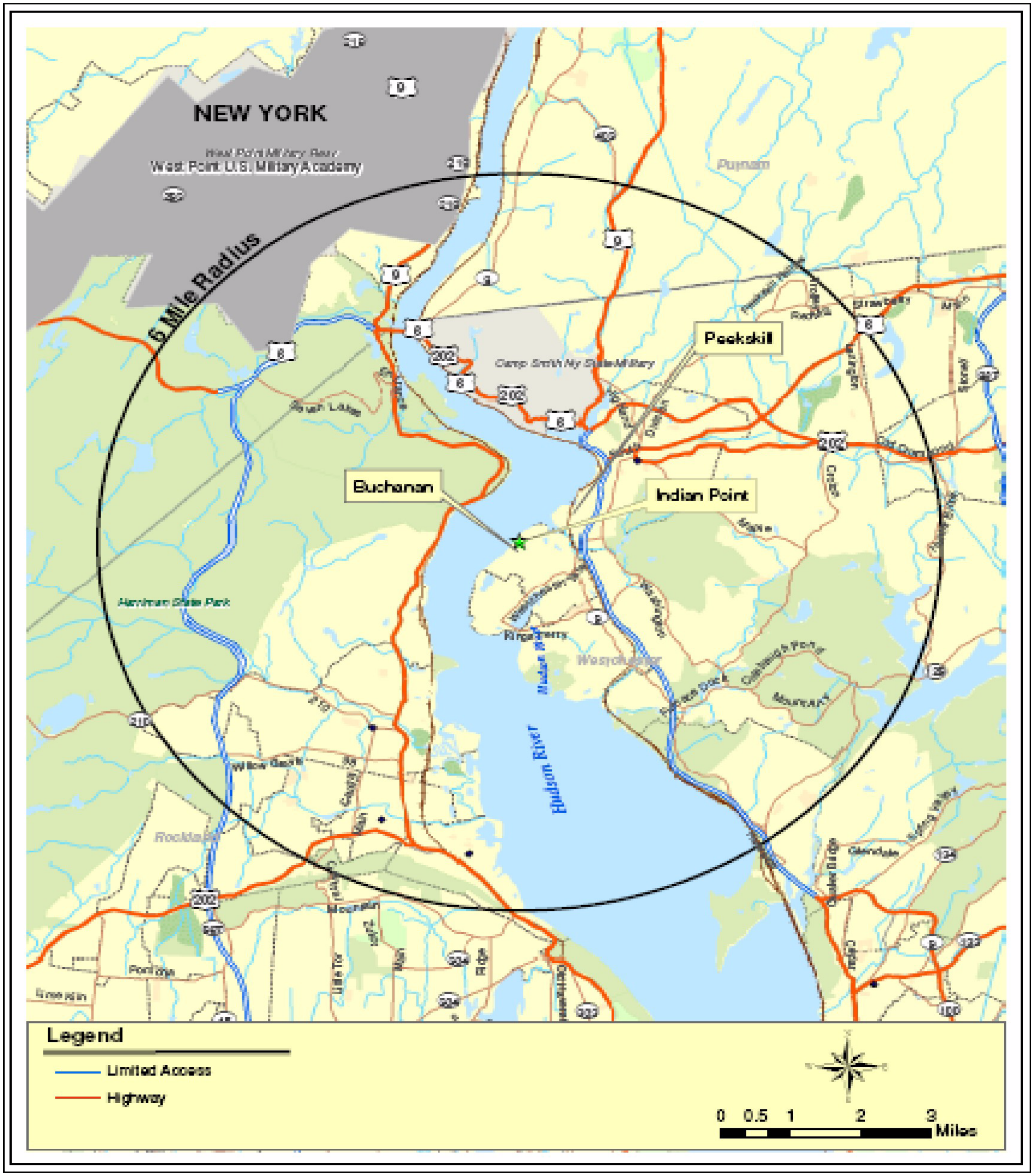
Site Description

IP2 and IP3 are located on a 239-acre (97-hectare) site on the eastern bank of the Hudson River in the village of Buchanan, Westchester County, New York, about 24 miles (mi) (39 kilometers [km]) north of New York City, New York (Figures 1 and 2). Privately owned land bounds the north, south, and east sides of the property (Figure 3). The area is generally described as an eastern deciduous forest, dominated by oak (*Quercus*), maple (*Acer*), and beech (*Fagus*) species. The lower Hudson River is a tidal estuary, flowing 152 miles (244 km) from the Federal Dam at Troy, New York, to the Battery in New York City. IP2 and IP3 are located at River Mile (RM) 43 (RKM 69), where the average water depth is 40 feet (ft) (12 meters [m]), and the average width of the river is 4500 ft (1370 m). The Hudson River is tidal all the way to the Federal Dam, and the salinity zone in the vicinity of the facility is oligohaline (low salinity, ranging from 0.5 to 5 parts per thousand (ppt)), with the salinity changing with the level of freshwater flow. Water temperature ranges from a winter minimum of 34 degrees Fahrenheit (F) (1 degree Celsius (C)) to a summer maximum of 77 degrees F (25 degrees C) (Entergy 2007a).

The mid-Hudson River provided the cooling water for four other power plants: Roseton Generating Station, Danskammer Point Generating Station, Bowline Point Generating Station, and Lovett Generating Station; all four stations are fossil-fueled steam electric stations, located on the western shore of the river, and all use once-through cooling. Roseton consists of two units and is located at RM 66 (RKM 106), 23 mi (37 km) north of IP2 and IP3. Just 0.5 mi (0.9 km) north of Roseton is Danskammer, with four units. Bowline lies about five mi (eight km) south of IP2 and IP3 and consists of two units (Entergy 2007a; CHGEC 1999). Lovett, almost directly across the river from IP2 and IP3, is no longer operating.

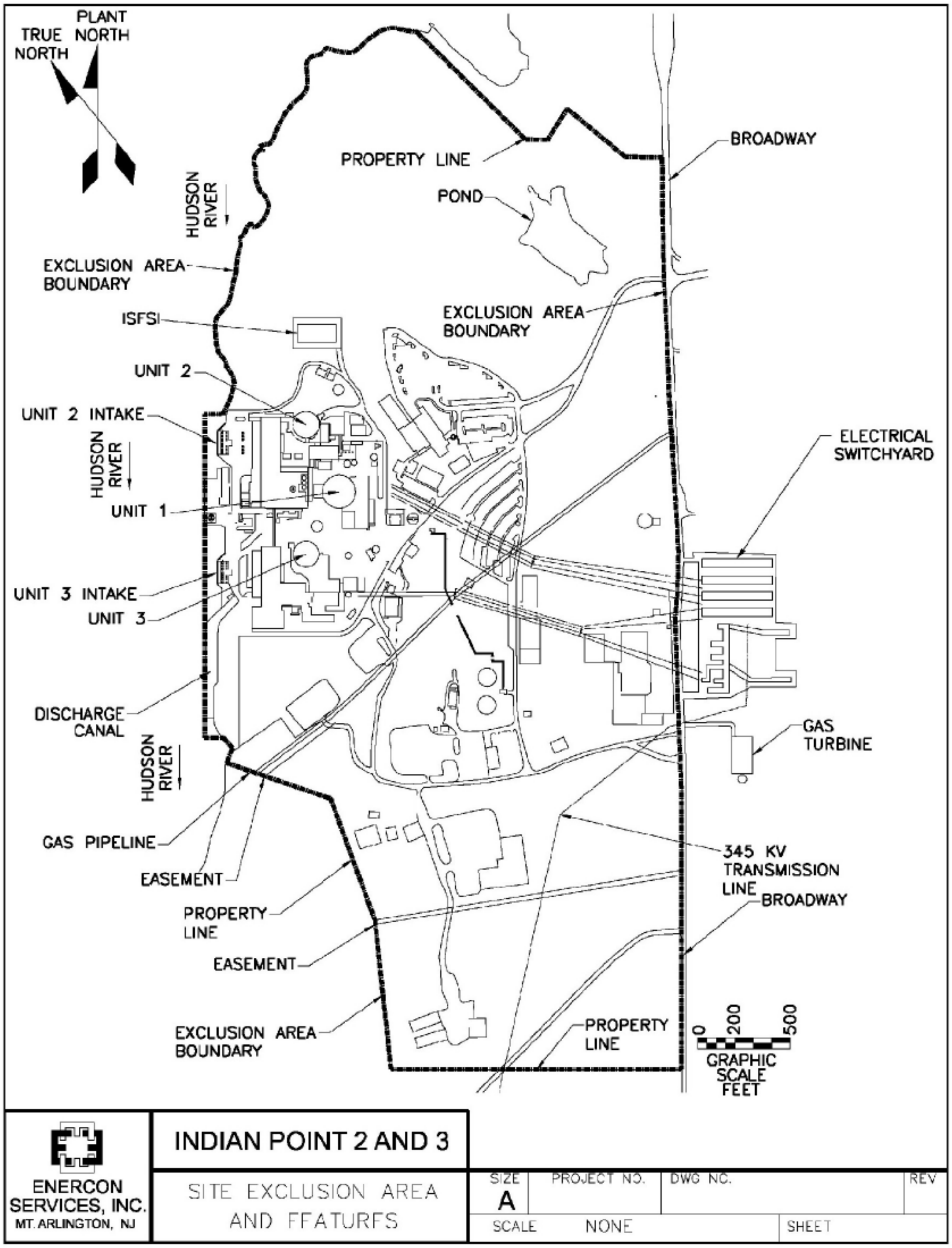
Source: Entergy 2007a

Figure 1: Location of IP2 and IP3, 50-mile (80-km) radius



Source: Entergy 2007a

Figure 2: Location of IP2 and IP3, 6-mile (10-km) radius

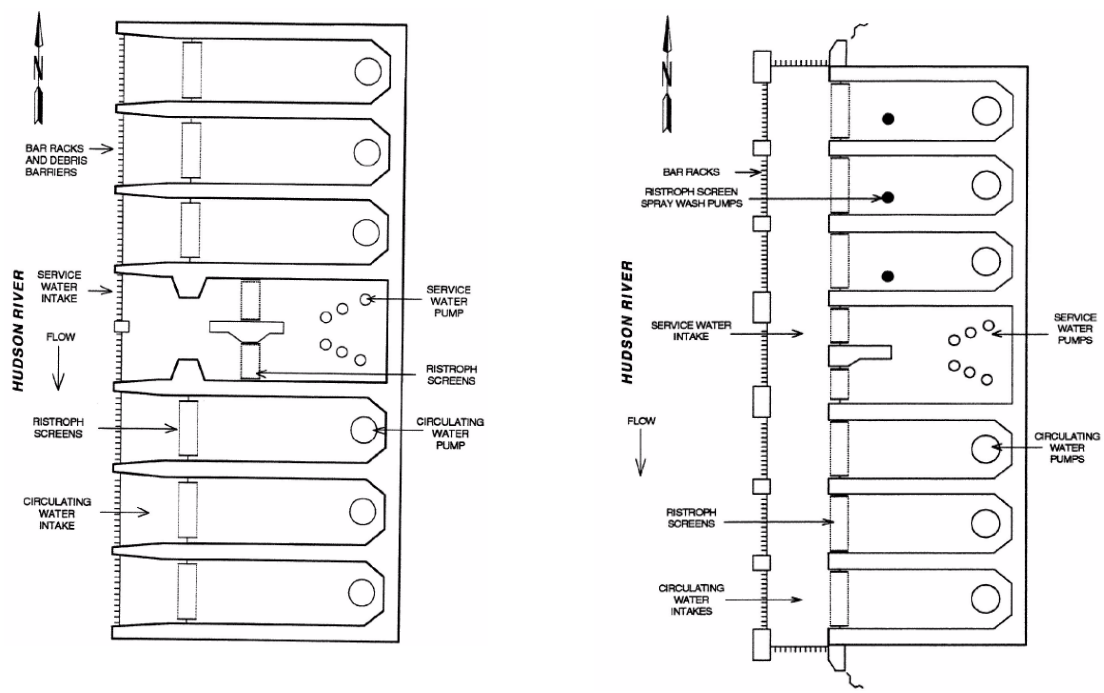


Source: Entergy 2007a

Figure 3: IP2 and IP3 property boundaries and environs

Description of Plants and Cooling Systems

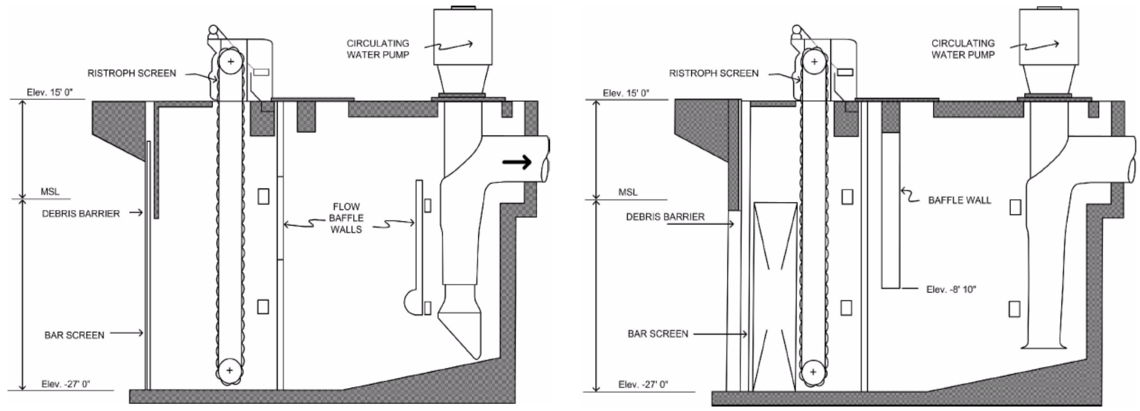
IP2 and IP3 are pressurized-water reactors with turbine generators that produce a net output of 6432 megawatts-thermal and approximately 2158 megawatts-electrical. Both IP2 and IP3 use water from the Hudson River for their once-through condensers and auxiliary cooling systems. Each unit has seven intake bays (Figure 4), into which the river water flows, passing under the floating debris skimmer wall and through Ristroph traveling screens (Figure 5). IP2 has six dual-speed circulating water pumps that can each pump 140,000 gallons per minute (gpm) (8.83 cubic meters per second [m^3/s]) at full speed and 84,000 gpm (5.30 m^3/s) at reduced speed; at full speed, the approach velocity is approximately 1 foot per second (fps) (0.30 meters per second [m/s]) and at reduced speed, the approach velocity is 0.6 fps (0.2 m/s). IP3 also has six dual-speed circulating water pumps. The full speed flow rate of each of these pumps is 140,000 gpm (8.83 m^3/s), with a 1 fps (0.30 m/s) approach velocity; the reduced speed is 64,000 gpm (4.04 m^3/s), with a 0.6 fps (0.2 m/s) approach velocity (Entergy 2007a).



Source: Entergy 2007a

Figure 4: IP2 intake structure (left) and IP3 intake structure (right)

The traveling screens employed by IP2 and IP3 are modified vertical Ristroph-type traveling screens installed in 1990 and 1991 at IP3 and IP2, respectively. The screens were designed in concert with the Hudson River Fishermen’s Association, with screen basket lip troughs to retain water and minimize vortex stress (CHGEC 1999). Studies indicated that, assuming the screens continued to operate as they had during laboratory and field testing, the screens were “the screening device most likely to impose the least mortalities in the rescue of entrapped fish by mechanical means” (Fletcher 1990). The same study concluded that refinements to the screens would be unlikely to greatly reduce fish kills.



Source: Entergy 2007a

Figure 5: IP2 intake system (left) and IP3 intake system (right)

There are two spray-wash systems—the high-pressure spray wash removes debris from the front of the traveling screen mechanism; the low-pressure spray washes fish from the rear of the mechanism into a fish sluice system to return them to the river. A 0.25 x 0.5-inch (in.) (0.635 x 1.27-centimeter (cm)) clear opening slot mesh on the screen basket panels was included to minimize abrasion as the fish were washed into the collection sluice. The sluice system is a 12-in.-diameter (30.5-cm–diameter) pipe that discharges fish into the river at a depth of 35 ft (10.7 m), 200 ft (61 m) from shore (CHGEC 1999).

Status Review of Shortnose Sturgeon

Life History

The shortnose sturgeon (*Acipenser brevirostrum*, family Acipenseridae) is amphidromous, with a range extending from the St. Johns River, FL, to the St. John River, Canada. Unlike anadromous species, shortnose sturgeon spend the majority of their lives in freshwater and move into salt water periodically without relation to spawning (Collette and Klein-MacPhee, 2002). From colonial times, shortnose sturgeon have rarely been the target of commercial fisheries but have frequently been taken as incidental bycatch in Atlantic sturgeon and shad gillnet fisheries (NEFSC 2006; Dadswell et al. 1984). The shortnose sturgeon was listed on March 11, 1967, as endangered under the ESA. In 1998, NMFS completed a recovery plan for the shortnose sturgeon (NMFS 1998).

Shortnose sturgeon can grow up to 143 cm (56 in.) in total length and can weigh up to 23 kilograms (kg) (51 pounds [lb]). Females are known to live up to 67 years, while males typically do not live beyond 30 years. As young adults, the sex ratio is 1:1; however, among fish larger than 90 cm (35 in.), measured from nose to the fork of the tail, the ratio of females to males increases to 4:1. Throughout the range of the shortnose sturgeon, males and females mature at 45 to 55 cm (18 to 22 in.) fork length, but the age at which this length is achieved varies by geography. At the southern extent of the sturgeon's range, in Florida, males reach maturity at age two, and females reach maturity at six years or younger; in Canada, males can reach maturity as late as 11 years, and females, 13 years. In one to two years after reaching maturity, males begin to spawn at two-year intervals, while females may not spawn for the first time until five years after maturing and, thereafter, spawn at three- to five-year intervals (Dadswell et al. 1984).

In the Hudson River, shortnose sturgeon migrate into freshwater to spawn during late winter or early summer when water temperatures are between 8 and 15 degrees C (NMFS 2009). Eggs sink and adhere to the hard surfaces on the river bottom, hatching after 4 to 6 days. Larvae consume their yolk sac and begin feeding in 8 to 12 days, as they migrate downstream away from the spawning site, remaining close to the river bottom (Kynard 1997; Collette and Klein-MacPhee 2002). The juveniles, which feed on benthic insects and crustaceans, do not migrate to the estuaries until the following winter, where they remain for three to five years. As adults, they migrate to the near-shore marine environment, where their diet consists of mollusks and large crustaceans (Dadswell 1984).

Status of Shortnose Sturgeon in Hudson River

Shortnose sturgeon inhabit the lower Hudson River; the Federal Dam creates a physical barrier preventing the species from swimming farther north. They are found dispersed throughout the river-estuary from late spring to early fall and then congregate to winter near Sturgeon Point (RM 86). Spawning occurs in the spring, just downstream of the Federal Dam at Troy, between RM 118 and 148 (between Coxsackie and Troy) (Bain et al. 2007; NMFS 2000). According to the NMFS environmental assessment (2000) for a permit for the incidental take of shortnose sturgeon at the nearby power plants, Roseton and Danskammer, larvae are typically found upstream of the intakes of all five power plants along the mid-Hudson River.

The Hudson River population of the shortnose sturgeon was estimated to be approximately 13,000 adults in 1979–1980. Based on population studies done in the mid-1990s, the population has apparently increased as much as 400 percent since then, up to almost 57,000 adult fish. Bain et al. (2007) suggested that the total population of the shortnose sturgeon in the Hudson River is approximately 61,000, including juveniles and nonspawning adults, although NMFS (2009) indicates that the adult population may be less than half that size (approximately 30,000 individuals). Woodland and Secor (2007) ascribed the population growth to several strong year-classes and two decades of sustained annual recruitment. Bain et al. (2007) maintained that the annual trawl surveys conducted by the electric utilities (CHGEC 1999) show an increase in abundance between the mid-1980s and mid-1990s, supporting the finding that the Hudson River population has increased. The NRC staff assessed the population trend for yearling and older shortnose sturgeon in the fall juvenile survey data provided by the applicant and found a small but statistically significant increase in the catch-per-unit-effort from 1975 to 2005.

Impact Assessment of Indian Point on the Shortnose Sturgeon Population Entrainment

The southern extent of the shortnose sturgeon spawning area in the Hudson River is approximately RM 118 (RKM 190), about 75 RM (121 RKM) upstream of the intake of IP2 and IP3 (NMFS 2000). The eggs of shortnose sturgeon are demersal, sinking and adhering to the bottom of the river, and, upon hatching, the larvae in both yolk-sac and post-yolk-sac stages remain on the bottom of the river, primarily upstream of RM 110 (RKM 177) (NMFS 2000). Shortnose sturgeon larvae grow rapidly, and, after a few weeks, they are too large to be entrained by the cooling intake (Dadswell 1979). Because the egg and larval life stages of the shortnose sturgeon (the life stages susceptible to entrainment) are not found near the intake for IP2 and IP3, the probability of their entrainment at IP2 and IP3 is low.

IP2 and IP3 monitored entrainment from 1972 through 1987. Entrainment monitoring became more intensive at Indian Point from 1981 through 1987, and sampling was conducted for nearly 24 hours per day, four to seven days per week, during the spawning season in the spring (NMFS 2000). Entrainment monitoring reports list no shortnose sturgeon eggs or larvae at IP2 and IP3. NMFS (2000) lists only eight sturgeon larvae collected at any of the mid-Hudson River power plants (all eight were collected at Danskammer, and four of the eight may have been Atlantic sturgeon). Entrainment sampling data supplied by the applicant (Entergy 2007b) include large numbers of larvae for which the species could not be determined, although sturgeon larvae are distinctive and most likely were identified when they occurred. Entergy currently conducts no monitoring program to record entrainment at IP2 and IP3, and any entrainable life stages of the shortnose sturgeon taken in recent years would go unrecorded.

Based on the life history of the shortnose sturgeon, the location of spawning grounds within the Hudson River, and the patterns of movement for eggs and larvae, the number of shortnose sturgeon in early life stages entrained at IP2 and IP3 is probably low or zero. The available data from past entrainment monitoring do not indicate that entrainment was occurring. Therefore, the NRC staff concludes that the continued operation of Indian Point for an additional 20 years is not likely to adversely affect the population of shortnose sturgeon in the Hudson River through entrainment.

Impingement

IP2 and IP3 monitored impingement of most fish species daily until 1981, reduced collections to a randomly selected schedule of 110 days per year until 1991, and then ceased monitoring in 1991 with the installation of the modified Ristroph traveling screens. IP2 and IP3 monitored the impingement of sturgeon species daily from 1974 through 1990 (Entergy 2009). As described in Section 2.2.5.3 of the 2008 draft SEIS (NRC 2008) and the final SEIS (NRC 2010), the Ristroph screens, installed in 1990 and 1991, were designed in a collaborative effort with the Hudson River Fishermen's Association to minimize the mortality of impinged fish.

In 2000, NMFS prepared an environmental assessment (EA) for the incidental take of shortnose sturgeon at Roseton and Danskammer (NMFS 2000). The EA included the estimated total number (Table 1) of shortnose sturgeon impinged at Roseton, Danskammer, Bowline Point, Lovett, and IP2 and IP3, with adjustments to include the periods when sampling was not conducted.

Table 1: Estimated Total and Average Shortnose Sturgeon Impinged by Mid-Hudson River Power Plants, Adjusted for Periods Without Sampling

	1972–1998		1989–1998	
Power Plant	**Total**	**Average No. Impinged/Year**	**Total**	**Average No. Impinged/Year**
Bowline Point	23	0.9	0	0
Lovett	0	0	0	0
IP2	37	1.4	8	0.8
IP3	26	1.0	8	0.8
Roseton	49	1.8	15	1.5
Danskammer Point	140	5.2	44	4.4
Total	275	10.2	75	7.5

Source: Adapted from NMFS 2000.

Entergy (2009) provided revised shortnose sturgeon impingement data (Table 2), which are available through the NRC's online Agencywide Documents Access and Management System (ADAMS). The average impingement rate of shortnose sturgeon at IP2 and IP3 combined from 1975 through 1990 is about four fish per year. Appendix 1 to this BA reproduces detailed information from Entergy (2009) on the impinged fish. These data are the most recent and complete available.

An increase in the population of shortnose sturgeon in the Hudson River would most likely result in an increase in impinged shortnose sturgeon at IP2 and IP3. If the population data presented by Bain et al. (2007) and Woodland and Secor (2007) are accurate, then a four-fold increase in population between the mid-1980s and mid-1990s could result in a similar increase in impingement rates. Impingement data (Table 2), however, do not increase concomitantly with population through 1990. A population increase would mean that the population-level effect of taking an individual shortnose sturgeon would decrease.

When considering the effects of impingement, it is important to consider the affected species' impingement mortality rate. For IP2 and IP3, however, there are few data regarding the survival of the shortnose sturgeon after impingement. In 1979, NMFS issued a biological opinion (BO) relating to the take of shortnose sturgeon at Indian Point (Dadswell 1979). At the time, there was only one year in which records describing the status of impinged shortnose sturgeon were kept. In that year, 60 percent of collected impinged shortnose sturgeon were dead when collected. The BO assumed both that all dead sturgeon died as a result of the impingement and that no impingement-related mortality occurred after the impinged sturgeon were released.

Table 2: Estimated* Numbers of Impinged Shortnose Sturgeon from Impingement Monitoring at Indian Point Units 2 and 3

Year	Unit 2	Unit 3
1975	3	NA
1976	2	0
1977	11	2
1978	5	5
1979	4	3
1980	0	2
1981	0	0
1982	0	0
1983	0	0
1984	3	2
1985	0	0
1986	0	0
1987	0	2
1988	7	2
1989	0	2
1990	3	0
Yearly Mean	2.8	1.2
Sum of Unit Yearly Means	4.0	

*Numbers are corrected for collection efficiency and then rounded to whole numbers.
NA means data not available.
Source: Entergy 2009, ML091950345

The BO estimated that, in a worst-case scenario, 35 shortnose sturgeon would be impinged at IP2 and IP3 per year, and that 60 percent (21 individuals) would die on the intake screens. At the time, the population of adult shortnose sturgeon in the Hudson River was estimated to be 6,000, and this level of mortality would result in a 0.3 to 0.4 percent death rate caused by impingement at IP2 and IP3 (Dadswell 1979). The average yearly impingement rate from 1975 through 1990 based on revised data (Entergy 2009) is about four shortnose sturgeon, a rate almost an order of magnitude lower than Dadswell's (1979) worst-case assumption of 35 fish per year in the BO. Also, as stated above, the population of shortnose sturgeon in the Hudson River has increased and the population-level effect of IP2/IP3 impingement is thus lower than was previously estimated by NMFS in its BO.

Because all monitoring of impingement ceased after the Ristroph screens were installed in 1991, no updated mortality rate estimates for impinged shortnose sturgeon exist at IP2 and IP3. The NRC staff does not know the current level of impingement or the level of mortality. Although the laboratory and field tests (Fletcher 1990) performed on the modified Ristroph screens were not conducted using the shortnose sturgeon, the tests did show that injury and death were reduced for most species when compared to the first version of screens that were proposed (and rejected, based on their "unexceptional performance") (Fletcher 1990). If the NRC staff assumes that the modified Ristroph screens performed as well as the Fletcher's 1990 results indicated, then mortality and injury from impingement would be lower than reported by the NMFS in its BO (Dadswell 1979), and the impact to the species would be less. Without current monitoring, however, the NRC staff cannot confirm this.

In its BO, NMFS (Dadswell 1979) found that that operation of IP2 and IP3 is "not likely to jeopardize the continued existence of the shortnose sturgeon because, even assuming 100% mortality of the impinged fish, its contribution to the natural annual mortality is negligible." The NRC staff finds that the best estimate of takes of shortnose sturgeon by IP2 and IP3 based on revised data (Entergy 2009) is much less than that assumed by Dadswell (1979) in the NMFS BO, that installation of Ristroph screens since the original BO was prepared may have decreased the mortality rate of shortnose sturgeon that are impinged, and that the population of shortnose sturgeon in the Hudson River is increasing although impingement rates appear not to have increased concomitantly through 1990. The NRC staff recognizes the difficulties in drawing conclusions from two-decade old impingement data and incomplete impingement mortality data, but concludes that, based on the best available information, impingement and entrainment resulting from operation of IP2 and IP3 for an additional 20 years beyond the original license term are not likely to jeopardize the continued existence of the endangered shortnose sturgeon in the Hudson River.

Thermal Impacts

The discharge of heated water into the Hudson River can cause lethal or sublethal effects on resident fish, influence food web characteristics and structure, and create barriers to migratory fish moving from marine to freshwater environments.

State Pollution Discharge Elimination System (SPDES) permit NY-0004472 regulates thermal discharges associated with the operation of IP2 and IP3. This permit imposes effluent limitations, monitoring requirements, and other conditions to ensure that all discharges are in compliance with Article 17 of the Environmental Conservation Law of New York State, Part 704 of the Official Compilation of the Rules and Regulations of the State of New York, and the Clean Water Act. Specific conditions of the SPDES permit related to thermal discharges from IP2 and IP3 are specified by NYSDEC (2003) and include the following:

> The maximum discharge temperature is not to exceed 110 degrees F (43 degrees C).
>
> The daily average discharge temperature between April 15 and June 30 is not to exceed 93.2 degrees F (34 degrees C) for an average of more than 10 days per year during the term of the permit, beginning in 1981, provided that it not exceed 93.2 degrees F (34 degrees C) on more than 15 days during that period in any year.

The final environmental impact statement (FEIS) associated with the SPDES permit for IP2 and IP3 (NYSDEC 2003) concludes that "Thermal modeling indicates that the thermal discharge from Indian Point causes water temperatures to rise more than allowed." The thermal modeling referred to in the FEIS appears to represent a worst-case scenario; the modeling indicates the potential for the discharges from IP2 and IP3 to violate the conditions of the IP2 and IP3 SPDES permit, which could result in a negative impact on the shortnose sturgeon. IP2 and IP3 have not yet completed triaxial thermal studies, to completely assess the size and nature of the thermal plume created by the discharge from IP2 and IP3 and the possible impact on the sturgeon. The NRC staff understands, however, that Entergy has collected triaxial thermal data, and will submit a final, verified thermal model to NYSDEC in the next year.

According to the NMFS Final Recovery Plan for the Shortnose Sturgeon (NMFS 1998), "During summer months, especially in southern rivers, shortnose sturgeon must cope with the physiological stress of water temperatures that often exceed 82 degrees F (28 degrees C)." Although the area closest to the discharge from IP2 and IP3 can exceed these temperatures, the summer maximum temperature of the Hudson River in the area of IP2 and IP3 is 77 degrees F (25 degrees C) (Entergy 2007a). The combined discharge from both Indian Point units is about 1.75 million gpm (110 m^3/s), including the service water (Entergy 2007a). Table 3 presents the net downstream flow (controlling for the influence of tides) of the Hudson River at Indian Point. These data suggest that discharges from IP2 and IP3 equal, at most, 15% of the river flow 20% of the time, while up to 2% of the time, IP2 and IP3 discharges equal 97% or more of the downstream river flow. This variation – due to differences in seasonal precipitation, tidal influence, and other factors – suggests that discharges may mix in very different ways under different conditions.

Table 3: Cumulative Frequency Distribution of Net Downstream Flows of Hudson River

Million gallons per minute (gpm)	Cumulative percentile
11.7	20
6.8	40
4.71	60
3.1	80
1.8	98

Adapted from Entergy 2007a

The NRC staff cannot determine, based on available information, whether a shortnose sturgeon in the Hudson River would experience any prolonged physiological stress from the thermal plume caused by the discharge from IP2 and IP3. Shortnose sturgeon could be forced to seek refuge from elevated water temperatures as they are forced to do in southern rivers, and this could limit their available habitat. If studies reveal that the plume is buoyant, shortnose sturgeon could pass underneath the plume on their passage past the facility, but there are no data to indicate that this is the case.

As noted earlier, the NYSDEC thermal modeling of the Hudson River suggests that the discharge from IP2 and IP3 could exceed the limits specified in the SPDES permit, but without a triaxial thermal study, the exact size and nature of the thermal plume is unknown. Information about the species, based on the NMFS recovery plan, suggests that increased temperatures can have a significant effect on the shortnose sturgeon. Therefore, the NRC staff concludes that the continued thermal effects from operation of IP2 and IP3 for an additional 20 years could potentially adversely affect the population of shortnose sturgeon in the Hudson River through thermal discharge, but the staff is unable to determine the extent to which the population would be affected.

Conclusion

Renewal of the operating licenses of IP2 and IP3 to include another 20 years of operation could potentially adversely affect the population of shortnose sturgeon in the Hudson River due to the thermal effects of once-through cooling. An analysis of the revised impingement data recently submitted by Entergy indicates that impingement and entrainment would not adversely affect the population of shortnose sturgeon. Sufficient information is not available at this time for the NRC staff to quantify the extent to which the shortnose sturgeon population could be affected by thermal effects, though forthcoming data is likely to provide additional information.

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Appendix 1 to Biological Opinion

This appendix presents a reproduction of Tables 2a, 2b and 4 from Entergy (2009) showing detailed information on shortnose sturgeon impinged at IP2 and IP3 for the years 1974 through 1990. The Entergy submittal is available at ADAMS Accession No. ML091950345.

Table 2a. Individual Data File Records of Shortnose Sturgeon Collected by Impingement at Indian Point Unit No. 2 in Each Year, 1974 through 1990.

Unit	Year	Taxon	Date	Sample Number	Total Weight (g)	Length (mmtl)	Condition (alive or dead)	H2O Temp (deg C)	Total Count	Table V-36 DEIS 1999	DSEIS 2008 Table 4-11	Coll. Eff. Adj_Cnt	Comments
2	1974	Shortnose Sturgeon	5-May-74	212508	532			7.0	1			2.19	
2	1974	Shortnose Sturgeon	20-Jun-74	217109	1702			21.5	1			3.02	
2	1974	Shortnose Sturgeon	8-Aug-74	222009	1588			25.7	1			3.39	
2	**Total 1974**	**Shortnose Sturgeon**							**3**	**3**	**NR**	**8.60**	**1974 not reported in DESIS Table 4-11**
2	1975	Shortnose Sturgeon	20-Jun-75	217109	84			23.0	1			3.14	
2	**Total 1975**	**Shortnose Sturgeon**							**1**	**1**	**3**	**3.14**	
2	1976	Shortnose Sturgeon	16-Feb-76	204708	253			2.5	1			2.01	
2	**Total 1976**	**Shortnose Sturgeon**							**1**	**2**	**2**	**2.01**	
2	1977	Shortnose Sturgeon	23-Jan-77	202309	516			0.5	1			1.94	
2	1977	Shortnose Sturgeon	23-Feb-77	205409	1800			3.0	1			2.03	
2	1977	Shortnose Sturgeon	2-Apr-77	209209	67			5.3	2			4.23	two fish combined; no individual records
2	1977	Shortnose Sturgeon	25-May-77	214509	73			19.2	1			2.85	
2	**Total 1977**	**Shortnose Sturgeon**							**5**	**6**	**11**	**11.06**	
2	1978	Shortnose Sturgeon	9-Jan-78	200904	27			1.7	1			1.98	
2	1978	Shortnose Sturgeon	14-Nov-78	231808	940			14.5	1			2.55	
2	**Total 1978**	**Shortnose Sturgeon**							**2**	**2**	**5**	**4.53**	
2	1979	Shortnose Sturgeon	28-Feb-79	205909	567			0.7	1			1.95	
2	1979	Shortnose Sturgeon	29-Apr-79	211908	625			10.9	1			2.36	
2	**Total 1979**	**Shortnose Sturgeon**							**2**	**2**	**4**	**4.31**	
2	**Total 1980**	**Shortnose Sturgeon**							**0**	**0**	**NR**	**0.00**	
2	**Total 1981**	**Shortnose Sturgeon**							**0**	**0**	**NR**	**0.00**	
2	**Total 1982**	**Shortnose Sturgeon**							**0**	**0**	**NR**	**0.00**	
2	**Total 1983**	**Shortnose Sturgeon**							**0**	**0**	**NR**	**0.00**	
2	1984	Shortnose Sturgeon	30-May-84	215108	673			17.8	1			2.75	
2	**Total 1984**	**Shortnose Sturgeon**							**1**	**1**	**176**	**2.75**	
2	**Total 1985**	**Shortnose Sturgeon**							**0**		**NR**	**0.00**	
2	**Total 1986**	**Shortnose Sturgeon**							**0**	**0**	**NR**	**0.00**	
2	1987	Shortnose Sturgeon	8-Mar-87	206707	127	320	D	3.0	1			2.03	
2	1987	Shortnose Sturgeon	27-Feb-87	NS	1845	710	A	4.3	1			2.08	
2	**Total 1987**	**Shortnose Sturgeon**							**2**	**1(1)**	**116**	**4.11**	
2	1988	Shortnose Sturgeon	1-Feb-88	NS	637	580	D	1.6	1			1.98	
2	1988	Shortnose Sturgeon	27-Apr-88	NS	1160	605	D	14.1	1			2.52	
2	1988	Shortnose Sturgeon	4-Nov-88	NS	1785	672	D	13.9	1			2.52	
2	**Total 1988**	**Shortnose Sturgeon**							**3**	**0(3)**	**NR**	**7.02**	
2	**Total 1989**	**Shortnose Sturgeon**							**0**	**0**	**NR**	**0.00**	
2	1989	Shortnose Sturgeon	18-Sep-90	NS	687	443	D	25.5	1			3.37	
2	**Total 1990**	**Shortnose Sturgeon**							**1**	**0(1)**	**NR**	**3.37**	
2	**1975-1990**	**Shortnose Sturgeon**							**18**	**18(5)**	**317**	**42.31**	

NS Collected on a non-scheduled sampling date
NR Not reported
na Not available
1.7 Water temperature estimated from weekly average
Blank space = no data in the SAS Impingement Data Files
(1) Numbers in parentheses indicate number of shortnose sturgeon taken on non-sample days.

Table 2b. Individual Data File Records of Shortnose Sturgeon Collected by Impingement at Indian Point Unit No. 3 in Each Year, 1974 through 1990.

Unit	Year	Taxon	Date	Sample Number	Total Weight (g)	Length (mmtl)	Condition (alive or dead)	H2O Temp (deg C)	Total Count	V-36 DEIS 1999	DSEIS 2008 Table 4-11	Coll. Eff. Adj_Cnt	Comments
3	**Total 1974**	**Shortnose Sturgeon**							**0**	**NR**	**NR**	**0.00**	
3	**Total 1975**	**Shortnose Sturgeon**							**NR**	**NR**	**NR**	**NR**	
3	**Total 1976**	**Shortnose Sturgeon**							**0**	**0**	**NR**	**0.00**	
3	1977	Shortnose Sturgeon	23-Sep-77	326609	99			23.0	1			1.87	
3	**Total 1977**	**Shortnose Sturgeon**							**1**	**1**	**2**	**1.87**	
3	1978	Shortnose Sturgeon	27-Jan-78	302709	65			3.8	1			1.46	
3	1978	Shortnose Sturgeon	2-Mar-78	306109	54			2.9	1			1.44	
3	1978	Shortnose Sturgeon	27-May-78	314709	62			16.9	1			1.72	
3	**Total 1978**	**Shortnose Sturgeon**							**3**	**3**	**5**	**4.62**	
3	1979	Shortnose Sturgeon	3-Apr-79	309309	450			8.0	1			1.53	
3	1979	Shortnose Sturgeon	4-May-79	312407	595			12.2	1			1.61	
3	**Total 1979**	**Shortnose Sturgeon**							**2**	**2**	**3**	**3.14**	
3	1980	Shortnose Sturgeon	29-Apr-80	312004	525			13.3	1			1.64	
3	**Total 1980**	**Shortnose Sturgeon**							**1**	**1**	**2**	**1.64**	
3	**Total 1981**	**Shortnose Sturgeon**							**0**	**0**	**NR**	**0.00**	
3	**Total 1982**	**Shortnose Sturgeon**							**0**	**0**	**NR**	**0.00**	
3	**Total 1983**	**Shortnose Sturgeon**							**0**	**0**	**NR**	**0.00**	
3	1984	Shortnose Sturgeon	19-May-84	314010	598			15.8	1			1.69	
3	**Total 1984**	**Shortnose Sturgeon**							**1**	**1**	**154**	**1.69**	
3	**Total 1985**	**Shortnose Sturgeon**							**0**	**0**	**NR**	**0.00**	
3	**Total 1986**	**Shortnose Sturgeon**							**0**	**0**	**NR**	**0.00**	
3	1987	Shortnose Sturgeon	29-Apr-87	311908	325	433	D	13.0	1			1.63	
3	**Total 1987**	**Shortnose Sturgeon**							**1**	**1**	**55**	**1.63**	
3	1988	Shortnose Sturgeon	19-Aug-88	323210	479	434	D	28.0	1			2.02	
3	**Total 1988**	**Shortnose Sturgeon**							**1**	**1**	**186**	**2.02**	
3	19899	Shortnose Sturgeon	6-Oct-89	NS	600	530	A	21.0	1			1.82	
3	**Total 1989**	**Shortnose Sturgeon**							**1**	**0(1)**	**NR**	**1.82**	
3	**Total 1990**	**Shortnose Sturgeon**							**0**	**0**	**NR**	**0.00**	
3	**1975-1990**	**Shortnose Sturgeon**							**11**	**10(1)**	**407**	**18.43**	

NS Collected on a non-scheduled sampling date

NR Not reported

na Not available

1.7 Water temperature estimated from weekly average

Blank space = no data in the SAS Impingement Data Files

(1) Numbers in parentheses indicate number of shortnose sturgeon taken on non-sample days.

Table 4. Impingement Data File Level 5 Actual Counts and Level 5 Counts Adjusted for Collection Efficiency for Shortnose and Atlantic Sturgeon Collected in Impingement Samples, Indian Point, 1975 through 199(

	IP2						IP3						IP2 & IP3	
	Shortnose Sturgeon		Atlantic Sturgeon		Total IP2		Shortnose Sturgeon		Atlantic Sturgeon		Total IP3			
Study Year	Level 5 Count	Level 5 Count Adjusted for Collection Efficiency[a]	Level 5 Count	Level 5 Count Adjusted for Collection Efficiency	Level 5 Count	Level 5 Count Adjusted for Collection Efficiency	Level 5 Count	Level 5 Count Adjusted for Collection Efficiency	Level 5 Count	Level 5 Count Adjusted for Collection Efficiency	Level 5 Count	Level 5 Count Adjusted for Collection Efficiency	Grand Total Level 5 Count	Grand Total Level 5 Collection Efficiency Adjusted Count
1975	1	3.14	118	301.81	119	304.95	NR	NR	NR	NR	NR	NR	119	304.95
1976	1	2.01	8	16.64	9	18.65	0	0.00	8	14.09	8	14.09	17	32.74
1977	5	11.06	44	104.85	49	115.91	1	1.87	153	252.20	154	254.07	203	369.98
1978	2	4.53	16	38.28	18	42.81	3	4.62	21	31.43	24	36.05	42	78.86
1979	2	4.31	32	74.75	34	79.06	2	3.14	38	60.97	40	64.11	74	143.17
1980	0	0.00	9	23.72	9	23.72	1	1.64	10	16.58	11	18.22	20	41.94
1981	0	0.00	3	8.01	3	8.01	0	0.00	5	7.46	5	7.46	8	15.47
1982	0	0.00	1	2.39	1	2.39	0	0.00	1	1.41	1	1.41	2	3.80
1983	0	0.00	3	6.11	3	6.11	0	0.00	0	0.00	0	0.00	3	6.11
1984	1	2.75	3	6.43	4	9.18	1	1.69	5	9.75	6	11.44	10	20.62
1985	0	0.00	9	19.23	9	19.23	0	0.00	17	25.00	17	25.00	26	44.23
1986	0	0.00	2	5.54	2	5.54	0	0.00	5	5.79	5	5.79	7	11.33
1987	2	4.11	2	6.01	4	10.12	1	1.63	1	1.79	2	3.42	6	13.54
1988	3	7.02	1	2.11	4	9.13	1	2.02	0	0.00	1	2.02	5	11.15
1989	0	0.00	0	0	0	0.00	1	1.82	0	0.00	1	1.82	1	1.82
1990	1	3.37	0	0	1	3.37	0	0.00	2	3.07	2	3.07	3	6.44
Grand Total	**18**	**42.30**	**251**	**615.88**	**269**	**658.18**	**11**	**18.43**	**266**	**429.54**	**277**	**447.97**	**546**	**1,106.15**

NR - Not reported

[a] Unit specific collection efficiency coefficients calculated according to the equations presented in the 1990 Indian Point Annual Report and applied to the Level 5 raw count.