AFFIDAVIT OF VICTOR J. SCHULER
SENIOR VICE PRESIDENT
ICHTHYOLOGICAL ASSOCIATES, INC.

STATE OF DELAWARE)
) SS.
COUNTY OF CASTLE)

VICTOR J. SCHULER, of full age, being duly sworn according to law, upon his oath deposes and says:

1. I am Senior Vice President of Ichthyological Associates, Inc. ("IA"). Since 1968 I have served as Resident Project Director of all ecological studies conducted in relation to the Salem Nuclear Generating Station and the Hope Creek Generating Station, both located on Artificial Island in New Jersey. These studies are sponsored by Public Service Electric and Gas Company ("PSE&G"). My responsibilities include advising PSE&G on ecological matters, and the direction and supervision of the more than 60 life scientists doing aquatic and terrestrial ecological research in the various Artificial Island studies.

2. I received a Bachelor of Science Degree from Cornell University in 1966 and a Master of Science degree from the same institution in 1969. From 1966 until 1968 I was a staff research assistant at Cornell University and participated in a number of research projects involving Cayuga Lake. From 1967 to 1968 I was employed by IA as a Senior

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Research Biologist. I was engaged in research regarding swim speeds and stamina of fishes in Conowingo Reservoir in Pennsylvania. From 1968 to the present I have been employed by IA as Senior Scientist, Project Director, Vice President and presently Senior Vice President, in conjunction with ecological studies in the Delaware River and estuary with reference to nuclear generating station siting and licensing. I have conducted or supervised research in the areas of species population and life history, swim speed of fishes, fish-way design, evaluation of dredging on resident and anadromous fishes, cooling-water intake structure design, effects of heated plumes on aquatic organisms, power plant siting, and entrainment and impingment of aquatic organisms in industrial cooling water systems. Research conducted by myself or under my direct supervision has resulted in more than 35 technical and scientific reports.

3. I am a life member of the American Fisheries Society and Professionally Certified by that organization. I am also a member of the Atlantic Estuarian Research Society and American Institute of Fisheries Research Biologists.

4. Ichthyological Associates, Inc. is an ecological consulting firm that has served a national clientele since 1966. The founder and President is Edward C. Raney, Professor of Zoology Emeritus, Cornell University, an internationally recognized expert in aquatic biology. The officers and

senior staff are practicing scientists with individual and combined records of expertise and achievement. IA has office-laboratories in New York, Pennsylvania, Delaware and New Jersey. The staff of more than 250 biologists includes competence in all types of aquatic and terrestrial field studies, laboratory and experimental research, fish screening and diversion studies, and hydrological studies.

5. Ichthyological Associates has been ecological consultant to Public Service Electric & Gas Company on the Salem project since 1968 and the Hope Creek project since 1973. I have served as Resident Project Director since its inception. In that capacity, IA has designed and conducted studies to define the aquatic community of the Delaware River near Artificial Island, and to anticipate and minimize its involvement, and to determine the ecological significance thereof, with the Salem Station. Similar predictive studies have been done for the Hope Creek Station. Throughout the design and construction of the intake structures for Salem and Hope Creek, IA has been consulted by PSE&G. I am familiar with the development and present status of both intake systems. The intake structures for the two stations are described in the affidavit of Robert P. Douglas, Licensing Manager of PSE&G. I have been directly involved in determining the ecological efficacy of the Salem Intake through continuous sampling and data interpretation in impingement

and entrainment monitoring programs. IA, through me and the other scientists participating in the Artificial Island studies, has had significant input into the design of and conducted proof-of-concept research and development of the Hope Creek intake system as described in detail in the Affidavit of Robert P. Douglas at ¶¶ 11-15.

6. The water screening system at Salem was initially and still is a vertical travelling screen array. However, as more fully described in the Affidavit of Robert P. Douglas, pre-screen flow patterns and thru-screen velocities have been adjusted, the screens themselves have been significantly modified, and complementing facilities have been added, to collectively minimize the extent and effect of aquatic organism involvement with the system. IA has throughout, by PSE&G mandate, been responsible for the identification of potential problems and for recommendation of existing or development of prototype technology to maximize protection to aquatic life. The present system incorporates provisions for minimal impingement time for fish that do contact the screens through continuous rotation of the travelling screens. Each screen basket is fitted with a full-length water-filled trough in which impinged fish are transported over the top screen sprocket and from which they are quickly transferred, by means of soft spray, to a sluice common to all screens which exits back in the river and in which is maintained a

continuous flow of water. By this system, time and trauma of screen involvement are minimized, and organisms are returned to their natural waters in as good condition as possible. Numbers and conditions of organisms are regularly monitored during scheduled sampling, and the efficiency of this system has been demonstrated. An additional capability to discharge the sluice flow in the direction of tidal flow largely precludes recirculation and further enhances survival.

7. The shortnose sturgeon is characterized by a fusiform, nearly cylindrical body, an elongated snout rounded at the tip which extends over a small protusable toothless mouth, and an essentially cartilaginous skeleton. Its scales have degenerated to form heavy bony scutes or shields which are pronounced in young individuals but become blunter and less defined with age. The shortnose sturgeon is small compared to other sturgeons, attaining a maximum length of about 97 cm (fork length, FL)(Dasdwell, 1979).

8. The shortnose sturgeon inhabits large estuaries and nearshore waters along the Atlantic coast of North America from New Brunswick, Canada to the Saint Johns River, Florida. Reproducing populations have recently been studied in the Saint John River, New Brunswick, Canada (Dadswell, 1979); Montsweag Bay, Maine (McCleave et al., 1977), the upper Connecticut River, Massachusetts (Taubert and Reed, 1978a, 1978b), the Hudson River, New York (Dovel, 1978) and the

Altamaha River, Georgia (Heidt and Gilbert, 1979). The status of populations in other drainages is unknown at present.

9. Utilization of various regions of an estuary by shortnose sturgeon is dependent on life stage, season, and, to some extent, latitude. Recent evidence suggests that northern populations remain essentially within the estuary throughout the year whereas southern populations may spend considerable periods in coastal waters, entering estuaries primarily in spring to spawn.

10. Seasonal movements of shortnose sturgeon have been studied in detail only in the Saint John River Estuary (Dadswell, 1979). In that system, adults move in spring from overwintering areas in the deeper, high salinity, portion of the lower estuary to the upper tidal freshwater reaches to spawn. After spawning, adults may remain in the upper estuary but generally move to a summer foraging area located mid-estuary between the 1 and 3 ppt isohalines. Juveniles remain in the upper estuary until they are ca 45 cm in length and are ca. 8 years of age. Older juveniles, and adults between spawning periods (males generally spawn once every 2 years and females once every 3-5 years), may remain in the lower estuary during spring and summer, moving inshore to inhabit shallow waters near the mouths of tidal creeks and embayments. In fall most adults and some juveniles

leave the foraging areas and move towards the overwintering areas. Some ripening adults, however, may migrate upriver in fall and overwinter in freshwater near the spawning areas.

11. Northern populations spawn during early to mid-May at water temperature of 10-15 C in New Brunswick (Dadswell, 1979), and 10-12 C in the Connecticut River (Taubert and Reed, 1978a, 1978b); more southern populations spawn somewhat earlier. In the Hudson River Estuary spawning appears to take place in late April and early May (Dovel, 1978); in the Delaware River it occurs during mid- to late April (Meehan, 1910; Hoff, 1965). Eggs of the shortnose sturgeon are demersal and adhere to the gravel, rubble, and boulders which comprise the preferred spawning substrate (Taubert and Reed, 1978a, 1978b; Dadswell, 1979). Larvae remain closely associated with the spawning substrate and seldom enter the drift component of the river.

12. Growth rate and age at maturation vary considerably with latitude. Dadswell (1979) reported that shortnose sturgeon in New Brunswick, Canada, averaged 50 cm, 90 cm, and 100 cm (FL) at 9, 25, and 35 years of age, respectively. In this population 50 percent of the males and females were mature at 12.4 and 17.2 years old, respectively. In the Altamaha River, Georgia growth is more rapid, with specimens attaining 50 cm after 2 years and 90 cm at 10 years of age; males were mature at 5 years and females at 8 years.

13. Swim speed studies by M. J. Dadswell (Biological Station, St. Andrews, N.B.; pers. comm.) with juvenile shortnose sturgeon 15-35 cm in length have demonstrated maximum swim speeds of ca. 2 body lengths per second. Cruising or "wandering" speeds of ultrasonically tagged adults, averaged over 6-11 hr periods, ranged from 0.07 to 0.37 body lengths per second (8.1-34.0 cm per sec) (McCleave et al., 1977).

14. The original taxonomic description of the shortnose sturgeon, which was based on specimens from the Delaware River Estuary, was by LeSueur (1818) who stated that the shortnose sturgeon was sought commercially and commanded a higher price than the Atlantic sturgeon in the Philadelphia market. Other historical literature, published during the late nineteenth and early twentieth centuries, suggest that abundance was low. Ryder (1890) felt that the five shortnose sturgeon he obtained in 1888 were the first positively identified specimens taken in the Delaware River since LeSueur's type specimens, and he concluded that the species was not very abundant. Vladykov and Greeley (1963) recorded six specimens from the Delaware River between 1907 and 1913, and Meehan (1910) reported the capture of 18 specimens near Torresdale, Pa. in 1906.

15. It is likely, however, that the abundance of the shortnose sturgeon in the Delaware River Estuary has been

severely underestimated. Its close resemblance to the more common Atlantic sturgeon has probably resulted in many shortnose sturgeon being mistaken for young Atlantic sturgeon. It is known that considerable numbers of "young" sturgeon were and continue to be taken as a by-catch of the shad and other gill net fisheries, but since these were not properly identified or enumerated it is not known what proportion were shortnose.

16. A moderate number of shortnose sturgeon have been taken in recent years incidental to other fishery investigations. From 1954 to the present there have been 40 documented or semi-documented captures (excluding the two specimens involved with the Salem CWS intake) of shortnose sturgeon in the Delaware River Estuary. Two were recorded in 1954 at Scudder's Falls (Hoff, 1965) and the balance were taken between 1969 and 1979. Some 17 specimens were captured in the upper tidal freshwater portion of the estuary between Newbold Island and Trenton, NJ (RM 125-138); two above the Fall Line at Lambertville, PA (RM 149); eight near Pea Patch Island, DE (RM 61); two near Artificial Island (RM 50); and 10 in Delaware Bay near Little Creek, DE (RM 28). Twenty-five were taken in small mesh gill nets during shad and river herring surveys, nine were taken by 16-ft bottom trawl, two were foul-hooked, one was found dead on shore, and method of capture is not known for one specimen. The seasonal-spatial distri-

bution of specimens for which capture dates are known appeared similar to that observed in other estuaries (Dadswell, 1979). Of those taken in tidal freshwater, twelve were taken during spring and summer, and four during fall. The specimens near Artificial Island were taken in April and July, and those in the lower Bay during March and April. This distribution, however, may reflect more the distribution of sampling effort rather than the relative distribution of the shortnose sturgeon population.

17. In addition to these "documented" captures there is considerable anecdotal evidence that shortnose sturgeon are taken frequently by commercial fishermen, incidental to their operations for white perch, American shad, and weakfish.

18. A former shad gillnetter who fished the Delaware River near Bordentown, NJ, during the 1920's and 1930's told IA personnel in 1975 that he averaged about two shortnose sturgeon, which he called "mamooch," per day of fishing.

19. A commercial fisherman who is also an experienced and highly regarded fishery biologist told IA that he caught "hundreds of shortnose sturgeon" while fishing for Atlantic sturgeon out of Delaware City, DE, during the 1940's, 1950's and 1960's.

20. More recently, several responsible commercial gill-netters who have worked closely with IA personnel on fishery and blue crab surveys have found sturgeon, from 0-30 per

day, while fishing in Delaware Bay. Although most of these have been Atlantic sturgeon, shortnose sturgeon are also frequently observed. Several offshore trawl captains have recently told of having found shortnose sturgeon 10-15 miles off the mouth of Delaware Bay and Ocean City, MD during early fall.

21. The first shortnose sturgeon, approximately 45 cm, collected at the Salem Generating Station was taken on January 12, 1978 from the outboard trash bars, by plant personnel, at about 1100 hrs. It was considerably decomposed and considering the low water temperature and frequent cleaning of the trash bars was probably dead long before it contacted the intake structure. Identification was not certain at time of capture so the specimen was preserved and returned to the IA Middletown Lab where identification was verified and measurements taken.

22. The second specimen was found in the Salem inclined trash screen dumpster on June 26, 1978 at about 1300 hrs. and had been lifted via the travelling screens. The specimen, approximately 63 cm, was severely damaged and as it was obvious that the specimen would not survive if returned to the river, it was placed in a flowing ambient temperature river water bath in an attempt at resuscitation. This attempt was unsuccessful and the sturgeon died about 15 hours later. The specimen showed pronounced retraction of the abdomen

which allowed it to pass through the three-inch distance between the trash bars and which suggested that it was in poor physical condition prior to impingement. Based upon my knowledge of the swim speeds of the Shortnose Sturgeon, it is my conclusion that a healthy specimen would have easily been able to avoid the intake structure. It was returned to Middletown on the morning of June 27, measured, and preserved. The specimen was set aside for about 2 weeks. Mr. Roy Miller of the Delaware Department of Fish and Wildlife was notified on or about July 13, 1978 by Harold M. Brundage, III, an IA Senior Research Biologist. In a further discussion about one day later, Mr. Miller told Mr. Brundage and myself that the appropriate federal agencies had been notified. Both this and the previous specimen were transferred to the State on or about July 15, 1978.

23. A third shortnose sturgeon (83 cm) was taken by 16-ft bottom trawl near Artificial Island on July 27, 1979. The specimen was measured and released, and observed to swim vigorously away. Capture data were received on the morning of July 30, 1979, and Roy Miller was immediately notified by phone. Mr. Miller responded that we had fulfilled our obligation and that no further action was necessary.

24. Ichthyological Associates, Inc. has studied the fish community in the Delaware River Estuary since mid-1968 as part of a broad ecological investigation for the Salem Generating Station. During 1968 through mid-1978 the study

was centered on the region approximately 10 miles north and south of Artificial Island. In July 1978 the study was expanded to sample from the mouth of Delaware Bay (RM 0) to Wilmington, DE (RM 73).

25. Through 1969, the study was largely exploratory and various sampling devices were evaluated. The 16-ft semi-balloon bottom trawl was found to most effectively sample the types and size classes of fishes expected to be involved with the Salem cooling water intake and thermal plume. To more completely sample the fish community, samples were also taken with small mesh gill nets and beach seines.

26. From mid-1968 through mid-1979 approximately 11,700 trawl hauls were made in which only one shortnose sturgeon was taken. Although the 16-ft trawl is not considered optimum for adult shortnose sturgeon capture, this species is vulnerable to the gear, and this extremely low catch-frequency suggests that the species is not abundant near Artificial Island. Salem's cooling water system can also be regarded as a continuous, efficient (at least for smaller size classes) sampling device. The fact that only two shortnose sturgeon, one previously dead and the other damaged, have been observed at Salem indicates that impingeable size classes are not present near Artificial Island.

27. In addition to sampling for juvenile and adult fish an extensive quantitative sampling program for fish eggs

and larvae (ichthyoplankton) has been conducted since 1973. No shortnose sturgeon eggs or larvae have been taken, nor would they be expected due to the distant location of the expected upstream spawning grounds and the close association of eggs and larvae with the substrate.

28. The operation of the Salem and Hope Creek Generating Stations are not expected to impact the Shortnose Sturgeon population in the Delaware River Estuary for the following reasons:

a) No entrainment of shortnose sturgeon or larvae through the cooling water systems of these plants is expected. Based on the locations of spawning grounds in other estuaries (Dadswell, 1979; Taubert and Reed, 1978a, 1978b) and the capture of ripe females in the Delaware River Estuary (Meehan, 1910; Hoff, 1965) spawning is inferred to occur only in the upper tidal fresh-water reaches far upstream of Artifical Island. Eggs are demersal and adhesive and early larvae remain closely associated with the spawning substrate and rarely enter river drift.

b) Juvenile shortnose sturgeon are expected to remain in freshwater until they are 45 cm in length and therefore would not be available or vulnerable to the plants' intakes.

c) Adult shortnose sturgeon are expected to utilize the river near Artificial Island only during spring and fall principally as a migratory route between downbay overwintering areas and upriver spawning and foraging areas. There is no evidence that a habitat for the Shortnose Sturgeon exists at or near Artificial Island.

d) Even when shortnose sturgeon are present near the Salem intake healthy individuals are not expected to be impinged since their swim speed greatly exceeds the intake current velocity which averages 0.3 m/s. Juvenile shortnose sturgeon (15-35 cm) have demonstrated maximum swim speeds of ca. 2 body lengths per second (M. J. Dadswell, Biological Station, St. Andrews N.B.; pers. comm.). In addition, even cruising speeds of adults averaged over 6-11 hr periods were found to be frequently in excess of the mean intake velocity.

e) Even in the unlikely event that a shortnose sturgeon were impinged at Salem it would most likely be returned to the river in good condition by the fish return system (See Affidavit of Robert P. Douglas).

f) The Hope Creek Generating Station will employ closed cycle cooling via natural draft cooling towers and, as such, will require relatively small amounts of water from the river, thus greatly reducing the probability of impingement or entrainment. Further, there has been intensive consideration of various subsystems to even further minimize entrainment and impingement losses of life stages of all fish.

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Victor J. Schuler

Subscribed and sworn to before me

this ________ day of __________ 19__.

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Notary Public

My Commission expires ____________.

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