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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

BEFORE ADMINISTRATIVE JUDGES:

Lawrence Brenner, Chairman
Dr. Richard F. Cole
Dr. Peter A. Morris

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| In the Matter of<br><br>PHILADELPHIA ELECTRIC COMPANY<br><br>(Limerick Generating Station, Units 1 and 2) | ASLBP Docket No. 81-465-07 OL<br><br>(NRC Docket Nos. 50-352-OL 50-353-OL)<br><br>March 8, 1983 |

PARTIAL INITIAL DECISION
(ON SUPPLEMENTARY COOLING WATER SYSTEM CONTENTIONS)

Appearances

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# I. OPINION

## A. Summary of Conclusions

On the basis of the record before it, the Board finds contrary to the contention of the intervenor, that there would be no significant adverse impact on the populations of American shad and shortnose sturgeon in the Delaware River as a result of operation of the presently proposed Point Pleasant intake. The Board also finds that there is no evidence that the proposed intake would have an adverse impact on recreational activities in the Delaware River.

The Board finds that noise from operation of intake as it is presently proposed could have a significantly adverse impact on the Point Pleasant proposed historic district. The Board, in its order, is imposing a condition which requires that a determination be made, if the intake is built, as to whether there are such significant noise impacts and, if so, requires that such impact be minimized. The Board concludes that after any necessary noise mitigation measures have been undertaken, operation of and maintenance for the proposed intake and pumping station would not have a significantly adverse effect on the proposed historic district.

## B. Background

On March 17, 1981, the Philadelphia Electric Company (PECo or the Applicant) filed with the Nuclear Regulatory Commission (NRC or Commission) an application for licenses to operate Units 1 and 2 of its Limerick Generating Station. The application was docketed by the NRC on July 27, 1981.

The facility for which the licenses are sought is located in Limerick Township of Montgomery County, Pennsylvania. It is on the east bank of the Schuylkill River, approximately four miles downriver from Pottstown. Licenses are sought to operate two boiling water nuclear reactors, each with a rated core power level of 3,293 megawatts thermal and a net electrical output of 1,055 megawatts electric. Final Safety Analysis Report (FSAR) at 1.1-1.

On August 21, 1981, the Commission published in the Federal Register a notice of "Receipt of Application for Facility Operating Licenses; Consideration of Issuance of Facility Operating Licenses; Availability of Applicant's Environmental Report; and Opportunity for Hearing." 46 Fed. Reg. 42557 (1981). On September 14, 1981, this Atomic Safety and Licensing Board (Licensing Board or Board) was established to preside in this proceeding. 46 Fed. Reg. 45715 (1981).

Requests for a hearing and petitions to intervene were received from thirteen individuals and groups. A special prehearing conference was held on January 6-8, 1982 to consider these petitions and requests. On June 1, 1982, the Board issued a Special Prehearing Conference Order (SPCO) which admitted some of the petitioners as intervenors and admitted some of their proposed contentions for litigation. LBP-82-43A, 15 NRC 1423 (1982).

Del-Aware Unlimited, Inc. (Del-Aware) was among the groups admitted as intervenors. Four of Del-Aware's proposed contentions were admitted. The Board subsequently reconsidered and denied admission of one of these contentions. Memorandum and Order, slip op. at 5 (July 14, 1982). Three additional contentions were proposed by Del-Aware in September, 1982, and were denied admission by this Board. Memorandum and Order (January 24, 1983). Petitions to reconsider this denial and to file a late contention were filed by Del-Aware in February, 1983. These petitions are denied in a separate order being issued today.

Del-Aware's three admitted contentions concern environmental impacts from operation of a supplementary cooling water system which would furnish water to Limerick from the Delaware River and would also provide water to the Neshaminy Water Resources Authority (NWRA) for municipal use. (Finding 4). The supplementary cooling water system requires construction of an intake and a pumping station at Point Pleasant, Pennsylvania. Water will be carried from Point Pleasant through a transmission main to the proposed Bradshaw Reservoir. From the Bradshaw Reservoir, some of the water will be pumped into another transmission main and carried to the East Branch of the Perkiomen Creek.[1] After flowing for some distance in the Perkiomen Creek, this portion of the water will be pumped into a third transmission main which will carry it to the Limerick plant site, some thirty miles from Point Pleasant. See, SPCO, LBP-82-43A, 15 NRC at 1462-63.

Del-Aware's three admitted contentions allege that there will be significant impacts from operation of this system which were not anticipated at the time the construction permits were authorized, since they are attributable to changes in the proposed system since that time. The Board determined that, because the system had not yet been constructed and because mitigation of operational impacts can often best be achieved by design and location decisions made before construction,

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1 Water for use by the NWRA will be carried from the Bradshaw Reservoir by a different route.

it would make every effort to reach a decision on these contentions before the supplementary cooling water system was constructed. See SPCO, LBP-82-43A, 15 NRC at 1479-80; Memorandum and Order, slip op. at 3-4, 15-18 (July 14, 1982); Confirmatory Memorandum and Order (October 20, 1982). To that end, twelve days of hearing were held on these three contentions October 4-8, 18-22, and 25-26, 1982.

One of the contentions which was the subject of this hearing concerned the allegedly adverse effect a changed intake location would have on American shad, shortnose sturgeon and recreation. (Finding 6). Another contention concerned the impact of noise from operation of the intake pump station and the impact of dredging maintenance of the intake on the Point Pleasant proposed historic district (Finding 133). A third contention, concerning impacts of the Bradshaw Reservoir, was withdrawn by Del-Aware pursuant to a stipulation reached among Del-Aware, the Applicant, and the NRC Staff (Staff). (Finding 5).

## C. Scope of Decision

The Board's role in considering impacts of the supplementary cooling water system is complicated by the fact that several other federal agencies and parts of the NRC have role in reviewing this water diversion. These reviews have, in general, been ongoing as this hearing has progressed. We have previously discussed at some length the effect that the conclusions reached as part of these other reviews, particularly those reached by the DRBC, should have on our decision-making. See SPCO, supra, 15 NRC at 1423, 1458-70 ; Memorandum and Order Concerning Objections to the [SPCO], slip op. at 9-10 (July 14, 1982); Memorandum and Order (Denying Del-Aware's Request for Reconsideration of DRBC Preclusion on Water Allocation Issues), LBP-82-72, 16 NRC ___ (September 3, 1982).

Since the hearing on these issues was completed, the Army Corps of Engineers has issued a "dredge and fill" permit to the NWRA, pursuant to Section 404 of the Clean Water Act 33, U.S.C. § 1344 (1976 & Supp). The Applicant and the Staff have argued in their proposed findings that we are consequently confronted with a preclusion, pursuant to Section 511 (c)(2) of the Clean Water Act, on the matters considered by the Corps in issuing its permits. Section 511(c)(2) states:

> (2) Nothing in the National Environmental Policy Act of 1969 (83 Stat. 852) shall be deemed to --
>
> (A) authorize any Federal agency authorized to license or permit the conduct of any activity which may result in the discharge of a pollutant into the navigable waters to review any effluent limitation or other requirement established pursuant to this Act or the adequacy of any certification under section 401 of this Act; or
>
> (B) authorize any such agency to impose, as a condition precedent to the issuance of any license or permit, any effluent limitation other than any such limitation established pursuant to this Act.

33 U.S.C. § 1371 (1976 & Supp.)

Having conducted a full evidentiary hearing on these matters and considered them in greater detai than it appears to us that the Corps has, we would set forth our findings even if we concluded that the preclusion prevented us from ordering action we believed desirable. Because we have concluded, based on the merits of the record before us, that there will be no significant impact on the river from operation of the intake, we need not reach the question of whether § 511 (c)(2) would have barred us from ordering mitigation measures relative to such impacts.

We note, however, that one of the contentions which was the subject of this hearing concerned noise impacts on the surrounding environment. Actions we are ordering relating to this contention are not barred by the Clean Water Act preclusion. This Commission has consistently interpreted § 511 (c)(2) to apply only to aquatic impacts. See Public Service Co. of New Hampshire (Seabrook Station, Units 1 and 2), CLI-78-1, 7 NRC 1, 25, 26, 27, aff'd sub nom. New England Coalition on Nuclear Pollution v. NRC, 582 F.2d 87 (1st Cir. 1978); Tennessee Valley Authority (Yellow Creek Nuclear Plant, Units 1 and 2), ALAB-515, 8 NRC 702, 715 (1978). Indeed, this is the logical scope of the preclusion when one considers that the objective of the act from which the preclusion comes is "to restore, and maintain the chemical, physical, and biological integrity of the Nation's waters." Clean Water Act § 101, 33 U.S.C. § 1252.

In addition, the Staff argues that because the Final Environmental Statement (FES) on the operation of Limerick has not been issued and the overall cost/benefit analysis has not been done, we may not impose conditions in this order which require mitigation of particular impacts. We disagree. Although the overall cost/benefit balance for a plant may be favorable, the National Environmental Policy Act (NEPA), 42 U.S.C. §§ 4332 et seq. (1976), authorizes the Commission, and Licensing Boards in particular, to impose license conditions to minimize particular impacts. Detroit Edison Co. v. NRC, 630 F.2d 450 (6th Cir. 1980); Kansas Gas and Electric Co. (Wolf Creek Nuclear Generating Station, Unit No. 1), CLI-77-1, 5 NRC 1, 8-9 (1977); Public Service Co. of New Hampshire (Seabrook Station, Units 1 and 2), ALAB-422, 6 NRC 33, 82-84 (1977), aff'd. sub nom. Public Service Co. v. NRC, 582 F.2d 77 (1st Cir. 1978); Detroit Edison Co. (Greenwood Energy Center, Units 2 and 3), ALAB-247, 8 AEC 936, 944-45 (1974). Accordingly, we can order actions to minimize the particular impacts we have considered without awaiting the ultimate outcome of the cost/benefit balance.

Having thoroughly considered these particular impacts, however, we will not readdress them once the FES is issued. Our conclusions on the impacts contained in this Partial Initial Decision may be incorporated into the FES and may be considered in the cost/benefit balance. The fact that these issues will be covered in the FES will not, however, mean they can be relitigated in the context of that document. It would be senseless to repeat the full hearing on these issues. Indeed, res judicata should prevent any party from once again litigating them.

## D. The Proposed Intake

In July 1980, PECo and the NWRA changed their plans for the intake in the Delaware River which was to be a part of the proposed Point Pleasant diversion. Prior to 1980, the proposal had been to utilize a shoreline location in Point Pleasant and an intake with a vertical traveling screen. The new plans called for the intake to be located approximately 200 feet into the river from the Pennsylvania shore, off Point Pleasant, and to use a passive wedge-wire screen. In January 1982, it was decided to put the intake an additional 45 feet into the river along essentially the same alignment as had been proposed in July 1980. (Findings 7, 8, 10).

This last location is the one that is presently proposed. It would place the intake at river mile 157.2. This would be about 800 feet downriver of the confluence of the Delaware River and the Tohickon Creek. The intake would be about a mile and a half upstream from the Lumberville wing dam, in the pool formed by that dam. (Finding 9).

The proposed design for the intake calls for two rows of cylindrical screen sections, parallel and seven feet apart. Each row would consist of six 44-inch-diameter cylinders placed end to end. The cylinders would each have two 40-inch screen sections separated by a 44-inch solid section. The ends of each row would have protective conical end pieces. (Finding 10). Water would be able to flow into the screens around their total circumference, with the through-slot velocity remaining nearly uniform over the entire screen. (Finding 13).

The screens themselves would be made of wedge-wire wound helically around supports located at approximately six-inch intervals. The screen openings would be slots 2 mm in width. (Finding 11). This type of screen utilizes state-of-the-art technology and is superior to the vertical traveling screen which was originally planned. (Finding 12).

The bottom of the intake screens would be two feet above the river bottom. The intake would extend upwards about four feet from that point. However, even at the comparatively low flow of 3000 cubic feet per second (cfs), the top of the intake would be approximately four feet under the water surface. (Finding 15).

The river bottom below the intake screen would be covered with rip-rap. In placing the rip-rap the Applicant and NWRA would restore the contours of the river bottom to approximately what they are presently (before the intake is constructed). (Finding 18).

The maximum withdrawal by the intake would be 95 million gallons per day (MGD), which is the equivalent of 147 cfs. This would constitute 4.9% of the flow by Point Pleasant at a river flow of 3000 cfs. At the lowest anticipated flow of 2500 cfs, it would be 5.9% of the flow. Therefore, while at the lowest flows ever recorded, 95 MGD would constitute more than 10% of the water in the river at that point, it is unlikely to ever actually take that large a percentage of the river flow. (Findings 17, 71).

There would be a negligible drop in the water level of the river at the intake site as a result of the intake. At a comparatively low flow of 3000 cfs, the change in water level would be less than an inch. (Finding 16).

## E. Impact Of The Intake On Shortnose Sturgeon And American Shad

Del-Aware alleged that the proposed intake would have a serious impact on two fish species, American shad and shortnose sturgeon. In an effort to demonstrate this impact, Del-Aware presented evidence not only as to the characteristics and possible presence of those species, but also to show why the intake in its proposed location would be particularly likely to affect them.

Del-Aware sought to show that the intake would be located in an eddy. An eddy is a current of water which runs contrary to the main flow in the river and may actually move circularly. Del-Aware contended that if the intake were located where it would draw water from an eddy, juvenile fish, which might tend to congregate in the eddy, would be more seriously impacted than they would be if the intake drew water from the main flow of the river. In addition, Del-Aware argued that the circular flow of an eddy would cause fish eggs and larvae, which would be at the mercy of the current, to be exposed to the intake repeatedly and would increase the risk that they would be harmed. (Findings 19, 24).

At flows below 5000 to 6000 cfs there is an eddy adjacent to the Pennsylvania shore of the Delaware River at Point Pleasant. The eddy forms as a result of a rocky bar immediately downstream of the mouth of the Tohickon Creek. This bar plays a major role in determining the size of the eddy. As water flows increase over the bar, the eddy recedes towards the Pennsylvania shore and may cease to exist. The eddy's size is at its maximum when flows are below 3000 to 4000 cfs and no water flows over the rocky bar. Even at this time, however, the intake would be located approximately 85 to 90 feet further out into the river than the far edge of the eddy. Therefore, the eddy should not increase the impact the intake would have on fish. (Findings 20, 21, 22, 23, 25).

Del-Aware also sought to show that the Applicant had not accurately presented the velocity[2] at which water would be drawn to and through the intake screens. The Applicant's evidence showed that the maximum velocity through the intake screens would be 0.5 feet per second (fps) and the average velocity would be 0.35 fps. The velocity toward the intake screen would decrease dramatically at very small distances from the screen. For example, at one foot from the screen surface, the

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2 Technically, velocity is a measure of both speed and direction. During the hearing and in this decision, "velocity" has been used interchangeably with "speed".

average velocity toward the screen would be only 0.071 fps. (Findings 26, 27).

Del-Aware's witnesses alleged that the screen could become clogged, either through biofouling or fishing hooks, and this would cause higher intake velocities. (Finding 28). It is true that clogging would cause higher intake velocities. As a Del-Aware witness testified, however, wedge-wire screen intakes are less susceptible to clogging than are most intakes. The fact that this intake would be some distance into the river and completely below the surface would further reduce the likelihood that it would become clogged. The intake is equipped with an air backflush system which should prevent or minimize the build up of potentially clogging material. Other material could be removed by a diver. (Finding 14, 29). It, therefore, seems unlikely that significant clogging of the intake screens would occur. The Applicant's intake velocity figures should be realistic.

Bypass velocity is the velocity of the river water flowing past the screens parallel to the long axis of the intake. There was some testimony that a high ratio of bypass velocity to intake velocity helps to protect aquatic life from impingement and entrainment. Some witnesses advocated a minimum velocity ratio of 2 to 1; others indicated that the 2 to 1 ratio was not important and that with a 1 to 1 ratio, or even in the absence of any bypass velocity, wedge-wire screen intakes are effective in protecting aquatic life. (Findings 30, 31, 32, 33).

The type of fish for which protection is sought is a factor in determining the significance of the velocity ratio. Witnesses concluded, and, based upon the extensive testimony which was presented on the characteristics of American shad and shortnose sturgeon, we agree, that the velocity ratio would not be a significant factor in protecting these species. (Finding 34).

In spite of the evidence that a 2 to 1 ratio of bypass velocity to intake velocity is not a significant factor in protecting these fish, the Applicant sought to show that a 2 to 1 ratio would, in fact, be achieved, even at flows as low as 2500 cfs. Del-Aware conducted extensive cross-examination and presented some evidence to show that the Applicant's measurements of bypass velocity were in error.

Del-Aware succeeded in demonstrating that the Applicant's data on river flows, flow distributions and river stages at the intake site were less definitive than would be desirable. The Board, in consideration of the relevance of all of the factors affecting the resolution of this matter, has no hesitancy in reaching its ultimate conclusions. However, the Board's task would have been facilitated considerably and the hearing undoubtedly would have been simplified if the Applicant's data had been more certain. This is the first stage of a proceeding in which there are likely to be hearings on many contested issues. The Board hopes that in future hearings the Applicant, as the party with the burden of proof, will present more definitive data and these problems can be avoided.

The Applicant made velocity measurements in the river at Point Pleasant on November 7, 1980, when the river flow was approximately 3000 cfs and the water surface elevation was about 70.8 feet. The measurements indicated that the velocity ratio was approximately 2 to 1 for an intake velocity of 0.5 fps. (Finding 35).

A Del-Aware witness criticized the velocity measurements because they did not include an indication of the direction of the flow. (Finding 38). It is true that maximum velocities were recorded and that flow direction was not indicated. However, the maximum amount that the flow could have varied from parallel to the long axis of the intake would have been about 25 degrees and angling toward the Pennsylvania shore. A velocity measurement taken in this direction could be converted to bypass velocity by multiplying it by the cosine of the insection angle. For a 25 degree angle the cosine would be 0.906. Hence, the bypass velocity would have been over 90 percent of what was measured even if the flow were at a 25 degree angle to the intake. (Findings 37, 39, 40, 41, 46).

Del-Aware also questioned the distances into the river at which the Applicant indicated that velocity measurements were made. The Staff made three checks on the Applicant's data and, as a result of those checks concluded that the distance measurements were probably accurate. (Findings 42, 43, 44, 45, 47). The Staff's witness acknowledged that an error of up to 25 feet could have escaped detection by these checks. For any error to be that large and escape detection, it would have to have been such that the measurements were actually made further out in the river than the Applicant's data indicate. There is no real evidence that such an error occurred. Even if it did, however, the velocity at the intake would be about 75 percent of the velocity measured a hypothetical 25 feet further out. Thus, at the 7-foot depth the velocity would be over 0.80 fps, more than twice the average intake velocity and considerably more than the maximum intake velocity. (Findings 26, 48, 49).

The Applicant also made velocity measurements on July 23, 1981, when the flow was estimated at 4500 cfs. At this time velocities past the intake were measured at over 2 fps. (Finding 36). The Staff's witness on hydrology criticized this data. His concern, however, appeared to relate to only one velocity measurement which he believed was unrealistic because it was too low. (Finding 50). This single inaccuracy could easily result from a mistake in recording the data and does not strike us as a reason to totally discount the data. In any case, the July 1981 measurements are less important than the November 1980 ones, since those from November 1980 more nearly represent velocities at the low flows which have caused concern in this proceeding.

Del-Aware also questioned the method used by the Applicant to determine the flow passing Point Pleasant. The Applicant calculated that the drainage area tributary to the river at Point Pleasant is 97 percent of the drainage area tributary to the river at Trenton, where the nearest downstream gaging station is located. (Finding 51). Therefore, the flow at Point Pleasant would average approximately 97 percent of that measured at Trenton.

Using this percentage and flow measurements at Trenton, the Applicant developed a rating curve which purported to show the relationship between water surface elevation and river flow at Point Pleasant. (Finding 52). Del-Aware was critical of the rating curve, arguing that it failed to reflect hydraulic control exercised by the Lumberville wing dam. (Finding 53).

The wing dam is located approximately 1.5 miles downstream of Point Pleasant. It has a slot approximately 100 feet wide. The slot has a minimum elevation of 64.5 feet. The wings, on each side of the slot, have an elevation of 70.7 feet. Del-Aware alleges that at different elevations different segments of the dam provide hydraulic control. Del-Aware argues that the Applicant's rating curve is inaccurate at flows under 3500 cfs because it fails to reflect the changing hydraulic control below that point. (Findings 54, 55). To illustrate this, a Del-Aware witness took the data points used to construct the Applicant's rating curve and drew two essentially parallel lines through them. One of these lines went through the points above the 71.5-foot elevation; the other went through the points below the 71.5-foot elevation and was shifted over approximately 600 or 700 cfs from the first line. (Finding 56).

The part of the rating curve which is of concern is the part which reflects low flows. Del-Aware itself has indicated that the rating curve would essentially be a straight line at r  levations below 71.5 feet. (Finding 56). Applicant confirmed the accuracy of that portion of the rating cu through use of measurements at Point Pleasant on September 12, 1981, when the flow was 3640 cfs and the river elevation was 71.27 feet. (Finding 60). Therefore, although the Lumberville wing dam may act as a hydraulic control for flows in the Point Pleasant area, this fact does not render the rating curve inaccurate at low flows.

Del-Aware was also critical of the manner in which flows in the Delaware and Raritan Canal were treated in developing the rating curve. The maximum diversion from the Delaware River through that canal is 150 cfs. (Findings 57, 58). This is a small amount of water compared to the total flow in the Delaware. A discrepancy of this entire amount would probably be a smaller error than one would accept in terms of determining flow. Therefore, it would not have a significantly detrimental effect on the accuracy of the rating curve.

In determining that the Applicant's rating curve is probably reasonably accurate, the Board has also considered certain other factors. As a Del-Aware witness testified, the Applicant used common techniques in developing the rating curve. (Finding 59).

In addition, the Board has kept in mind the use to which the rating curve has been put, that is determination of river flow on the days when velocity measurements were made. (Finding 52). While there was some doubt about the accuracy of the determination of the 4500 cfs flow on July 23, 1981 (Findings 61, 63), the 3000 cfs flow for November 7, 1980 was believed by both the Staff and the Applicant, after performing checks on the value, to be within 100 cfs of the actual flow on that date. In fact, a Del-Aware witness indicated that, if anything, the 3000 cfs figure overstated the flow. (Finding 62).

Since the 3000 cfs flow is the one measured in the low flow range, it is more important that bypass velocities at that flow be substantial. If, in fact, the flow was even less than 3000 cfs and the bypass velocities still appeared substantial, that would indicate that there would be beneficial bypass velocities at even lower flows.

After considering Del-Aware's arguments concerning the Applicant's measurements of velocities and flows, the Board concludes that, at least insofar as the measurements made on November 7, 1980 are concerned, the Applicant's data are reasonably accurate and show that the river would flow by the intake with substantial bypass velocities at flows around 3000 cfs. The Board is also convinced that the data from November 7, 1980 are sufficiently accurate that they can be used to calculate approximate bypass velocities which would be expected at even lower flows.

Velocities at 3000 cfs may be used to calculate velocities at lower flows if the distribution of velocities across the river at 3000 cfs is known and if one may reasonably assume that the velocity distribution across the river will be similar at the lower flow. (Finding 64). The Applicant's data from November 7, 1980 provide reasonable definition of the velocity distribution across the river at that flow. (Finding 65).

The velocity profile at 2500 cfs should be sufficiently similar to that at 3000 cfs to allow the bypass velocity at 2500 cfs to be calculated with reasonable accuracy. Even at 3000 cfs, the river flow is low and would be concentrated in the main channel. The flow at 2500 cfs would also primarily be in the main channel. Thus, the cross-sectional area of the water flowing in the river would not be significantly different at 2500 cfs than at 3000 cfs. (The Lumberville wing dam, if it does provi ~ hydraulic control, would not provide a different control at 2500 cfs than at 3000 cfs. Even Del-Aware agreed that the control would be provided by the same part of the dam at flows of 3000 cfs or less. <u>See</u> Finding 55.) Since, if the cross-sectional area remains essentially the same, flow and river velocity will vary proportionally, the similar cross-sectional areas at 2500 cfs and 3000 cfs mean that the velocity distribution should be similar at flows of 2500 cfs and 3000 cfs. The ratio of average cross-sectional velocity to screen bypass velocity would be the same at the two flows. The bypass velocity at a flow of 2500 cfs can be calculated utilizing this ratio.

The Applicant and the Staff used the velocity measurements from November 7, 1980 to calculate what the bypass velocity of the river by the intake screens would be at 2500 cfs and concluded that the bypass velocity would be 0.8 fps. (Finding 66). Thus, even at 2500 cfs, the ratio of bypass velocity to the average intake velocity would be greater than 2 to 1 and the bypass velocity would be significantly higher than the maximum intake velocity (although not twice as high). Had we concluded that the ratio of bypass to intake velocity would be a significant factor in providing protection from the proposed intake, the calculated bypass velocity of 0.8 fps at 2500 cfs convinces us that the ratio would be adequate even at low flows.

We recognize that the bypass velocity at 2500 cfs could be somewhat lower than that calculated by the Applicant if the velocity measurement at 3000 cfs actually fails to reflect the flow passing the intake at an angle or any inaccuracy in horizontal measurements. However, even adjusting for these possible inaccuracies in the velocity measurements at 3000 cfs, we conclude the bypass velocity at 2500 cfs as calculated by this method would be close to the Applicant's 0.8 fps figure and would also provide an acceptable bypass to intake velocity ratio, even directly at the screens. Moreover, as noted, there is an extremely rapid decrease in intake velocity at very small distances from the screens. (Finding 27). Accordingly, at a distance of one foot from the screen, the ratio of bypass velocity (0.8 fps) to average intake velocity (0.071 fps) is very high -- over 11 to 1.

If there were a problem in maintaining an adequate ratio of bypass velocity to intake velocity, it would occur only at low flows since it is at low flows that the river velocity drops. The relative infrequency of low flows, particularly at those times of the year when vulnerable developmental stages of American shad and shortnose sturgeon could be present, further convinces us that there would not be a problem with maintaining an adequate velocity ratio.

Between 1913 and 1980, flows at Trenton have exceeded 2900 cfs 90 percent of the time. During that period, several storage projects and reservoirs have been built which should decrease the frequency of low flows. (Finding 67).

The lowest flow which the DRBC, the agency charged with allocating water in the Delaware River valley, anticipates will occur at Trenton in the future is 2500 cfs. (Finding 71). It is unlikely, however, that a flow this low would occur in April, May or June when shad and sturgeon eggs and larvae could be present. Historical data indicate that flows below 3000 cfs have rarely occurred during these months. In fact, in the past 20 years, such flows have occurred only about 1 percent of the time. (Findings 68, 69).

Juvenile shad and sturgeon could be present in the Point Pleasant area in July, and the historical record indicates that flows have been less than 3000 cfs a larger proportion of the time in July as compared with April through June. (Finding 70). Even during July, however, flows will be above 3000 cfs most of the time. Moreover, juvenile fish would be less dependent on the bypass velocity to assist them by the intake than eggs and larvae would be since juveniles are more mobile. Hence, low flows and a low bypass to intake velocity measurement would be of less concern at this time of year.

Because of a condition imposed by the DRBC which does not permit PECo to withdraw water from the Delaware River for use in cooling Limerick when flows at Trenton are under 3000 cfs unless PECo provides offstream storage from which it releases an amount of water equal to that it withdraws (Finding 72), the intake might never operate at flows below 3000 cfs. Even if PECo provides the offsite storage and withdraws water when flows at Trenton are less than 3000 cfs, this should be an infrequent occurrence. (Finding 67). Even at such times, the bypass velocity will be substantially higher than the intake velocity, probably more than twice the average intake velocity. (Finding 66. See also Opinion at p. 20-21). This should be more than adequate to protect shad and sturgeon.

Del-Aware also questioned whether the orientation of the intake screens relative to the river flow would be optimal for protecting the fish species in question. The slots of the screens at Point Pleasant would be roughly perpendicular to the flow; i.e., the length of the cylinders would be roughly parallel to the flow. (Finding 74). Based on the evidence presented, we conclude that the orientation of the screen slots is not an important factor contributing to the protection of fish. (Finding 73). Thus, we see no reason to consider other possible screen slot orientations.

In addition to the protective characteristics of the proposed intake, the characteristics of the two species of fish with which this hearing was concerned convince us that the intake would not have an adverse impact on these species. At all life stages of both species, the intake should have a minimal impact on the fish populations in the Delaware River.

One of the species in question is the shortnose sturgeon. The shortnose sturgeon is listed as an endangered species pursuant to the Endangered Species Act, as amended, 16 U.S.C. §§ 1531-43 (1976 & Supp). In compliance with that Act, the National Marine Fisheries Service prepared a Biological Opinion which evaluated the impact of the proposed pumping station on shortnose sturgeon. This Opinion concluded that, in compliance with the Act, the intake "is not likely to jeopardize the continued existence" of shortnose sturgeon in the Delaware River. <u>See</u> 16 U.S.C. § 1536 (a)(2). (Finding 75).

Although shortnose sturgeon occur in the Delaware River, there is no hard evidence that they occur at or upstream of Point Pleasant. Sampling for fish over a number of years in the stretch of the river in which the intake would be located has not found shortnose sturgeon. Nor did a study conducted between November 1981 and March 1982 which was designed specifically to sample for sturgeon in the vicinity of the proposed intake site. (Findings 76, 78, 79).

The 1981 to 1982 study used techniques appropriate for sampling for sturgeon although it was somewhat limited in terms of the number of samples taken. The study did not cover the entire period during which shortnose sturgeon could be migrating upriver to spawn. It did, however, include some sampling in late March, the time when the upriver migration begins. (Findings 79, 80).

The closest to Point Pleasant that shortnose sturgeon have actually been found is Lambertville, New Jersey. This is eight miles downstream from Point Pleasant. (Finding 77).

Sturgeon spawn over rubble, cobble or gravel bottoms in high velocity fresh water in or above the tidal reaches of the river. Spawning takes place in the main river channel near the river bottom. (Finding 82). In the Delaware River, sturgeon probably spawn in fresh water just below the Trenton fall line or in nontidal water immediately above those falls. (Finding 83). Although Point Pleasant is some distance upstream from Trenton, it does have a river bottom of the type over which sturgeon might spawn. (Finding 84).

Based on the lack of evidence of sturgeon at Point Pleasant despite sampling programs, the Board believes that it is unlikely that shortnose sturgeon spawn near Point Pleasant. On the other hand, sturgeon are difficult to sample for (Finding 80) and there has been no study at Point Pleasant specifically aimed at determining whether sturgeon spawn there. However, the Board concludes, for reasons explained below, that, even if sturgeon were to spawn near Point Pleasant, the intake would not have a substantial impact on the species.

Adult sturgeon, coming upriver to spawn should not, if healthy, be impacted by the proposed intake at all. Their size, swimming ability, and preference for the river bottom should ensure they would not be impinged or entrained. (Finding 81).

An adult female sturgeon lays approximately 140,000 eggs. The eggs are 3.0 to 3.2 mm in diameter. The eggs are dense and sink rapidly to the bottom, where they become affixed to the substrate on which they land. (Findings 82, 85).

The eggs, if present, would not be entrained or impinged by the intake in significant numbers. Because they sink rapidly, they would risk exposure to the intake for only the very short time it would take for them to sink from their spawning point near the river bottom to a depth not more than two feet off the river bottom. At that point, they would be below the intake screens and could not be affected. The few eggs that might be drawn to the intake during the short period required for them to sink would be too large to be entrained through the intake slots unless crushed. While crushing is possible, studies using wedge-wire screen intakes have shown that the eggs would be more likely to roll along the intake surface. Eventually, they would roll off the intake and could continue their descent to the river bottom. (Finding 86).

Nor would the intake have a serious impact on larval sturgeon. While there is some evidence that larvae less than about 21 mm in length or 19 days of age could be entrained if they came into contact with the intake, such contact with the intake is unlikely. The larvae have a very strong benthic orientation and, hence, remain extremely close to the river bottom for up to approximately 40 days. Since the bottom of the intake screens would be two feet above the river bottom, young larvae would be unlikely to move high enough in the water column to encounter the screens. In addition, sturgeon larvae demonstrate strong swimming ability. This swimming ability, which gets stronger as the larvae get older, should be sufficient to enable larvae which have outgrown their benthic orientation to escape from the pull of the proposed intake since the intake velocity would not exceed 0.5 fps. Therefore, sturgeon larvae should not suffer significant amounts of impingement or entrainment by the proposed intake even if they occur at Point Pleasant. (Findings 26, 27, 87, 88, 89, 90, 91, 92, 93).

Juvenile sturgeon are even larger and better swimmers than are sturgeon larvae. If they were present at Point Pleasant, it is even less likely that they would be adversely impacted by the intake than it is that larvae could be so impacted. (Finding 94).

In summary, the Board doubts that shortnose sturgeon spawn at Point Pleasant. Even if they do, however, there would be no significant impact from the intake at any life stage of sturgeon.

Insofar as American shad are concerned, there is no doubt that they occur in the Delaware River. Adults pass through the Point Pleasant area during their migration upstream to spawn; juveniles pass through Point Pleasant when migrating out to sea. Juveniles, in fact, use the pool formed by the Lumberville wing dam as a nursery area. (Findings 95, 96).

Witnesses for all the parties including Del-Aware agreed that the intake would not impinge or entrain adult shad. (Finding 95). There was more concern about the intake affecting juveniles.

In assessing the potential for impacts on juvenile shad, the Board first had to determine exactly when the juvenile stage begins for shad since the witnesses appeared to use the term in different ways. In this opinion, we are defining the juvenile stage as beginning approximately 30 days after the eggs hatch, when transformation occurs and the fish take on adult characteristics. At this time the fish would be approximately 26 to 30 mm long. (Finding 97). This is the definition of the juvenile stage which was given by Joseph Miller, a fishery biologist with the U.S. Fish and Wildlife Service, and we have adopted it because of all the witnesses who appeared before us, Mr. Miller had done the most extensive work on American shad in the Delaware River. We believe that Mr. Miller is the best source we had on characteristics of shad in the Delaware. We appreciate the efforts of Del-Aware in presenting him and other Federal and Pennsylvania fisheries experts as witnesses in this proceeding.

Juvenile shad would be protected from entrainment by the intake because of their size. (Finding 98). The potential problems for juvenile shad were impingement and descaling. It was conceded, however, that impingement would not be a problem if the intake velocity would not exceed 0.5 fps since the juveniles would have a strong enough swimming ability to escape the intake's pull. (Finding 99). As we have previously explained in this Opinion, we expect that the intake velocity would not exceed 0.5 fps. Therefore, we conclude the intake should not cause impingement of healthy juvenile shad.

The descaling problem which was alleged would occur if shad between 25 and 40 mm long were drawn against the intake and then used their swimming ability to escape. Some witnesses were concerned that this would cause the fish to lose scales and would eventually kill them. (Finding 100).

There are a number of factors which we believe render the potential for such descaling inconsequential. We note that the potential for descaling has not in any way been connected with this particular intake. The witnesses who raised this concern did not indicate that the problem would be worse if the intake were placed as proposed than it would be if the intake were placed elsewhere. These witnesses admitted that the same type of descaling could occur if a shad brushed against a rock. (Finding 100). This concern would, therefore, not appear to be connected in any way with the changes in the intake proposal which led to this contention being admitted.

We are also not certain how valid the concern would be. If shad can be killed by brushing against rocks, let alone against existing intakes in the river, we would expect to be presented evidence that large numbers of shad have died in this way. Yet we were presented no such evidence.

Even if such descaling would result from contact with the intake, however, we conclude that it would not cause a serious impact on the shad population in the river. The zone of influence of this intake relative to the total cross-section of the river at Point Pleasant is very small. One witness indicated that eggs and larvae, both less mobile than juveniles, would be in danger only if they passed with 2 inches of the intake screen. (Findings 27, 101). Thus, unless the juvenile shad population were concentrated extremely near the intake screens when passing Point Pleasant (and we have been presented no evidence in support of that unlikely circumstance), the percentage of the juvenile shad population which could be affected in this way would be exceedingly small. Even if all juvenile shad which passed within two inches of the intake were lost due to descaling, this would be a very small proportion of the total shad population. Particularly when we consider that we have no evidence of large kills due to descaling occurring elsewhere, we simply cannot envision that there would be a detectable change in the shad population attributable to descaling caused by the proposed intake.

There was some controversy about whether shad presently spawn at Point Pleasant or are likely to spawn there in the future. It appears that shad once spawned in the Delaware River from Philadelphia to the headwaters of the river in New York. By the 1970's, however, the shad's spawning range had shrunk and spawning only occurred above the Delaware Water Gap. In the 1980's the Shad's spawning range had once again begun to expand. There was conflicting testimony on the question of whether this reexpansion meant that spawning has been occurring as far downstream as Point Pleasant. In any event, if the spawning range were to expand to its total historic length, it would include Point Pleasant. The Applicant assumed in evaluating the impact of the intake that spawning would occur at Point Pleasant in the future if it does not occur there now. (Findings 102, 104). We agree that this is an appropriate assumption.[3]

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3 The Applicant collected objects at the Point Pleasant site which could have been shad eggs, but had not analyzed them to determine whether they were in fact shad eggs. (Finding 103). In the circumstances, we are willing to assume they are shad eggs and that spawning occurs at Point Pleasant.

Because shad spawning normally occurs in the downstream third of a pool and the intake would be located in the upstream portion of the Lumberville pool, spawning probably would not occur in the immediate vicinity of the intake. However, Del-Aware was concerned that eggs and larvae spawned in the pool just above the Lumberville pool would drift into the Lumberville pool and be adversely affected by the intake. (Finding 105). Since eggs and larvae are, to a certain extent, at the mercy of the flow, this concern deserves consideration.

Shad eggs apparently have a size range between 1.1 and 3.8 mm in diameter with a mean diameter of 2.83 mm.[4] Although most shad eggs would be larger than the 2 mm width of the intake slots, they could be crushed and forced into the intake. Witnesses for all parties agreed that eggs which passed sufficiently close to the proposed intake could be entrained. (Findings 106, 107).

The number of eggs passing sufficiently close to the intake slots to be entrained would, however, be limited. Shad eggs are demersal, normally sinking to the ocean bottom within 5 to 35 meters of where they are spawned. (Finding 108). Once the eggs have sunk to within 2 feet of the river bottom, they would be below the intake screens and not susceptible to entrainment. Moreover, eggs which spend the longest time

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4 The Staff gave a size range between 2.1 and 3.8 mm. To be conservative, we are utilizing the Applicant's figures which provide for smaller eggs.

in the water column and, hence, are most likely to encounter the intake are less likely to produce larvae even if not entrained. (Finding 110). The average egg has a less than one percent chance of hatching even if it is not affected by the intake. (Finding 109). This would tend to limit the effect that egg entrainment would have on the shad population.

Shad larvae could also be subjected to entrainment and impingement. The larvae are approximately 6 to 10 mm long when hatched and reach 20 mm at 17 or 18 days of age. They would be approximately 30 mm long at the time transformation occurs and they become juveniles. (Findings 97, 111). Until they reach 20 mm in length, the danger would be entrainment. After that time, it would be impingement. (Findings 116, 117).

Shad larvae display a behavior pattern of repeatedly rising to the river surface and then sinking to the river bottom. This means they can be found relatively uniformly throughout the water column. (Findings 112, 113). Therefore, unlike for eggs, it cannot be assumed that the potential exposure time for the larvae is limited. At worst, however, with the larvae distributed uniformly through the water column, the percentage of the larvae passing Point Pleasant which would be adversely affected would equal the percentage of the flow withdrawn. (Finding 118). At the lowest flow anticipated in the future, 2500 cfs, the intake operating at its maximum capacity would withdraw less than 6 percent of the flow. (Findings 17, 71). Actually, however, during the months when larvae could be present at Point Pleasant, flows this low are rather uncommon. (Findings 68, 69, 70, 119). Therefore, the percent of the flow which would be withdrawn would be less. For average flow conditions, less than 2 percent of the water passing the site would be removed by the intake. Therefore, less than 2 percent of the larvae passing Point Pleasant would be adversely affected by the intake. (Finding 120).

Avoidance behavior by the larvae could further reduce the percent impacted. Although larvae shorter than 20 to 25 mm are largely at the mercy of the current, even recently hatched larvae are capable of some mobility and avoidance response. Studies on larvae of other species of fish, some closely related to shad, have shown that larvae have some ability to resist intakes beginning when they are 10 to 15 mm long. (Findings 114, 115). This means that some larvae subjected to the intake's pull would be able to resist it and avoid becoming impinged or entrained. The fact that the intake's pull drops dramatically a very small distance from the intake screen (Finding 27), should facilitate escape by larvae located a short distance from the screens even if those larvae have not yet developed strong swimming ability. Indeed, a witness for Del-Aware indicated his concern was limited to larvae within two inches of the intake screens. (Finding 101).

Although the percent of shad eggs and larvae affected by the intake would be small, the fact remains that some impingement and entrainment is forseeable. This does not mean that the intake's impact would be significant.

There are hundreds of pools in the Delaware River which serve as spawning grounds for shad. (Finding 121). The percentage of the total Delaware River eggs and larvae population which would be affected would be considerably lower than the already low percentages of eggs and larvae affected at Point Pleasant.

Although Del-Aware was concerned that the loss of any shad eggs or larvae would have a detrimental effect on the ability of the shad to repopulate their historic spawning grounds (Finding 122), we cannot agree. Shad populations are currently expanding although spawning at Point Pleasant, if it occurs, is limited. Given the fact that of the 100,000 to 500,000 eggs laid by a female shad (Finding 109), only three eggs need to reach adulthood to continue population gains, the loss of something less than 2 percent of those eggs and the resulting larvae at Point Pleasant could not reasonably be expected to prevent further population expansion. Rather, we find that the intake will not have a significantly adverse effect on the shad population in the Delaware River or the ability of that population to expand. (Finding 123).

We conclude that the intake, as relocated, would have no significant adverse effect on the Delaware River populations of either American shad or shortnose sturgeon. Therefore, there would be no benefit to these species from moving the intake further from the west shore of the river or from placing the intake upstream or downstream of the presently proposed location. (Finding 124). The insignificant impact of the presently proposed location would certainly be no greater than that of the shoreline location evaluated at the construction permit stage, and would very probably be less.

## F. Impacts Of The Intake on Recreation

### 1. Effects on Boating, Rafting, and Tubing[5]

Contentions V-15 and V-16a (in part) included an allegation that the intake would adversely affect a major boating and recreation area. (Finding 6). Some of Del-Aware's witnesses indicated that they were concerned that the intake would be a hazard to people utilizing the area for boating, rafting, or tubing. (Finding 125). The purported danger was apparently that they would be injured either by direct contact with the intake or by becoming hooked on fishing lures which may have been caught on the intake.

The intake would be covered by four feet of water even at a comparatively low flow of 3000 cfs (Finding 15). This should be sufficient depth to prevent the intake from being a hazard. Tubers may float through areas where the water is no deeper than a foot or eighteen inches. (Finding 127). They are more likely to contact the river bottom in such shallow water than they are to hit the intake. The river

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5 "Tubing" involves floating down the river while sitting in or holding onto an inner tube.

in the vicinity of Point Pleasant contains rocks. (Finding 126).[6] Therefore, people in boats or rafts would be no more likely to contact the intake than they would be to contact rocks.

There would be no serious danger of injury from fishing hooks caught on the intake. Although fishing lures have been lost because they have become entangled with objects in the river, no witness was aware of any incident in which someone had been injured by these lures. (Finding 126). Lures caught on the intake would not be any more likely to cause injury than would those which have been caught on other objects, apparently without causing injuries.

In summary, the intake would not increase the risk of injury to boaters, rafters or tubers beyond that they already experience.

2. Effects on Fishing

Del-Aware witnesses were concerned that the intake would have an adverse impact on fishing at what they described as one of the six best shore fishing sites on the Pennsylvania side of the Delaware River between Trenton and Easton. Point Pleasant, these witnesses testified,

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6 Although no testimony specifically addressed the fact, the Board during its site visit observed that some of the rocks out toward the middle of the river were within four feet of the surface even though the river flow was not particularly low.

is the second best spot for shore fishing for shad in that reach of the river. (Finding 128). The reason for Point Pleasant's superiority as a fishing spot for shad is believed to be that shad, which travel in a relatively narrow section of the river during their upstream migration, are closer to the Pennsylvania shore and within casting distance at that point. (Finding 129).

The concern was that shad would shy away from the intake and would alter their migratory path in such a way that it would no longer be possible to reach them when casting from shore. The intake screens would begin two feet above the river bottom while the shad travel within one foot of the bottom. Therefore, the intake array should not directly impede the shad's route. The witnesses were concerned, however, that the shad, which they described as "spooky", would avoid passing beneath the intake. (Finding 130).

The Board concludes that there is no evidence that the intake would have a detrimental effect on the Pennsylvania shad fishery. No evidence was presented that the intake will actually be located in a normal pathway of the migrating shad, since no particular pathway was known. As the witnesses conceded, an intake located elsewhere in the river could have a more serious impact on shad fishing. While a shoreline location for the intake would be least likely to cause the shad to modify their migratory path, such a location has other drawbacks which would outweigh its possible benefits in terms of possibly not scaring fish beyond casting distance from the Pennsylvania shore. (Finding 131).

If, in fact, the intake were to be located in the path of the shad and they were to change their pathway to avoid it, it is equally possible that they would move towards the Pennsylvania shore as that they would move away from it. (Finding 132). Thus, the intake could actually improve the Pennsylvania shore shad fishing rather than harming it.

## G. Impacts On The Proposed Historic District

Contention V-16a concerns the impacts of noise and maintenance related to operation of the intake on the Point Pleasant proposed historic district. (Finding 133). Although the Point Pleasant district has not, as yet, been listed on the National Register of Historic Places, it has been declared eligible for such listing by the keeper of the National Register. The district's significance is related to its preservation of the atmosphere and environment of a nineteenth century canal town. (Finding 134).

Under the National Historic Preservation Act, 16 U.S.C. §§ 470-470(n) (1976 & Supp.), as interpreted by the Advisory Council on Historic Preservation in its regulations, noises which are out of character with an historic property or which would significantly alter the property's setting may constitute adverse effects which require consideration by federal agencies involved in the projects causing them. (Finding 135). Therefore, adverse noise effects on the proposed historic district resulting from operation of the intake must be considered.

In compliance with the Act, the Pennsylvania State Historic Preservation Officer and the Advisory Council on Historic Preservation have been consulted concerning the Point Pleasant diversion. Neither has identified noise from the proposed intake and pumping station as an adverse impact on the proposed historic district. (Finding 136).

Although the National Historic Preservation Act has been complied with, that does not preclude the need to comply with NEPA with regard to impacts on historic and cultural aspects of the environment. See Preservation Coalition, Inc. v. Pierce, 667 F.2d 851, 858-59 (9th Cir. 1982). Therefore, noise impacts on the proposed historic district must be evaluated and, if necessary, mitigation measures undertaken.

A survey to determine ambient noise levels was done on the pumping station property during 1981. The noise level was measured at one point on the site (a point 30 feet from the southern property line and 100 feet east of the road). This measurement was considered representative of the ambient noise level at any point on the property since the ambient noise level would not be expected to vary greatly over a small distance. (Findings 137, 139).

Ambient noise measurements are made by taking sound readings which exclude nearby transient noise sources. Generally the low background noise level is defined as the lowest noise level measured over a fifteen minute period. (Finding 138).

The Applicant evaluated the impact of the anticipated noise from the proposed pumping station by comparing it to a background noise level which would be exceeded ninety percent of the time ($L_{90}$ sound level). In effect, PECo used for comparison a value which included noise levels at all frequencies. However, PECo's value was an A-weighted noise level, meaning that it was measured by an instrument which was most sensitive to those frequencies to which the human ear is most sensitive. Hence, the value, while accurate, deemphasized noise levels at particular frequencies higher or lower than those best perceived by the human ear. (Findings 140, 141).

The Staff's witness on noise presented a convincing case why the A-weighted $L_{90}$ sound level is not appropriate for determining the noise impacts from the pumping station. (Finding 142). People may perceive and be annoyed by noises which exceed the background noise level at particular frequencies, yet the $L_{90}$ sound level may mask that effect by deemphasizing those frequencies. Indeed, the noise impact of the transformers associated with the pumping station would be deemphasized in just such a manner if the A-weighted $L_{90}$ sound level were used for comparison. (Finding 142).

The Staff's witness suggested a different method of determining noise impacts which would avoid the problems of deemphasizing particular, possibly annoying, noises. He advocated determining the masking level of the ambient noise at each frequency which is a component of the noise whose impacts are being evaluated. The masking level is calculated from the sound level at the particular frequency and at frequencies within approximately 20 hertz (Hz) of the frequency in question. (Finding 143). The noise being evaluated is then compared to the masking level at each of its frequency components. Studies have shown that if the noise being evaluated is 3 decibels (dB) above the masking level at a particular frequency, most people will be able to perceive it. If, at any frequency, it is 5 dB above the masking level, people will complain of accoustical discomfort and annoyance. (Finding 144).

In order to calculate masking levels, one must know the background noise levels at particular frequencies, i.e., have ambient octave band sound pressure levels. The Applicant had daytime octave band sound pressure levels. However, the Staff's witness indicated that ambient noise levels are ordinarily measured at night, between midnight and 4:00 a.m. He indicated he would expect nighttime noise levels to be somewhat less than those measured during the day, and therefore, for his evaluation he estimated that ambient nighttime noise levels would be 3 dB lower than the measured daytime ones. (Finding 139).

Noise sources associated with the proposed intake would be the pumps and other equipment within the pumping station and the transformers immediately outside of it. Although emergency generators were once planned, they have been deleted and, therefore, are not a potential noise source. (Findings 145, 146, 147, 153).

The pumphouse would contain four pumps driven by electrical motors, the fourth of which would not be installed until between the years 1990 and 2000. The pumps would have a sound level rating of no more than 86 dB. (Finding 145). Ventilating equipment and small air compressors would also be within the pumphouse, but their noise level would be approximately 10 dB less than that contributed by the pumps. (Finding 146).

To help contain the noise, the pumphouse would be insulated and without windows. Sound attenuating designs would be used for all ventilating systems. (Finding 148).[7] The pumphouse structure should sufficiently attenuate any pump and motor noise from inside it so that any noise outside it should be much lower than the ambient sound level. (Finding 150). The noise would be further attenuated at greater

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[7] At the time he testified, the Staff's witness was uncertain about the air intake location and sound specifications for the pumphouse doors. He testified, however, that it would be well within the state-of-the-art to remedy any problem of noise transmission to the outside by these pathways. (Finding 149).

distances from the noise source. (Finding 151). As a result of attenuation by the pumphouse structure and as a result of distance from the pumphouse, the noise from equipment within the pumphouse should be at or below ambient noise levels at the closest site property line. (Finding 152).

Two transformers would be located <u>outside</u> the pumphouse, immediately adjacent to it on the river side. They would be 15 to 20 feet apart and separated by a firewall. (Finding 153). The transformers would be rated as producing 57 dB (A-weighted). (Finding 154). Noise from the transformers would be composed of discrete frequencies with fundamentals occurring at 120 Hz and multiples thereof. The fact that the transformer noise consists of discrete frequencies increases the likelihood that it will change the character of noise in the area and annoy people even if its level does not exceed the overall ambient level. (Finding 155).

No comparison has been made of the noise which would be generated by the transformers at 120, 240, 360 and 480 Hz with the masking levels at those frequencies. The Staff's witness, who advocated the technique, had not at the time of the hearing received sufficient information on the transformers selected to make this comparison. Nor were we presented with such a comparison by the Applicant. The Staff's witness indicated, however, that based on the information he did have, he believed the transformer noise would be audible beyond the boundaries of the pumphouse site at those frequencies at which it has fundamentals. (Findings 156, 157).

The Staff's witness focused his concern on the four residences near the pumphouse property. Specifically, he felt the noise would be audible at what were designated Residences 1 and 4. Of these two, Residence 4 is apparently closer to the transformers, and therefore would suffer a greater noise impact. (Finding 158).

Technology exists, basically in the form of sound barriers or sound walls, which could be used to eliminate any audible offsite noise. This technology could be utilized at the pumping station if the station were built and operational and noise reduction proved necessary. However, for economic reasons, there is no plan to install sound walls unless they prove necessary. (Findings 159, 160).

The Board is imposing a condition which will require that, if the pumping station is constructed and operated, tests shall be performed to ascertain whether the transformers will cause audible noise away from the pumping station property. The methodology recommended by the Staff's witness is to be used in making this determination. If these tests show that noise is audible offsite, mitigation measures are required to minimize the noise impact. Specifically, the Board requires that within one month after the pumping station begins operation, the Applicant shall carry out the following noise measurements and calculations. Measurements shall be made between 12:00 a.m. and 4:00

a.m. at the site boundary at a point on the straight line between the transformers and Residence 4 (as shown in Policastro Testimony, ff. Tr. 1118, at Attachment 1) or at that point on the site boundary line where the maximum noise impact occurs (if that point is different). Measurements shall be obtained by reading the lowest level on the sound level meter (set on fast response) which is repeated several times (i.e., the mean minimum). At the specified location or locations the following measurements shall be made:

A. Measurement of the octave band sound pressure levels. From these measurements, the masking level shall be computed for transformer fundamental frequencies of 120, 240, 360, and 480 Hz.

B. Measurements at the 1/3 octave bands for those four bands containing the fundamental frequencies.

The results of these measurements and computations shall be reported to the Staff. The noise will be considered audible if the measured sound pressure level and the 1/3 octave band containing the fundamental frequency (from measurement B) is greater than the masking level computed (from measurement A) for that frequency. If any of the four transformer fundamentals is found to be audible, measures shall be taken which render that fundamental (those fundamentals) inaudible.

In the event such measures are necessary, they shall be undertaken promptly. If such measures are necessary or if additional equipment which could increase the noise level is added, the measurements and computations described above shall be repeated and the results reported to the Staff.

These measures should assure that there will be no adverse impact on the proposed historic district from noise impacts related to operation of the intake.

In addition to noise directly related to operation of the intake, Contention V-16a concerns the impacts resulting from dredging maintenance for the intake. (Finding 133). Although the contention was, on its face limited to dredging, the testimony presented primarily concerned other maintenance work. We have also evaluated the impacts associated with that work.

Insofar as dredging is concerned, the evidence suggests that none would be necessary. Essentially the velocity of the river passing the intake should keep material from building up beneath the intake. Comparison of river bottom measurements made fourteen years apart indicates that in the past the river velocity has prevented any substantial deposition of material. The rip-rap which would be placed under the intake should assure that this lack of deposition would continue. (Findings 161, 162).

Del-Aware's witnesses suggested that the intake would be damaged if debris and ice were swept against it and that this would require substantial noisy repair work. (Finding 163). We conclude that such damage would be unlikely and that, if it were to occur, it could be repaired without causing any substantial adverse impacts on the proposed historic district.

Del-Aware's own witness indicated that ice and/or debris are found in the river after rains. Rain, of course, increases the flow in the river. McNutt's testimony about the river's level when he has seen ice and debris floating in it confirms that this occurs at relatively high flows. (Finding 164). Since the top of the intake would be under four feet of water even at a comparatively low flow of 3000 cfs (Finding 15), the clearance provided at even higher flows should be sufficient to insure that the ice and debris, floating on the river's surface, would not come into contact with the intake.

The Applicant also plans to provide guard posts at the upstream end of the intake structure. These should deflect ice and debris and would assist in preventing the intake from being damaged in the manner hypothesized. (Finding 165).

The Applicant also indicated means by which the intake could be repaired with a minimum of noise in the unlikely event it was damaged. Debris accumulated against the intake could be removed from a boat or by a diver. (Finding 166). Neither of these should cause intrusive noise.

Damage to an intake screen could be repaired underwater or by removing and replacing the screen in question. Removal of a screen might require a barge and, perhaps, a crane. (Findings 167, 168). While a crane might entail some noise, it appears that it would be a repair method of last resort for damage which is unlikely to occur. Any such noise would be a remote possibility and of short duration if it were necessary.

We conclude that maintenance, either dredging or to repair damage caused by ice or debris is unlikely to be necessary. If such maintenance should occasionally prove necessary, it would not cause noise impacts adversely affecting the Point Pleasant proposed historic district.

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The matters examined during the evidentiary hearing which are not discussed in this Opinion were considered by the Board and found either to be without merit or not to affect our decision herein. Findings of Fact and Conclusions of Law which are annexed hereto are incorporated in the Opinion by reference as if set forth at length. In preparing its Findings of Fact and Conclusions of Law, the Board reviewed and considered the entire record and the Findings of Fact and Conclusions of Law proposed by the parties. Those proposed findings not incorporated directly or inferentially in this Initial Decision are rejected as being unsupported by the record of the case or as being unnecessary to the rendering of this decision.

## II. FINDINGS OF FACT

### A. Background

1. This partial initial decision concerns alleged operational impacts of the supplementary cooling water system which is proposed to convey water from the Delaware River for use at the Philadelphia Electric Company's Limerick Generating Station. 47 Fed. Reg. 38657 (1982).

2. The parties who participated in the hearing are the Philadelphia Electric Company (PECo or Applicant), Del-Aware Unlimited, Inc (Del-Aware), and the Staff of the United States Nuclear Regulatory Commission (Staff). Tr. 741-42. Although other intervenors and governmental agencies are participating in the adjudication concerning issuance of operating licenses for Limerick, they have not been involved in the proceedings which are the subject of this partial initial decision.

3. This Licensing Board has jurisdiction over the issues decided in this partial initial decision pursuant to the Atomic Energy Act of 1954, as amended, § 191, 42 U.S.C. § 2241 (1976); the National Environmental Policy Act, § 102, 42 U.S.C. § 4332 (1976); 10 C.F.R. § 2.721 (1982); Notice of Evidentiary Hearing on Supplementary Cooling Water System Issues, 47 Fed. Reg. 38657 (1982); Establishment of Atomic

Safety and Licensing Board to Preside in Proceeding, 46 Fed. Reg. 45715 (1981); Notice of Opportunity for Hearing, 46 Fed. Reg. 42557 (1981).

4. The Applicant proposes to supply supplementary cooling water to Limerick by means of the Point Pleasant diversion. The diversion project, involving several components, would withdraw a maximum of 95 million gallons of water per day (MGD) from the Delaware River. Of this, up to 46 MGD would be used as cooling water for Limerick. The remainder would be utilized by the Neshaminy Water Resources Authority (NWRA) to supply water for Bucks and Montgomery counties in Pennsylvania. Special Prehearing Conference Order, LBP-82-43A, 15 NRC 1423, 1461-63 (1982) (SPCO); Applicant's Testimony on "Water Issues," ff. Tr. 949, at 5; Applicant's Ex. 1A at Response to Question E291.4.

5. The two contentions which are addressed in this partial initial decision concern the potential operational impacts of the intake structure in the Delaware River and its associated pumping station. A third contention, relating to impacts of a reservoir which would be a part of the diversion, was withdrawn by Del-Aware pursuant to a stipulation among the parties during the course of the hearing. Tr. 2370-71; Stipulation Concerning Contention V-16b, ff. Tr. 2371. The remaining components of the Point Pleasant diversion, insofar as they would be used to convey supplemental cooling water to Limerick, were not at issue in this adjudication.

6. Contentions V-15 and V-16a (in part), as litigated in this proceeding, state:

> The intake will be relocated such that it will have significant adverse impact on American Shad and Snortnose Sturgeon. The relocation will adversely affect a major fish resource and boating and recreation area due to draw-down of the pool.

See SPCO, 15 NRC at 1479.

## B. Location and Description of Proposed Intake

7. In July, 1980, the proposed location for the intake in the Delaware River was changed from a position along the Pennsylvania shoreline at Point Pleasant to one located out in the river approximately 200 feet from the west, Pennsylvania, shoreline. Applicant's Testimony, ff. Tr. 949, at 2-3; Applicant's Ex. 2 at 1.

8. In January, 1982 the proposed position for the intake was moved an additional 45 feet from the west shoreline, without changing the alignment of the intake pipes appreciably. The reason for moving the screen was to take advantage of the higher river velocities farther out into the river. Applicant's Testimony, ff. Tr. 949, at 2-3; Bourquard at Tr. 1421-22.

9. The intake has been described as being located in the "pool" of the Delaware River formed by the Lumberville wing dam. The length of the "pool" as understood in this proceeding, extends upriver from the

Lumberville wing dam to the riffle or rapids near the mouth of the Tohickon Creek. The intake would be located in the Delaware River at river mile 157.2 near the upstream limit of the Lumberville pool in the lower section of the swift water passing the mouth of the Tohickon Creek. The intake would be about 800 feet downriver of the confluence of Tohickon Creek and the Delaware River and approximately 1.5 miles upriver of the Lumberville wing dam. Applicant's Testimony, ff. Tr. 949, at 6; Testimony of Dr. Michael T. Masnik, ff. Tr. 3504, at 4; Applicant's Ex. 4.

10. The type of intake screen planned was also changed. When the shoreline location was proposed, the intake was planned with a vertical traveling screen. Applicant's Testimony, ff. Tr. 949, at 2-3; Applicant's Ex. 2 at 1. The present design calls for a passive wedge-wire screen structure. There would be two parallel rows of screens located seven feet apart. Each row would consist of six cylindrical screen sections placed end-to-end with space between the cylinders, aligned generally parallel to the river. The cylinders would be 10 feet 4 inches long and have a 40 inch diameter. Each cylinder would have two 40 inch long sections of screen with a 44 inch solid piece between them. The lead and trailing screens would be protected by conical end pieces. Each row would be about 75 feet in total length. Applicant's Testimony, ff. Tr. 949, at 3-4 and Page 2 of Exhibit A; Masnik Testimony, ff. Tr. 3504, at 4-5.

11. The screening on the intake would be made of helically welded wedge-wire wound circumferentially around internal supports spaced about 6 inches apart. The narrow portion of the wedge-wire would face inward so that the exterior screen surface would be relatively smooth and flat. The screen openings would be slots 2 mm in width. Applicant's Testimony, ff. Tr. 949, at 4; Masnik Testimony, ff. Tr. 3504, at 4-5.

12. A passive wedge-wire screen intake utilizes state-of-the-art technology. Witnesses for all of the parties, including Del-Aware, agreed that the presently proposed intake location and design is preferable to the originally contemplated shoreline intake with a vertical traveling screen. Applicant's Testimony, ff. Tr. 949, at 3, 6; Boyer at Tr. 1350; Brundage at Tr. 2996; Miller at Tr. 3156-57; McCoy at Tr. 3302, Masnik at Tr. 3982.

13. The intake design is such that water would flow into the screens around their entire circumference. Applicant's Testimony, ff. Tr. 949, at 4. The design would be such that through-slot water velocities would be nearly uniform over the entire screen surface. Masnik Testimony, ff. Tr. 3504, at 5.

14. The intake would be provided with an air backflush system to assist in keeping the screens free from debris. The Applicant anticipates that the system would be operated about once a week except during the relatively short period when fallen leaves are in the river. During that period it is anticipated that the system would be operated

once or twice a day. Applicant's Testimony, ff. Tr. 949, at 4-5; Bourquard at Tr. 2435-36, 2557-8, 2561; Boyer at 2561.

15. The intake would be located with the lowest part of its screens two feet above the river bottom. At river flows of about 3,000 cubic feet per second (cfs), the intake would be in water approximately ten feet deep. Under those conditions, the water surface would be approximately four feet above the top of the intake. Applicant's Testimony, ff. Tr. 949, at 4, 13; Masnik Testimony, following Tr. 3504, at 4-5; Applicant's Ex. 2 at 4-5.

16. For a river flow of 3000 cfs, even with the proposed intake operating at its maximum pumping rate, the water level at Point Pleasant would drop by less than an inch. Testimony of Rex. G. Wescott, ff. Tr. 3490, at 3; Applicant's Testimony, ff. Tr. 949, at 13. See also, Phillippe at Tr. 3807-08. This amount of drawdown would be barely perceptible to the human eye and would have a totally negligible effect on the overall water level in the pool. Masnik Testimony, ff. Tr. 3504, at 25. The changes in the intake's proposed location would not affect the amount of drawdown since the intake would still be in the same pool. Wescott Testimony at 2.

17. If water were being withdrawn at the maximum rate of 95 MGD, at a river flow of 3000 cfs, 4.9% of the flow would be withdrawn. At a flow of 2500 cfs, the withdrawal of 95 MGD (147 cfs) would represent a withdrawal of 5.9% of the flow. Masnik Testimony, ff. Tr. 3504, at 15;

Masnik at Tr. 3557; Harmon at Tr. 8398. Emery at Tr. 2064. At the lowest flow historically recorded, which occurred in October, 1963, the intake operating at its maximum capacity would have withdrawn 12% of the 1180 cfs flow. Direct Testimony of Richard W. McCoy, ff. Tr. 3046, at Table 1; McCoy at 3211-12.

18. Riprap would be placed on the river bottom beneath the intake over an area approximately 24 x 90 feet. The riprap would be approximately two feet thick and would be composed of large stones (about 12 inches on a side). The contours of the bottom where the riprap would be placed would be restored to roughly what they were before the intake was constructed. Applicant's Testimony, ff. Tr. 949, at 16; Bourquard at Tr. 2551-54, 2556.

C. The Point Pleasant Eddy

19. An eddy is a current of water, running contrary to the main current (especially a current moving circularly). Applicant's Testimony, ff. Tr. 949, at 6; Bourquard at Tr. 2524.

20. During periods of relatively low flow (below 5000-6000 cfs) the Delaware River at River Mile 157.2 (the proposed intake location) can be described as consisting of two parts: (1) a main channel or portion of relatively high flow velocity and (2) a slack water portion, to the Pennsylvania shore side of the main channel, containing a

clockwise moving body of water referred to as an eddy. Applicant's Testimony, ff. Tr. 949, at 6.

21. The eddy forms as a result of a rocky bar immediately downstream of the Tohickon Creek which causes a slack water area downriver of the bar on the Pennsylvania side of the river. Depending upon the river flow, water may or may not pass over the bar, and the amount of water flowing over the bar controls the size and location of the eddy. Harmon at Tr. 1406; Boyer at Tr. 1404, 1425, 1427; Plevyak at Tr. 1936.

22. With increasing river flows, the bar is covered by more and more water, and the eddy is forced downstream and shrinks in width away from the middle of the river. At particularly high flows, the eddy may cease to exist. Harmon at Tr. 1406; Boyer at Tr. 1404, 2766-7; Bourquard at Tr. 2614; Wescott at Tr. 3938. As the water flow drops below 5000 to 6000 cfs, the bar gradually starts to become exposed and the eddy expands upstream and widens out from the Pennsylvania shore. When the full length of the bar is exposed (at flows of approximately 3000 to 4000 cfs), the eddy achieves its maximum width in terms of the distance it extends from the Pennsylvania shore. Bourquard at 2614-15; McCoy at Tr. 3262; Kaufmann at 2098-99; Harmon at Tr. 1406, 1410; Boyer at Tr. 1413.

23. At its maximum width the eddy does not appear to extend past a point designated by the Applicant as Station 7 + 75. Bourquard at

Tr. 1405. Essentially, this designation signifies a distance of 775 feet from a point along the river road selected by the Applicant to be used as a point of reference in determining locations. This "station" system of designating locations is designed to avoid describing distances into the river in relation to the shore since the shoreline will change with changing flows. Bourquard at Tr. 2193; Applicant's Ex. 4.

24. Del-Aware alleged that the intake would be located in or would draw water from the eddy and that this would increase the risk of harm to developmental stages of American shad and shortnose sturgeon. Del-Aware theorized that the slow clockwise circulation in the eddy would cause them to be exposed to the intake repeatedly and for a longer period of time. Kaufmann at Tr. 1959, 2068-70; Emery at Tr. 2067, Miller at Tr. 3054.

25. The center of the proposed intake would be located at Station 8 + 62, or about 87 feet further out into the river than the estimated edge of the fully developed eddy. Harmon at Tr. 1410; Boyer at Tr. 1413, 1424. Witnesses for all the parties agreed that the proposed intake would not be in the eddy. Applicant's Testimony, ff. Tr. 949, at 6; Plevyak at Tr. 1940; Wescott at Tr. 3937, 3941, 3965; Harmon at Tr. 2573, Bourquard at Tr. 2574; Phillippe at Tr. 3756.

D. Intake Velocity

26. The maximum velocity through the intake screens would be 0.5 feet per second (fps), with an average velocity of 0.35 fps. Applicant's Testimony, ff. Tr. 949, at 5; Applicant's Ex. 2 at 1; Boyer at Tr. 1351; Emery at Tr 1768, 1774.

27. The design of the intake is such that the speed at which water would be drawn toward the intake would decrease very rapidly as the distance from the screen surface increases. At a distance of one foot from the screen, the average velocity toward the screen would fall to 0.071 fps. At five feet, the Applicant calculated that the average velocity toward the screen would have decreased to 0.011 fps. The velocity at ten feet was calculated to be 0.0037 fps. Applicant's Testimony, ff. Tr. 949, at 5; Masnik Testimony, ff. Tr. 3504, at 5; Boyer at Tr. 1363; Harmon at Tr. 2899.

28. Del-Aware's witnesses expressed concern that the screens could become clogged, causing the velocity through the slots to increase. The witnesses suggested that biofouling or fishing hooks could cause clogging. Direct Testimony of Charles Emery, ff. Tr. 1736, at 19; Kaufmann at Tr. 1879-80; McCoy at Tr. 3165-66, 3292-93; Miller at Tr. 3291-92.

29. Del-Aware's witness, Charles Emery, testified that a wedge-wire screen is less susceptible to clogging than most others and

that the intake's proposed position in the river would make the screens less susceptible to clogging. Applicant's witnesses testified that they considered biofouling, other than by leaves, unlikely to occur because of the absence of biofouling organisms in the Delaware River. If leaves or frazil ice were to accumulate on the screens, the Applicant indicated that they would be removed by the air backflush system. The intake location is such that contact with fishing hooks would be minimized. Embedded hooks, if any, could be removed by a diver. Emery at Tr. 1770-71, 1815, 1884; Harmon at Tr. 2585-86; Boyer at Tr. 2537-38, 2557-58; Bourquard at Tr. 2436-37, 2557-61, 2820-21; Dickinson at Tr. 2854-55.

E. Ratio of Bypass Velocity to Intake Velocity

30. Bypass velocity is the speed of the river water passing directly in front of and parallel to the long axis of the intake. A high ratio of the bypass velocity to the screen intake velocity is one of the factors that may enhance the protective value of an intake screen in reducing entrainment and impingement of aquatic life. Harmon at Tr. 2401, 2519, 2893; Brundage at Tr. 2932-33, 2939, 2944; McCoy at Tr. 3302; Miller at Tr. 3311; Emery at Tr. 2064.

31. Based on a study by Hanson and upon experience with vertical traveling screens, it has been said that a ratio of bypass velocity to screen intake velocity of a minimum of 2 to 1 is considered optimal with

respect to minimizing impingement and entrainment problems at wedgewire intake screens. Masnik Testimony, ff. Tr. 3504, at 18; Brundage at Tr. 2932; McCoy at Tr. 3351; Harmon at Tr. 2580-81. This 2 to 1 ratio would exist for the proposed intake operating at full capacity if the river velocity were 1.0 fps. Brundage at Tr. 2939.

32. Some witnesses suggested that field trials have not seemed to support the theory that a 2 to 1 ratio of bypass velocity to intake velocity is important. Brundage at Tr. 2978; Masnik at Tr. 3587, 4028.

33. Passive wedge-wire screens provide considerable protection from impingement and entrainment in comparison to traveling screens even at a 1 to 1 bypass to intake velocity ratio or in the absence of any bypass velocity. Harmon at Tr. 2359, 2397, 2582, 2851; Boyer at Tr. 2672, 2804-05. There is negligible difference between the protection afforded by a passive screen with a 2 to 1 bypass ratio as compared to a passive screen with a 1 to 1 ratio. Harmon at Tr. 2399-2400, 2853.

34. The type of fish to be protected is a consideration in determining whether a higher bypass to intake velocity ratio is beneficial for a particular wedge-wire intake screen. Harmon at Tr. 2359. There would be no biologically significant impact on either shortnose sturgeon or American shad from the proposed intake even if there were no bypass velocity. Harmon at Tr. 2827; Masnik at Tr. 4025. Bypass velocity, and the ratio of bypass velocity to intake velocity are of little

significance in providing protection to these two species. Harmon at 2826; Brundage at Tr. 2957-58.

F. Applicant's Velocity Measurements

35. Velocity measurements made by Applicant at the intake site on November 7, 1980, with a river flow of approximately 3000 cfs and a water surface elevation of 70.8 feet, indicated that the river velocity at the location and depth of the intake was at or in excess of the 1.0 fps required to provide a 2 to 1 bypass to intake velocity ratio at the maximum intake rate. (West screens - 0.98 to 1.2 fps; east screens - 1.1 to 1.35 fps; intake velocity in the range of 0.35 to 0.5 fps). Applicant's Ex. 1-A at Response to Question E240.27 (see Figures E 240.27-1 and -3); Applicant's Testimony, ff. Tr. 949, at 5.

36. Measurements taken at the intake site (Station 8 + 62) on July 23, 1981, when the flow was estimated at 4500 cfs and the river elevation was 71.4 feet, showed velocities of over 2 fps at the intake depth locations. Applicant's Ex. 1-A Response to Question E240.27 (see Figures E 240.27-2 and -3).

37. The instrument used by Applicant to measure river velocity should be accurate to within 5 percent. Phillippe at Tr. 3826.

38. A Del-Aware witness criticized the Applicant's velocity measurements because the Applicant had not recorded the direction of the

flow for which the velocity was measured. Supplemental (Rebuttal) Testimony of Johnathan Phillippe, ff. Tr. 3658, at 9.

39. The velocities measured by Applicant were maximum velocities. Harmon at Tr. 2209. There are some uncertainties as to the direction of the water flow. Based upon the bathymetry, i.e., information on the topography of the river bottom derived from measurements of water depth, the Tohickon bar and the trend toward the Pennsylvania shore (Applicant's Ex. 4), it appears that the direction of the current could intersect the intake at a direction as great as 20-25° from parallel with the long axis of the intake structure and angling toward the Pennsylvania side. Phillippe at Tr. 3735, 3850; Wescott at Tr. 3610-3611.

40. Maximum water velocities measured at an angle to the intake can be converted to bypass velocities by multiplying them by the value of the cosine of the intersection angle. Wescott at Tr. 3611; Phillippe at Tr. 3850.

41. The cosine of an intersection angle of 15° is 0.966. The cosine of 25° is 0.906. Phillippe at Tr. 3851.

42. Del-Aware's witness contended that the Applicant's determination of distances across the river at which velocity readings were made were inaccurate because the Applicant relied on an out-of-calibra-

tion split-image rangefinder on November 7, 1980. Phillippe Suppl. Testimony, ff. Tr. 3658, at 10-11; Phillippe at Tr. 3769-70.

43. In oral testimony, the Staff indicated that it had made three separate checks of the Applicant's velocity measurements of November 7, 1980. The first check involved calculating the total flow by summing the products of measured velocities and associated cross-sectional areas. The Staff calculated a flow value of 3070 cfs as compared to Applicant's calculated flow of 2950 cfs. Wescott at Tr. 3599. See also, Wescott at Tr. 3835.

44. The second independent check concerned the location of the measurement stations and involved plotting the depth integrated velocities versus the cross section to assure that the maximum velocities were occurring at the line of maximum depth and that the profile seemed to represent what might be expected based upon the cross section of the river at the intake. As a result of that exercise, a Staff witness concluded that the distance measurements could not have been off very much. Id. at Tr. 3600.

45. The Staff's third check involved using the velocity distribution in the water column to calculate a roughness coefficient for the river channel. The calculated coefficient was then compared to coefficient values commonly associated with rocky river bottom situations. The calculated coefficient (a Mannings' "n" value) was 0.46, a very reasonable value for a rocky bottom such as that which exists at the

intake site. The favorable correlation of "n" values is an indication that the depth variation of velocity was probably accurate. Id.

46. As a result of the checks made by the Staff on Applicant's velocity and distance measurements of November 7, 1980, a Staff witness stated that he was led to believe that the velocity measurements made on November 7, 1980 are probably accurate to within a tenth of a foot per second. Wescott at Tr. 3598-99.

47. Also, as a result of these checks, the Staff witness stated he believes the distance measurements were also accurate. Wescott at Tr. 3600, 3616-17.

48. The distance measurements made on November 7, 1980 could be in error by as much as 25 feet without being apparent in the checks. Phillippe at Tr. 3835-3837; Wescott at Tr. 3925-26. In the event that an error of that magnitude occurred, it would probably have been in the direction such that the measurements were taken further out in the river than the Applicant's data indicates they were. Wescott at Tr. 3926; Phillippe at Tr. 3837.

49. Assuming arguendo that an error of up to 25 feet occurred, based on the Applicant's plot of velocity against distance for November 7, 1980, at the intake location (Station 8 + 62) at the 7 foot depth, the velocity at the actual intake location would be approximately 75 percent of the measured velocity value or a minimum of 0.82 fps.

Applicant's Ex. 1-A at Response to Question E240.27 (see Figure E 240.27-1).

50. A Staff witness questioned the accuracy of the Applicant's velocity profile from July 23, 1981 because he found the Mannings' "n" value he calculated using that data would not be reasonable for a rocky bottom like that at Point Pleasant. He noted that the probable reason for this was a single unrealistically low, and probably erroneous value at the 10 foot depth. Wescott at Tr. 3921-23.

G. Determination of Flow at Point Pleasant

51. Flows at Point Pleasant may be calculated by taking the ratio of the drainage area tributary to the river at Point Pleasant and the drainage area at Trenton and multiplying the measured flow at Trenton by that ratio. The calculated drainage area ratio is 0.97. Bourquard at Tr. 2283, 2287-88; Phillippe at Tr. 3663.

52. Applicant developed a rating curve showing water surface elevation correlated to river flow at Point Pleasant. Bourquard at Tr. 2272. The rating curve was used as the basis for river flow during times when velocity measurements were made. Phillippe Suppl. Testimony, ff. Tr. 3658, at 7; Bourquard at Tr. 2272.

53. Del-Aware argues that the rating curve fails to reflect the fact that the Lumberville Wing Dam is a hydraulic control for the water

level at the proposed intake site in the low flow ranges and states that the rating curve is not accurate for low flows. Phillippe Suppl. Testimony, ff. Tr. 3658, at 7, 8.

54. The Lumberville Wing Dam is a partial constriction of the river located approximately 1.5 miles downstream of Point Pleasant. Because it has a slot opening and its cross-sectional area changes, its impact is different at flows which overtop the side wings from its impact at flows which do not. The top of the wing walls is 70.7 ft. The slot section has a width of approximately 100 feet and a minimum weir elevation of 64.5 feet. Bourquard at Tr. 2592; Wescott Testimony, ff. Tr. 3490, at 2; Del-Aware Ex. 1B.

55. Del-Aware alleges that river flows under 5000 cfs are affected in various ways by the hydraulic control provided by the Lumberville wing dam. At flows below roughly 3000 cfs, the weir section controls; while at flows in the range of 3000 to 5000 cfs, control is provided by both the weir and the broad crested wing dam. Del-Aware states that somewhere between 5000 cfs and 8000 cfs the effects of the dam are dissipated. Because of this situation, the upper flow portions of the rating curve probably are realistic while significant problems exist below the 3500 cfs flow level. Phillippe Suppl. Testimony, ff. Tr. 3658, at 7; Phillippe at Tr. 3700.

56. A Del-Aware witness stated that the data points used to construct the rating curve fell into two distinct sets of data points,

further stating that trend lines drawn through each of the two separate clusters resulted in essentially two parallel lines above and below the 71.5 foot elevation and displaced by 600 or 700 cfs for a given elevation. The witness attributed the displacement to the effect of the weir at different flow volumes. Phillippe at Tr. 3773-74.

57. Del-Aware questioned the treatment of flows in the Delaware and Raritan canal in developing the rating curve. Phillippe Suppl. Testimony, ff. Tr. 3658, at 8.

58. The Delaware and Raritan Canal comes off the Delaware River below Point Pleasant and above the Lumberville wing dam and flows parallel to the river to a point above Trenton. Boyer at 2833-34. The net diversion via this canal is presently limited by physical restriction to 60 MGD or 90 cfs. The authorized maximum diversion from the Delaware River is 100 MGD or 150 cfs. Boyer at Tr. 2834. Additional water flowing into the Canal is largely returned to the Delaware through overflow points at stream crossings and thus is included in flows at Trenton. Boyer at Tr. 2835-36, 2858-63, 2869.

59. Applicant's method of constructing the rating curve involved techniques commonly used for such work. Phillippe at Tr. 3698-3700.

60. One point on the Applicant's rating curve is the result of actual flow measurements made by the United States Geological Survey

(USGS) on September 12, 1981. On that date the flow at Lumberville was measured at 3340 and the flow into the Delaware and Raritan Canal was measured at 300 cfs, giving a total flow of 3640 cfs at Point Pleasant. Bourquard at Tr. 2261-2265. The river elevation at the Point Pleasant intake was simultaneously measured and was found to be 71.27 feet. Boyer at Tr. 2336. The Applicant's witnesses indicated that this confirmed the accuracy of the rating curve. Bourquard at Tr. 2269.

61. A witness for the Applicant testified that at flows of approximately 4500 cfs, the elevation shown by the rating curve should be accurate to within 0.1 foot. Bourquard at Tr. 2305.

62. The Staff and the Applicant believed that the flow measurement of 3000 cfs on November 7, 1980 was accurate to within 100 cfs. Bourquard at Tr. 2273; Wescott at Tr. 3931. Del-Aware's hydrological witness indicated that the flow on November 7, 1980 was, if anything, less than 3000 cfs. Phillippe at Tr. 3769.

63. Both the Applicant and the Staff indicated that the July 23, 1981 flow figure of 4500 cfs was less precise. Bourquard at Tr. 2272; Wescott at Tr. 3920-21.

H. Bypass Velocity at Low Flow

64. Velocity measurements taken at low flows such as 3000 cfs may be used to estimate velocities which may occur at lower flows such as

2500 cfs. Provided that there is no significant difference in water level the velocity distribution should be nearly identical, that is, the ratio of screen bypass velocity to average cross-sectional velocity at 2500 cfs is the same as it is at 3000 cfs. Wescott at Tr. 3609-3610.

65. The Applicant's velocity measurements define the cross-sectional velocity distribution in the river at low flows and are adequate to draw conclusions as to the likely velocity distribution past the screens during periods of ecological concern. Wescott Testimony, ff. Tr. 3490, at 4.

66. Using the minimum velocity measured at a screen location (west intake - 7 foot level) at 3000 cfs, the calculated ratio of screen bypass velocity to average cross-sectional velocity was 1.4. Assuming a constant bypass/average cross-sectional velocity of 1.4, the bypass velocity at a river flow of 2500 cfs was calculated to be 0.8 fps. Wescott at Tr. 3609-10; Boyer at Tr. 1350-51.

## I. Occurrence of Low Flows

67. Historically, flows at the Trenton gage have exceeded 2900 cfs 90 percent of the time for the period 1913 to 1980. During this period, many presently existing storage projects or reservoirs which can increase river flow were not in operation. Since the drought of the 1960's there has been an addition of approximately 135 billion gallons

of storage on the Delaware River, i.e., an increase of 56 percent. Boyer at Tr. 1360-62, 2575-77.

68. During the months of April, May and June when the early life stages of fish are most likely to occur, daily flow records over the last 20 years show that flows below 3000 cfs in the Delaware River at Trenton have occurred about 1 percent of the time. Brundage at Tr. 3003; Masnik at Tr. 3558.

69. Historically, over the last twenty years flows at Trenton during April and May have never gone below 3,000 cfs. McCoy at Tr. 3212. See also Phillippe Testimony, ff. Tr. 3658, at 4. Four times in the past 23 years, the minimum daily flow for June has been 3000 cfs or below. This indicates that on at least one day during the month, the flow has been that low. McCoy at Tr. 3214-15. Del-Aware presented data, however, that over the past 17 years flows have been less than 3050 cfs only 2.9% of the time in June. Phillippe Testimony at 4.

70. Flows have been somewhat lower in July when juvenile fish may be present. During twelve of the last thirty years the minimum daily flow for July has been below 3000 cfs. McCoy at Tr. 3345. Over 17 years, flows during July were below 3050 cfs 19.4% of the time. Phillippe Testimony, ff. Tr. 3658, at 4.

71. According to the Executive Director of the Delaware River Basin Commission (DRBC), the lowest anticipated flow at Trenton is 2500 cfs. This estimate is based on current hydrology and existing upstream storage. Hansler at Tr. 1261. It does not consider storage from the proposed Merrill Creek reservoir. Id. at Tr. 1272-74.

72. The DRBC has conditioned the withdrawal rights such that water used for Limerick can be withdrawn from the Delaware River so long as the river's flow exceeds 3000 cfs at Trenton unless PECo and other utilities provide offstream storage within the basin. In that case PECo could withdraw up to the amount they release from a storage system, up to their total allocation (46 MGD for Limerick), regardless of the flow in the Delaware. Hansler at Tr. 1227.

## J. Orientation of the Intake Screens Relative to the Flow

73. Screen slot orientation is a factor to consider in determining the efficacy of the screens. Brundage at Tr. 2933-34. However, the orientation is not a major protective feature since screens of this type have been shown effective at a variety of orientations to the flow. Harmon at Tr. 2814; Masnik at Tr. 3986.

74. The screen slots of the Point Pleasant intake screen would be roughly perpendicular to the flow. Harmon at Tr. 2807. Brundage at Tr. 2969; McCoy at Tr. 3306.

K. Impact on Shortnose Sturgeon

75. The shortnose sturgeon is on the list of endangered species maintained by the Secretary of the Interior pursuant to the Endangered Species Act, as amended, 16 U.S.C. §§ 1531-43 (1976 & Supp); 50 C.F.R. § 17.11 (1981). The National Marine Fisheries Service, has prepared, pursuant to the requirements of that act, a Biological Opinion finding that operation of the Point Pleasant Pumping Station is not likely to jeopardize the existence of shortnose sturgeon in the Delaware River. National Marine Fisheries Service, Endangered Species Act: Section 7 Consultation - Biological Opinion.

76. Shortnose sturgeon exist in the Delaware River. However, no shortnose sturgeon have been found at or above Point Pleasant. Applicant's Testimony, ff. Tr. 949, at 7, 9.

77. Lambertville, New Jersey, at river mile 149, is the farthest upstream location where the taking of shortnose sturgeon has been recorded. Two sturgeon were taken there in 1975 and eleven were taken in 1981. Lambertville is eight miles downstream from Point Pleasant. Applicant's Testimony, ff. Tr. 949, at 10; Masnik Testimony, ff. Tr. 3504, at 7; Harmon at Tr. 2681-82.

78. State and federal agencies have sampled for fish for a number of years in the stretch of the river in which the intake will be

located. No shortnose sturgeon have ever been found there. Harmon at Tr. 2681.

79. Harold M. Brundage III, a fisheries biologist who has studied shortnose sturgeon in the Delaware River estuary since 1978, conducted a sampling program for shortnose sturgeon in the vicinity of the Point Pleasant intake during the months of November, December, February and March of 1981-82. He also found no sturgeon. While Brundage's study was not conducted during the sturgeon's spawning season, sturgeon migrate upriver to spawn during March, April and early May. Therefore, the failure to find Sturgeon at Point Pleasant in late March is some indication that they do not spawn there. Harmon at Tr. 2427; Brundage at Tr. 2924, 2989-90, 3005-06; Applicant's Testimony, ff. Tr. 949, at 10-11; Professional Qualifications of Harold M. Brundage, III, following Tr. 2965.

80. Shortnose sturgeon are a comparatively difficult fish for which to sample. McCoy at Tr. 3068-69; Miller at Tr. 3071. Brundage used the appropriate methods in conducting his sampling program although his program was somewhat limited in the number of locations and frequency of samples. McCoy at Tr. 3070-71.

81. Healthy adult shortnose sturgeon, if present, would be protected from impingement by their size, swimming ability, and preference for staying at the bottom of the river. Masnik Testimony,

ff. Tr. 3504, at 8-9; Masnik at Tr. 3981; Emery at Tr. 1871-72; Harmon at Tr. 2888; Brundage at Tr. 2959-60.

82. Sturgeon spawn over rubble, cobble or gravel bottoms in high velocity fresh water in the range of 9°C to 12°C. They spawn in or above the tidal reaches of the river. A single sturgeon will lay approximately 140,000 eggs. The actual spawning occurs in the channel, near the river bottom. Applicant's Testimony, ff. Tr. 949, at 10; Emery at Tr. 1803, 1814; Brundage at Tr. 2924, 2928, 2991, 3030-31.

83. Sturgeon in the Delaware River probably spawn in the tidal waters immediately below the fall line at Trenton or in the non-tidal river immediately upstream of the falls. Brundage at Tr. 2984.

84. Although the Point Pleasant area has a river bottom which would be suitable for use by spawning sturgeon, there is no evidence to indicate Sturgeon actually spawn there. Masnik Testimony, ff. Tr. 3504, at 6-7; Brundage at Tr. 2928.

85. Shortnose sturgeon eggs are 3.0 to 3.2 mm in diameter. They are dense and demersal, and accordingly sink rapidly out of the water column. It is unlikely that they would drift far with the current before sinking to the bottom. The eggs are adhesive and become affixed to the substrate on which they land. Applicant's Testimony, ff. Tr. 949, at 11; Masnik Testimony, ff. Tr. 3504, at 7; Emery at Tr. 1798-99; Brundage at Tr. 2969.

86. If shortnose sturgeon were to spawn at Point Pleasant, it is highly unlikely that sturgeon eggs would be entrained or impinged in significant numbers. The eggs would be in the water column only a short time before adhering to the bottom. Therefore, there would be only a short time during which they could come into contact with the intake. In addition, the eggs are larger than the slots in the intake. While it would be possible for them to be crushed and extruded, work by Hanson has shown that it is more likely that they would roll along the intake surface and eventually off the intake. Applicant's Testimony, ff. Tr. 949, at 11; Masnik Testimony, ff. Tr. 3504, at 6-7; Emery at Tr. 1799-1801; Harmon at Tr. 2845; Brundage at Tr. 2969, 3028; Masnik at Tr. 3981.

87. Shortnose sturgeon larvae are very benthicly oriented during their first days of life. Until they are sixteen days old they occupy interstitial spaces, essentially without moving off the bottom. After sixteen days there may be some movement off the bottom, but some benthic orientation may continue for up to 43 days. Applicant's Testimony, ff. Tr. 949, at 11; Masnik Testimony ff. Tr. 3504, at 7-8; Kaufmann at Tr. 1869; Harmon at Tr. 2516-17; Brundage at Tr. 2945-46, 2988; Masnik at Tr. 3592-96.

88. There is some evidence that shortnose sturgeon larvae which are less than 20.5 mm in total length (a size reached at approximately 18.5 days of age) may be susceptible to entrainment if they contact the intake screens. Masnik Testimony, ff. Tr. 3504, at 7; Brundage at Tr. 2942-43.

89. Given their strong bottom orientation, there is little likelihood that if larvae small enough to become entrained are present, they would encounter even the lower portion of the intake screens, located two feet off the bottom. Applicant's Testimony, ff. Tr. 949, at 11-12; Masnik Testimony, ff. Tr. 3504, at 8; Harmon at Tr. 2515-17. One of Del-Aware's witnesses stated that he didn't think that any sturgeon larvae would be entrained. Emery at Tr. 1870.

90. Shortnose sturgeon larvae show strong swimming ability even before they begin to move off the bottom. A 15.5 mm larva can sustain burst swimming for approximately 38.1 cm. A 16.5 mm larva has a burst speed of approximately 14.7 cm/sec (about 0.6 fps). Brundage at Tr. 2988, 3016.

91. Larger larvae, which might venture further up in the water column where they might encounter the intake, would be protected from impingement by their strong swimming ability and the hydrodynamics of the intake. Brundage at Tr. 2972, 302[illegible] at Tr. 3981-82.

92. Charles Emery, an employee of the Pennsylvania Fish Commission, expressed concern that shortnose sturgeon might be susceptible to impingement within the first 25 days of life. Mr. Emery

apparently based his conclusion on the size of the larvae and did not take into account the benthic orientation and swimming ability of the larvae. Emery at Tr. 1870-71.

93. Given the design of the intake, if shortnose sturgeon larvae were present in the vicinity of the Point Pleasant intake, the effect upon them would be "infinitesimally small" (Harmon at Tr. 2845), there would be "virtually no impingement" (Brundage at Tr. 2972), and both entrainment and impingement would be "highly unlikely". Masnik at Tr. 3981.

94. It is highly unlikely that healthy juvenile sturgeon, which are both larger and stronger swimmers than larvae, would be impinged on the Point Pleasant intake. Masnik Testimony, ff. Tr. 3504, at 8; Masnik at Tr. 3981; Brundage at Tr. 2960.

## L. Impact on American Shad

95. American Shad spawn in the Delaware River and pass through the Point Pleasant area during their migration. However, all the witnesses were in agreement that the intake would not cause impingement or entrainment of adult shad. Applicant's Testimony, ff. Tr. 949, at 8; Masnik Testimony, ff. Tr. 3504, at 22-23; Kaufmann at Tr. 1792, 1855, 1883, 1950; Miller at Tr. 3244.

96. Juvenile Shad pass through the Point Pleasant area during their outmigration and use the Lumberville pool, which extends from the Lumberville wing dam to a riffle near the mouth of the Tohickon Creek, as a nursery area. Applicant's Testimony, ff. Tr. 949, at 7.

97. Several witnesses gave differing ages and sizes which they felt indicated the start of the juvenile stage i.e., that the larvae had undergone transformation and become juvenile fish. See Masnik, Testimony, ff. Tr. 3504, at 13; Emery at Tr. 2109-10; Miller at Tr. 3169, 3219, 3239-42. These differences may not indicate disagreements, but could reflect a lack of precision in defining the beginning of the juvenile stage. For the purposes of this opinion, however, we adopt the description given by Mr. Miller, a fishery biologist who has worked extensively with American Shad in the Delaware River, that transformation occurs at approximately 28-30 mm in length. This would be approximately 30 days after hatching. Direct testimony of Joseph P. Miller on behalf of Del-Aware, Inc., ff. Tr. 3046, at 1; Miller at Tr. 3168-69.

98. There would be virtually no possibility of entrainment of juvenile shad because of their size and their stage of development. Miller at Tr. 3168-69, 3241-42.

99. Healthy juvenile shad should not be impinged by the intake. Even Del-Aware's witnesses testified that, for shad larger than 25 mm,

an intake velocity of 0.5 feet per second should not cause impingement. Masnik Testimony, ff. Tr. 3504, at 22-23; Emery at Tr. 1963-64, 2066.

100. Del-Aware's witnesses were concerned that shad 25-40 mm in total length could be drawn to the intake and escape only after making contact with the screen surface. Concern was expressed that this could kill the fish by causing them to lose their scales. Emery at Tr. 1962-63, 1977, 2066. Descaling could also occur if the shad were to brush against a rock (Emery at Tr. 2143), so the problem is not unique to intakes. Moreover, the witnesses did not indicate that the problem was worse for the proposed location than for other locations. Kaufmann at Tr. 2143.

101. The small zone of influence of this intake compared to the cross-section of the river at Point Pleasant (<u>See</u> finding 27) minimizes the likelihood that descaling of juveniles as a result of contact with the intake would be a problem. The same witnesses who expressed concern that juveniles might be pulled to the intake and suffer descaling problems indicated that the zone of influence of the intake was sufficiently small that their concern was essentially limited to the area within two inches of the screens insofar as eggs and larvae were concerned. Kaufmann at Tr. 1882. Since juveniles have much greater mobility than eggs and larvae (Miller at Tr. 3168-70), the area in which they could be impacted should be even smaller.

102. Historically, American shad spawned in the Delaware River from Philadelphia to the headwaters of the river in New York. Testimony of

Michael Kaufmann, ff. Tr. 1736, at 6; Miller Testimony, ff. Tr. 3046, at 1-2. During the twentieth century the spawning range in the Delaware declined, perhaps due to pollution causing low dissolved oxygen levels in the estuary beginning in late April or May each year. Thus, in the 1970's, shad spawning in the Delaware occurred only upstream of the Delaware Water Gap. Miller Testimony at 2-3; Masnik Testimony, ff. Tr. 3504, at 12; Kaufmann Testimony, at 5-8. In 1980 and 1981, however, the low dissolved oxygen levels did not occur until later in the spring. Kaufmann at Tr. 2103-04. During these years there was evidence of shad spawning downriver of the Delaware Water Gap. There is evidence that shad may have been spawning between Lambertville and Easton, much closer to Point Pleasant than where spawning occurred during the 1970's. Specifically, "running ripe" shad have been observed at Lambertville, 8 miles south of Point Pleasant. This condition occurs in shad only during or shortly prior to spawning. Kaufmann Testimony at 9; Miller Testimony at 3-4; Emery at Tr. 1762-63, 1780-81, 2002; Kaufmann at Tr. 1942-43.

103. Several months before the hearing, the Applicant collected samples of what could have been shad eggs at Point Pleasant. By the time of the hearing, the Applicant had not yet analyzed the samples to ascertain if they did, in fact, contain shad eggs. Harmon at Tr. 2363-64, 2405.

104. There was conflicting testimony as to whether spawning has occurred at Point Pleasant in the past two years. Applicant's Testimony,

ff. Tr. 949, at 7; Masnik Testimony, ff. Tr. 3504, at 12; Kaufmann at Tr. 1785, 1976, 2101-03; Emery at Tr. 1785; Miller at Tr. 3049, 3129-30, 3355. Point Pleasant is within the stretch of the river in which spawning historically occurred, and spawning could occur there in the future if it is not occurring at the present time. Kaufmann Testimony, ff. Tr. 1736, at 9-10; Miller at Tr. 3049. For purposes of evaluating the intake's potential impact on shad, the Applicant assumed that spawning will occur at Point Pleasant. Harmon at Tr. 2405, 2408.

105. Shad normally spawn in the downstream 1/3 of a pool. Thus, spawning probably would not occur in the immediate vicinity of the intake. Kaufmann at Tr. 1943, 1961. Rather, concerns were raised that eggs and larvae spawned in the pool immediately upstream from the Lumberville pool in which the intake is located would drift into the Lumberville pool and be impinged or entrained. Kaufmann at Tr. 1961.

106. The Applicant's and the Staff's witnesses gave slightly different ranges for the size of shad eggs. The Applicant presented testimony that shad eggs range from 1.1 to 3.8 mm in diameter. Applicant's Testimony, ff. Tr. 949, at 8. A Staff witness testified that the eggs ranged from 2.1 to 3.8 mm in diameter. Masnik Testimony, ff. Tr. 3504, at 16.

107. Shad eggs have a mean diameter of 2.83 mm. Applicant's Testimony, ff. Tr. 949, at 8. Thus, most of the eggs would be larger

than the intake slots. In addition, the eggs water harden within a few minutes of spawning if they have been fertilized. Miller at Tr. 3153, 3348. However, even a water hardened egg is relatively fragile and may be crushed and pulled through the intake or may be damaged by being pulled against it. Emery at Tr. 1768; Miller at Tr. 3153-58. Witnesses for all the parties agreed that eggs which were sufficiently close to the intake could be entrained. Masnik Testimony, ff. Tr. 3504, at 14; Kaufmann at Tr. 1950; Harmon at Tr. 2398-9; Miller at Tr. 3153-3195.

108. Shad eggs are demersal. They rapidly sink to the bottom within approximately 5 to 35 meters from the point of spawning although they may be carried further. Masnik Testimony, ff. Tr. 3504, at 12, 16; Emery at Tr. 1761-62, 2136; Miller at Tr. 3204, 3296. During the period of sinking, they could be exposed to the intake.

109. A single shad female lays an estimated 100,000 to 500,000 eggs. Masnik at Tr. 3564. See also, Emery at Tr. 1760; Miller at Tr. 3157. Less than one percent of these eggs would hatch even if they were not affected by the intake. Emery at Tr. 1761; Masnik at Tr. 3560.

110. One witness indicated that eggs which spent a longer time in the water column before sinking to the bottom, would be less likely to survive. Since a longer time spent in the water column would increase the time of potential interaction with the intake, the eggs most likely to be impacted by the intake would likely be eggs which would not have produced larvae even if they were not so impacted. Masnik at Tr. 4006-07.

111. Shad larvae are 5.7 to 10.0 mm in length when hatched. Larvae range in size from approximately 7.0 to 30.0 mm. They reach 20.0 mm at approximately 17 or 18 days of age. Masnik Testimony, ff. Tr. 3504, at 13, 17; Miller at Tr. 3218-19; Emery at Tr. 2109.

112. Shad larvae display a behavior pattern whereby they rise to the water surface and then sink to the bottom. They then rise again to the surface and repeat the pattern. Masnik Testimony, ff. Tr. 3504, at 13, 20; Miller at Tr. 3052-53.

113. Larvae can be found anywhere in the water column. Miller at Tr. 3298. It is reasonable to assume that larvae are distributed uniformly throughout the water passing an intake site. Harmon at Tr. 2897.

114. Larvae less than 20 to 25 mm in length are basically at the mercy of the current. Emery at Tr. 2109; Harmon at Tr. 2423; Miller at Tr. 3052-53, 3204. While in the larval stage, a shad may be carried 40 to 50 miles downstream. Miller at Tr. 3221-22.

115. All larvae, even those just hatched, have some mobility and some avoidance capability. Miller at Tr. 3169-70, 3223, 3331; Harmon at Tr. 2423-25, 2553-54. Although the ability to avoid the intake may be limited in small larvae (Miller at Tr. 3331), other species which, like

shad, are members of the alosa genus have shown resistance to intakes when 10 to 15 mm in length. Applicant's Testimony, ff. Tr. 949, at 9; Harmon at Tr. 2421-22. In addition, studies on species other than shad have shown that larvae are entrained by intakes with wedge-wire screens at a lesser rate than would be expected on the basis of physical exclusion alone. Masnik Testimony, ff. Tr. 3504, at 17-18.

116. Shad larvae which are 20 mm or less in total length and pass sufficiently close to the intake screens will be susceptible to entrainment. Miller Testimony, ff. Tr. 3046, at 4; Masnik Testimony, ff. Tr. 3504, at 14, 17; Miller at 2220; Harmon at 2853.

117. Larger larvae (20-30 mm) may be subject to impingement or bruising if they pass sufficiently close to the intake screens. Masnik Testimony, ff. Tr. 3504, at 21; Harmon at Tr. 2416; Miller at Tr. 3220, 3241-42.

118. Assuming that larvae are distributed uniformly in the water passing by the intake site, and assuming no physical exclusion or avoidance behavior, at worst the percentage of larvae lost will equal the percentage of the total flow which is withdrawn. Masnik Testimony, ff. Tr. 3504, at 15; Emery at Tr. 2063-65; Harmon at Tr. 2397-98.

119. Shad spawn in April, May, and early June. Emery at Tr. 2061-62. The larvae hatch within two weeks after the eggs are

fertilized (Emery at Tr. 2108), and transformation to the juvenile stage occurs about a month later (see Finding 97). Eggs and larvae could be in the Point Pleasant vicinity during the months of April, May, June, and July.

120. For average flow conditions, the percentage of water volume removed at the maximal pumping rate, and thus, the percentage of larvae impacted (assuming uniform distribution, no avoidance, and no physical exclusion) would be less than two percent of those passing the site. Masnik Testimony, ff. Tr. 3504, at 15.

121. The Lumberville pool and the Point Pleasant vicinity have no unique value as a spawning site for shad. Masnik at Tr. 3577. There are hundreds of other pools in the Delaware River which are spawning grounds for shad. Kaufmann at Tr. 1943-44. See Finding 102.

122. One of Del-Aware's witnesses expressed concern that the loss of any shad eggs or larvae would have a detrimental effect on the ability of shad to expand their total historic spawning range. Miller at Tr. 3201, 3274, 3330.

123. A Staff witness testified that the intake "will not jeopardize the continued existence or anticipated future gains in population" of American shad in the Delaware River. Masnik Testimony, ff. Tr. 3504, at

11, 21-23. See also Masnik at 3550-52, 3561, 3987-3993. The Applicant's biological witness agreed. Harmon at Tr. 2846, 2885.

124. In view of the insignificant effect the intake will have on American shad and shortnose sturgeon populations, there is no significant benefit to be gained from locating the intake further from the west bank of the river. Masnik at Tr. 3548-49, 4032; Brundage at Tr. 2959.

## M. Impacts on Recreation

125. Some of Del-Aware's witnesses expressed concern that the intake could be a danger to boaters, rafters, and tubers (i.e., people floating down the river sitting in or holding onto an innertube). Emery Testimony, ff. Tr. 1736, at 14;[8] Direct Testimony of Stanley Plevyak, ff. Tr. 1930, at 2; Plevyak at Tr. 2021.

126. Although the witnesses testified that there are rocks in the river and that fishing lures and hooks have been lost on items already in the river (Emery at Tr. 1814; Plevyak at Tr. 1967-70), they could not detail any incidents of the type about which they were concerned, with

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[8] Although in the bound-in testimony this is indicated to be Michael Kaufmann's testimony, Mr. Emery indicated that actually his testimony began on page fourteen of the prefiled material. Tr. 1736.

regard to the intake. Emery at Tr. 1816, 1888; Kaufmann at Tr. 1887-88; Plevyak at Tr. 2013.

127. The intake would be covered by approximately four feet of water at flows of 3,000 cfs. (See Finding 15). Tubers sometimes float through areas where the water is only a foot to 18 inches deep. Kaufmann at Tr. 1887; Plevyak at Tr. 2012. These areas may contain rocks. Kaufmann at Tr. 1887.

128. Del-Aware presented evidence that Point Pleasant is one of the six best shore fishing spots on the Pennsylvania side of the Delaware between Trenton and Easton and the second best spot for shore fishing for shad in that area. Kaufmann Testimony, following Tr. 1736, at 10-11; Plevyak at Tr. 1951.

129. Shad migrating upriver to spawn are believed to travel in a relatively narrow section of the river where they find an appropriate velocity. At Point Pleasant this migratory path is sufficiently close to shore that fishermen can cast into it from the Pennsylvania shore. Kaufmann Testimony, ff. Tr. 1736, at 13-14; Kaufmann at Tr. 1788, 1793.

130. Although shad travel within one foot of the bottom during their migration (Kaufmann at Tr. 1862) and the intake screens will be two feet above the bottom (see Finding 15), the shad, which are "spooky" (Miller at Tr. 3245, 3348-49), might change their migratory path if they were to encounter the intake and move beyond the range of fishermen

casting from the Pennsylvania shore. Kaufmann Testimony, ff. Tr. 1736, at 13-14; Kaufmann at 1792, 1951.

131. The witnesses did not indicate whether the intake, as proposed, would be in the migratory path of the shad. Thus, it could be that a different location for the intake would have a more serious impact on shad fishing. Kaufmann at Tr. 1957. Although a shoreline location would be least likely to divert migrating shad, the witnesses did not favor it because of its other drawbacks. Kaufmann at Tr. 1956-58.

132. If the intake were located so that it caused diversion of migrating shad, the witnesses were not certain whether the fish would move towards Pennsylvania and the fishermen or towards New Jersey and away from the fishermen. Kaufmann at Tr. 1793-4, 2129-30.

## N. Noise from Intake Operation

133. Contention V-16a states:

> Noise effects and constant dredging maintenance connected with operations of the intake and its associated pump station will adversely affect the peace and tranquility of the Point Pleasant proposed historic district.

See SPCO, LBP-82-43A, 15 NRC at 1479.

134. The Point Pleasant Historic District has been declared eligible for listing on the National Register of Historic Places by the keeper of the National Register. NRC Staff Testimony of

Brian J. Richter on Limerick Contention V-16a, ff. Tr. 1118, at 3 n.1. The District is significant because it preserves the atmosphere and environment of a canal town in the nineteenth century. Direct Testimony of Professor Pierce Lewis at 2-4;[9] Richter Testimony, at attachment 1.

135. Noises which would be out of character with a property or would alter its setting may constitute adverse effects on National Register sites which must be considered by federal agencies. Richter, Testimony, ff. Tr. 1118, at 4; 36 C.F.R. § 800.3(b).

136. Although the Pennsylvania State Historic Preservation Officer and the Federal Advisory Council on Historic Preservation, which are responsible for providing expert advice on the impacts of federally licensed projects, have been consulted about the Point Pleasant diversion project, neither has identified noise from the intake and pumping station as an adverse impact on the proposed historical district. Richter Testimony, ff. Tr. 1118, at 4-5.

137. A site noise survey was done in 1981 to determine ambient noise levels. Applicant's Testimony, ff. Tr. 949, at 13. The ambient

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9 Professor Lewis' Testimony is bound into the record in an earlier form following Tr. 4036. By agreement of the parties (Tr. 3950-51), Professor Lewis' testimony was submitted with minor changes on November 4, 1982, accompanied by his affidavit that he adopted it as his testimony in the proceeding.

noise level was measured at a site 30 feet from the southern property line of the pumping station and 100 feet east of the road. Moiseev at Tr. 1058-59. Because ambient noise levels do not generally vary much over a short distance, this may reasonably be considered representative of the ambient noise level for the entire pumphouse property. Moiseev at Tr. 1059.

138. Ambient noise levels are measured by excluding transient noise sources such as the sound of a car passing nearby. Moiseev at Tr. 1041-42. To get a low background reading, one generally takes the lowest noise level measured over a fifteen minute period. Policastro at Tr. 1143, 1145.

139. The Applicant's data on ambient noise were collected during October. Moiseev at Tr. 1069. The Applicant measured low noise levels for a full day and measured daytime octave band sound pressure levels. Applicant's Testimony, ff. Tr. 949, at 13; NRC Staff Testimony of Anthony Policastro in Response to Contention V-16a, ff. Tr. 1118, at Ex. 2. It is standard practice to measure ambient noise levels between midnight and 4:00 a.m. Policastro at Tr. 1147. Applicant does not have nighttime ambient octave band sound pressure levels, but one would expect nighttime noise levels to be somewhat lower than those during the day. Policastro at Tr. 1143-1146. The Staff's expert on noise estimated that nighttime levels would be three decibels (dB) below the measured daytime levels. Policastro at Tr. 1175.

140. The Applicant evaluated the noise impact of the pumping station and the intake by comparing it to an overall A-weighted ambient sound level which is exceeded 90 percent of the time ($L_{90}$). Moiseev at Tr. 999, 1036-37; Policastro at Tr. 1141.

141. An A-weighted noise level is one which is measured on a filtered instrument system which biases the meter to respond as would an average human ear. Thus, it is less sensitive to noises at low or high frequencies than it is to frequencies in the middle range. Applicant's Testimony, ff. Tr. 949, at n. 14.

142. The $L_{90}$ sound level is not an appropriate figure to use for planning purposes because, being A-weighted, it deemphasizes the lower frequency range. That lower frequency range is the area in which transformer noise may be annoying. Policastro at Tr. 1141-42.

143. To determine whether a noise will be annoying to people, it should be compared with the masking level of the ambient noise at each tone at which it has a component. The masking level is calculated from the sound level at a particular tone and at nearby frequencies (within about 20 hertz). Policastro at Tr. 1129-31.

144. Generally, people are able to perceive a noise that is 3 dB above the masking level at any particular tone. People begin to complain of acoustical discomfort or annoyance when tones are 5 dB above

the masking levels. Policastro at Tr. 1157-58, 1181. The 5 dB level for annoyance apparently applies at any frequency. Policastro at Tr. 1180.

145. The pumphouse would contain four vertical multistage centrifugal pumps driven by electric motors. The fourth pump is proposed to be installed between the years 1990 and 2000. Applicant's Testimony, ff. Tr. 949, at 14. The technical specifications call for pumps to have a sound level rating of no more than 86 dB as measured by IEEE Standard 85. Bourquard at Tr. 987-88.

146. The other noise sources within the pumphouse would be ventilating equipment and small air compressors. The noise they contribute would be about 10 dB less than that of the pumps. Boyer at Tr. 1062; Moiseev at Tr. 1062-63.

147. The plans no longer call for emergency generators, and the Applicant's witness indicated that no such machinery would be added in the future. Boyer at Tr. 1021-23.

148. The pumphouse walls would be insulated. The floors would be concrete. The roof would be insulated concrete plank. There would be no windows. Sound attenuating designs would be used for all ventilating systems. Applicant's Testimony, ff. Tr. 949, at 14-15.

149. The Staff's witness on noise had not ascertained at the time he testified what the sound specifications were for the doors of the pumphouse or exactly where the air intake would be located. Policastro at Tr. 1122-23. He did not seem to consider this lack of information to affect seriously his ability to draw conclusions, and he testified that it was well within state-of-the-art technology to remedy any problems which might exist concerning noise transmission to the outside of the building by these pathways. Policastro at Tr. 1166-69.

150. The pumphouse structure would attenuate the noise generated inside it sufficiently that there would be very little noise outside it and what noise there is would be well below the ambient sound level. Policastro at 1121-22, 1124-25.

151. Further noise attenuation would occur at greater distances from the noise source (e.g., the pump). The 86 dB rating for the pumps is at a distance of one meter. Moiseev at Tr. 1009. The rule of thumb is that noise attenuates 6 dB with doubling of the distance from the source. Moiseev at Tr. 1005.

152. As a result of attenuation due to the pumphouse structure and distance, the noise from equipment inside the pumphouse would be at or below ambient noise levels at the closest site property line. Applicant's Testimony, ff. Tr. 949, at 15; Moiseev at Tr. 979-80, 984-86, 1001, 1004, and 1026.

153. There would be two transformers outside the building. Applicant's Testimony, ff. Tr. 949, at 14-15. The transformers would be immediately adjacent to the side of the building facing the river (the east side). They would be approximately 100 feet from the Delaware Canal. Boyer at 990. The transformers would be 15 to 20 feet apart and there would be a firewall between them. Boyer at 990-91.

154. Although the specifications had not yet been changed to reflect it, the Applicant's Senior Vice President - Nuclear Power testified that a decision had been made to use low noise level transformers. These transformers are rated at 57 dB using A-weighted measurements, or 10 dB below standard transformers. The Applicant is committed to modifying the specifications to reflect that these "quieted" transformers would be required. Boyer at Tr. 1030-31; Moiseev at Tr. 1030.

155. Transformers produce a steady state noise consisting of noise at discrete frequencies. The noise has a fundamental frequency at 120 hertz (Hz) and harmonic frequencies at multiples thereof. Moiseev at Tr. 1066, 1068. These discrete frequencies may render the noise bothersome even though it is only a low pitched hum. Moiseev at Tr. 1088-89. The discrete frequencies also mean that transformer noise may change the character of the noise in an area even if the overall background noise level is not exceeded. Policastro at Tr. 1129-1131.

156. To determine whether the transformer noise would be annoying to people, the noise level must be compared to the masking level at each of the discrete frequencies at which the transformer has a fundamental frequency or harmonic frequency (i.e., 120, 240, 360, and 480 Hz). This has not been done. Policastro at Tr. 1126, 1130-31.

157. Although the Staff's witness had not received information on the final design of the transformers so that he could make this comparison (Policastro at Tr. 1125-26), he believed, on the basis of the information that he did have, that the transformers would cause audible noise beyond the pumphouse property site at those tones at which it has fundamentals. Policastro at Tr. 1132.

158. The Staff's witness was concerned that the transformers would produce objectionable noise at nearby residences which he referred to as Residences 1 and 4. Testimony of Anthony Policastro, ff. Tr. 1118, at 5; Policastro at Tr. 1138-39. Residence 4 would be closer to the transformers than would Residence 1. Policastro Testimony at Ex. 1.

159. Technology exists (e.g. sound barriers) which could be used to eliminate any noise off the pumphouse site which would be annoying. Moiseev at Tr. 1046, 1055; Policastro at Tr. 1132-33, 1153, 1158-59. If further quieting is necessary, this technology may be utilized at the Point Pleasant pumphouse site. Cost, however, weighs against requiring use of such technology unless it proves necessary to further reduce noise. Moiseev at Tr. 1046-47; Bourquard at Tr. 1047; Policastro at Tr. 1132.

160. The Applicant estimated that sound barriers would cost approximately $35,000 to $40,000 to install. Bourquard at Tr. 1048.

## O. Impacts from Dredging and Maintenance

161. Although Contention V-16a alleges adverse impacts from dredging maintenance, no evidence was presented that any maintenance dredging would be required once construction is complete. Rather, the evidence indicated that the riprap placed beneath the intake should aid in keeping the bottom there swept clean. Bourquard at Tr. 2662. Essentially, the flow velocity should be sufficient to prevent material from accumulating under the intake. Applicant's Testimony, ff. Tr. 949, at 15; Bourquard at Tr. 2823.

162. Comparison of ground surface elevation measurements made in connection with the taking of core borings at Point Pleasant in 1981 with contours established by a survey made fourteen years earlier indicate that the bottom grade had not changed significantly as a result of material deposited during that period. Applicant's Testimony, ff. Tr. 949, at 15-16; Bourquard at Tr. 2176-77, 2607-09.

163. Del-Aware's witnesses were also concerned that the intake would be damaged by ice and debris in the river being swept against it, and that this would necessitate complicated and noisy repair work.

Testimony of Richard McNutt, ff. Tr. 3382, at 2, 4, 5, 8; Phillippe at Tr. 3793-95.

164. Del-Aware's chief witness on the question of damage to the intake testified that ice blocks and debris floating down the river occurred after rains. McNutt at Tr. 3401, 3403-04, 3409-10, 3442-43. He testified that he was concerned with a six inch flow over the bar of rocks at the mouth of Tohickon Creek at the time ice blocks would exist. McNutt at Tr. 3435. He also discussed a 20 foot by 20 foot block of ice going over the Lumberville wing dam. McNutt at Tr. 3449. This confirms the view that ice and debris would be floating in the river primarily when there are relatively high flows covering the intake. See also Applicant's Testimony, ff. Tr. 949, at 16; Boyer at 2537.

165. Additional protection from damage by ice or debris would be provided by three 12-inch diameter vertical steel guard posts at the upstream end of the intake structure. Applicant's Testimony, ff. Tr. 949, at 16; Boyer at Tr. 2541.

166. Should debris accumulate against the intake structure, it would be removed from a boat or by a diver. Applicant's Testimony, ff. Tr. 949, at 16. The Applicant anticipates the need to clear away debris perhaps once a year. Boyer at Tr. 2538.

167. If the intake were damaged, repair work could be performed under water. Boyer at Tr. 2546; McNutt at Tr. 3439-40.

168. If necessary, an intake screen section could be removed for repair and replaced. Divers could accomplish this without difficulty. Boyer at Tr. 2539-40. This might require a barge in the river and, perhaps, a crane. McNutt at Tr. 3446-47.

## III. CONCLUSIONS OF LAW

Based upon the foregoing Opinion and Findings of Fact which are supported by reliable, probative and substantial evidence as required by the Administrative Procedure Act and the Commission's Rules of Practice, and upon consideration of the entire evidentiary record in this proceeding, the Board reaches the following conclusions pursuant to 10 C.F.R. § 2.760a:

1. With respect to Contentions V-15 and V-16a (in part), there will be no adverse impact on American shad, shortnose sturgeon, boating, or recreation which would render invalid the favorable cost-benefit analysis from the construction permit stage, and there will be no impacts requiring mitigation measures for compliance with Section 102 of the National Environmental Policy Act of 1969, 42 U.S.C. § 4332 (1976).

2. With respect to Contention V-16a, the Board is imposing a condition in its Order, infra, which will require mitigation measures to be taken if operation of the intake creates annoying noise levels off the pumping station site. Once this condition is complied with, operation and maintenance of the intake and its associated pumping

station will not cause impacts which render invalid the favorable cost-benefit analysis performed at the construction permit stage or require further mitigation measures for compliance with Section 102 of the National Environmental Policy Act of 1969, 42 U.S.C. § 4332 (1976).

## IV. ORDER

WHEREFORE, in accordance with the Atomic Energy Act of 1954, as amended, and the Rules of Practice of the Commission, and based on the foregoing Findings of Fact and Conclusions of Law, IT IS ORDERED that:

1) Within one month after the proposed pumping station begins operation, the Applicant shall carry out the following noise measurements and calculations. Measurements shall be made between 12:00 a.m. and 4:00 a.m. at the site boundary at a point on the straight line between the transformers and Residence 4 (as shown in Policastro Testimony, ff. Tr. 1118, at Attachment 1) or at that point on the site boundary line where the maximum noise impact occurs (if that point is different). Measurements shall be obtained by reading the lowest level on the sound level meter (set on fast response) which is repeated several times (i.e., the mean minimum).

At the specified location the following measurements shall be made:

A. Measurement of the octave band sound pressure levels. From those measurements, the masking level shall be computed for the transformer fundamental frequencies at 120, 240, 360 and 480 Hz.

B. Measurements at the 1/3 octave bands for those four bands containing the fundamental frequencies.

The results of these measurements and computations shall be reported to the Staff.

The noise will be considered audible if the measured sound pressure level and the 1/3 octave band containing the fundamental frequency (from measurement B) is greater than the masking level computed (from measurement A) for that frequency. If any of the four transformer fundamentals is found to be audible, measures shall be taken promptly which render that fundamental (those fundamentals) inaudible.

If such measures are necessary or if any additional equipment which could affect the noise level is added, the measurements and computations described above shall be repeated and the results reported to the Staff.

2) In accordance with 10 C.F.R. §§ 2.760, 2.762, 2.764, 2.785, and 2.786, this Partial Initial Decision shall become effective and shall constitute, with respect to matters resolved herein, the final decision of the Commission thirty (30) days after issuance hereof, subject to any review pursuant to the above cited Rules of Practice. Applying the rationale of Boston Edison Co. (Pilgrim, Unit 2), ALAB-632, 13 NRC 91,

93 n. 2 (1981); Duke Power Co. (Perkins, Units 1, 2 and 3), ALAB-597, 11 NRC 870 (1980), and Houston Lighting and Power Co. (Allens Creek, Units 1 and 2), ALAB-301, 2 NRC 853 (1975), this partial initial decision is appealable t this time. Exceptions to this decision may be filed with the Atomic Safety and Licensing Appeal Board within ten (10) days after service of this Partial Initial Decision. A brief in support of such exceptions may be filed within thirty (30) days thereafter, forty (40) days in the case of the Staff. Within thirty (30) days after service of the brief of appellant, forty (40) days in the case of the Staff, any other party may file a brief in support of, or in opposition to such exceptions.

IT IS SO ORDERED.

FOR THE ATOMIC SAFETY
AND LICENSING BOARD

Lawrence Brenner

Lawrence Brenner, Chairman
ADMINISTRATIVE JUDGE

Richard F. Cole

Dr. Richard F. Cole
ADMINISTRATIVE JUDGE

Peter A. Morris

Dr. Peter A. Morris
ADMINISTRATIVE JUDGE

Bethesda, Maryland
March 8, 1983

An index of exhibits and witness qualifications
is attached as Appendix A [unpublished].

# APPENDIX A

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

BEFORE ADMINISTRATIVE JUDGES:

Lawrence Brenner, Chairman
Dr. Richard F. Cole
Dr. Peter A. Morris

| | |
|---|---|
| In the Matter of | ASLBP Docket No. 81-465-07 OL |
| PHILADELPHIA ELECTRIC COMPANY | (NRC Docket Nos. 50-352-OL 50-353-OL) |
| (Limerick Generating Station, Units 1 and 2) | March 8, 1983 |

PARTIAL INITIAL DECISION
(ON SUPPLEMENTARY COOLING WATER SYSTEM CONTENTIONS)

**APPENDIX A**

1. **Exhibits received into evidence:**

**Staff Exhibits**

| No. | | Received | Identified | Bound In |
|---|---|---|---|---|
| 1 | Drawing of American Shad, 21 mm. larva. | | 3223 | 3223 |
| 2 | Exhibit 4 from Applicant Exhibit 2, Point Pleasant Pumping Station, Delaware River Channel Section at Water Intake. | | 3487 | |
| 3 | Exhibit 5 from Applicant Exhibit 2, Point Pleasant Pumping Station Location and Layout Plan, General Profile, December 22, 1981, revised January 13, 1981. | | 3488 | |
| 4 | Exhibit 10 from Applicant Exhibit 2, Point Pleasant Pumping Station Intake Screen Assembly and Piping Details, September 1, 1981, revised January 13, 1982. | | 3488 | |
| 5 | Assessment of the impacts of the proposed Point Pleasant Pumping Station and intake structure on the shortnose sturgeon, by H. Brundage, 1982. | | 3501 | |

## Del-Aware Exhibits

| No. | | Received | Identified | Bound In |
|---|---|---|---|---|
| 1-A | Issue #1 Response on water quality data at Point Pleasant. | 1313 | 1299 | 1315 |
| 1-B | Issue #2 Response on sea level elevation of Lumberville Dam. | 1313 | 1300 | 1315 |
| 1-C | Issue #4 Response on further assessments of intake location after 1980 Environmental Assessment. | 1313 | 1301 | 1315 |
| 1-D | Issue #6 Response on cross section data on Delaware River at Point Pleasant. | 1313 | 1302 | 1315 |
| 1-E | Issue #7 Response on status of Point Pleasant withdrawal in Recommendation 13. | 1316 (Rejected) | 1302 | 1318 |
| 1-F | Issue #5 Response on current status of Merrill Creek project. | 1317 (Rejected) | 1302 | 1318 |
| 2 | Tabulation of available data and Delaware River Flow Velocities at Intake Site (3). | | 1376 | 1376 |
| 3 | Water Quality Analyses, Area-Specific Dilution Studies, Region III, January 1981. | | 1449 | 1478 |
| 4 | Water Quality Analyses, Ten Area-Specific Dilution Studies. | | 1460 | 1478 |
| 5 | Letter to Mr. Hansler from Mr. Torok dated March 12, 1980. | | 1465 | 1478 |
| 6 | Letter to Col. Baldwin from Mr. Pence dated March 17, 1982. | 1494 | 1471 | 1478 |
| 7 | Development of Relationship Between Water Discharge and Water Surface Elevation, January 4, 1982. | | 1639 | 1727 |
| 8 | Draft - Background Report Concerning the Interstate Water Management Recommendations of the Parties to the U.S. Supreme Court Decree of 1954 to the DRBC (Without Appendices). | | 1660 | 2509 |

| No. | | Received | Identified | Bound In |
|---|---|---|---|---|
| 9 | Letter to E.H. Bourquard from P.L. Harmon dated July 28, 1981 and three Tables on Velocity Measurements. | 2225 | 2211 | 2225 |
| 10 | The American Shad (Alosa sapidissima) in the Delaware River, by J.P. Miller, F.R. Griffiths and P.A. Thurston-Rogers. | | 2227 | 2229 |
| 11 | Rating Curve - Point Pleasant Intake Site. | | 2275 | 2330 |
| 12 | USGS Data Sheets for October 1980, May 1981 and July 1981. | 2329 | 2320 | 2330 |
| 13 | Point Pleasant Pumping Station Preliminary Design, Sheets 1, 2 and 3 of 4. | | 2321 | 2330 |
| 14 | Letter to W.H. Dickinson from E.H. Bourquard dated August 10, 1982, including Tables. | | 2392 | 2392 |
| 15 | Memorandum from W.H. Dickinson, "Mechanical Engineering Division," dated May 14, 1982. | | 2460 | |
| 16 | Memorandum from D.L. Morad, "Making Water System Status Report," dated December 16, 1981. | | 2465 | 2509 |
| 17 | Memorandum of meeting of January 5, 1982 (2 pages) including Figures and Excerpts of Hansen paper, by E.H. Bourquard. | | 2570 | |
| 18 | Actual versus Measured Readings (Rangefinder) dated March 1981 (Tables) from handwritten note from Mr. Bourquard to Mr. Harmon dated March 10-11, 1981. | | 2758 | 2825 |
| 19 | Delaware Intake Points Below, Read and Actual Distance from Split-Image Measuring Devices, E.H. Bourquard, dated March 10, 1981. | | 2768 | 2825 |
| 20 | Letter from H.M. Brundage III to R.A. Flowers, dated July 27, 1982. | | 2966 | 2975 |

| No. | | Received | Identified | Bound In |
|---|---|---|---|---|
| 21 | Single page, marked "13," excerpted from "Assessment of the impacts of the proposed Point Pleasant Pumping Station and intake structure on the shortnose sturgeon." | | 2975 | 2975 |
| 22 | Letter from H.M. Brundage III to E.H. Bourquard dated November 30, 1981. | | 3026 | 3027 |
| 23 | Letter from C. Culp, U.S. Fish and Wildlife Service to R. Baldwin, dated September 14, 1982. | | 3342 | |
| 24 | Photographs identified in McNutt testimony, including Cross-referenced Photo Numbers List. | 3384 | 3384 | |
| 25 | Policastro 1 with J.T. Phillippe's markings. | | 3748 | 3899 |
| 26 | J.T. Phillippe's plotting of 17-18 points relating to Trenton. | | 3776 | 3899 |
| 27 | Excerpts from Ecological Studies of the Nanticoke River and Nearby Area, Volume II, dated December 1980. | | 3953 | |

## Applicant Exhibits

| No. | | Received | Identified | Bound In |
|---|---|---|---|---|
| 1 | Environmental Report Section (with index), including portions of Exhibits 1, 1A and 1B directly applicable to contentions. | 949 | 937,974 | 950 |
| 1A | September 3, 1982 Responses to Requests for Additional Information. | 949 | 938,974 | |
| 1B | September 17, 1982 Responses to Requests for Additional Information. | 949 | 938,974 | |
| 2 | January 22, 1982 letter from E.H. Bourquard to Corps of Engineers with Table 1. | 1328 | 1324 | 1328 |
| 3 | Applicant's list of Exhibits and other documents which the Licensing Board is requested to officially notice. | | 1334 | 1336 |
| 4 | Map of Point Pleasant showing location of intake. | 2154 | 2152 | |
| 5 | Letter from P.L. Harmon to E.H. Bourquard (revision of Table 1 in November 1980 report), dated May 11, 1981. | 2829 | 2829 | 2832 |
| 6 | Letter from R.L. Baldwin, Corps of Engineers to H.N. Larsen, U.S. Fish and Wildlife Service, dated September 24, 1982, concerning Notice of Intent to Issue a Department of Army Permit to NWRA. | | 3179 | 3180 |

## Board Exhibits

| No. | | Received | Identified | Bound In |
|---|---|---|---|---|
| 1 | Page 15 of "Biological Evaluation of the Proposed Water Intake in the Delaware River at Point Pleasant, Pennsylvania for NWRA" by P.L. Harmon, dated November 1980. | | 2637 | |
| 2 | Cover letter from Mr. Richmond to Mr. Conner (index of contents); letter to Col. Baldwin from Pennsylvania Historic Museum Commission dated September 28, 1981; letter from Mr. Gordon of National Marine Fisheries Service to Mr. Sugarman dated September 30, 1982; letter from Mr. Hoffman of EPA to Mr. Cianfranni of Army Corps of Engineers dated August 5, 1982, signed by Col. Baldwin on October 14, 1982; Memorandum of Agreement between Corps of Engineers, the Advisory Council on Historic Preservation, and the State Historic Preservation Officer. | | 3955 | |

2. Professional Qualifications of Witnesses:

| Professional Qualifications | Transcript Page |
|---|---|
| Vincent S. Boyer | 933 |
| W. Haines Dickinson, Jr. | 933 |
| E.H. Bourquard | 933 |
| Neil Moiseev | 933 |
| Anthony J. Policastro | 1118 |
| Brian J. Richter | 1118 |
| Paul L. Harmon | 1321 |
| John E. Edinger | 1321 |
| George D. Pence | 1439 |
| Charles E. Emery, III | 1736 |
| Michael Lee Kaufman | 1736 |
| Stanley Plevyak | 1930 |
| Harold M. Brundage, III | 2965 |
| Richard Hunt McNutt | 3382 |
| Rex G. Wescott | 3490 |
| Michael T. Masnik | 3504 |
| Jonathan T. Phillippe | 3658 |
| Pierce F. Lewis | 4036 |