UNITED STATES OF AMERICA NUCLEAR REGULATORY COMMISSION

In the Matter of) Philadelphia Electric Company) Docket Nos. 50-352 (Limerick Generating Station) Units 1 and 2))

APPLICANT'S ANSWERS TO INTERVENOR AWPP'S (ROMANO) FIRST SET OF INTERROGATORIES ON CARBURETOR ICING CONTENTION

DISCOVERY 13 SEPTEMBER 26, 1983

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Interrogatory No. (p)

The U.S. Federal Aviation Administration's Department of Transportation flyer re Advisory Circular AC-00-6, "Aviation Weather" (U.S. Government Printing Office) states the basic requirements for a thunder storm and its hazardous effects such as wind shear are: (1) Unstable air, (2) an initial updraft, and (3) high moisture content as with 35 million gallons of water as vapor at approximately 112 degrees F rising rapidly. Did PECo. do studies that prove the cooling towers do not initiate conditions conducive to wind shear and thunder storms?

Answer

The Air and Water Pollution Patrol cites FAA Circular AC-00-6, and asks whether PECO did studies to prove that cooling towers do not initiate conditions conducive to wind shear and thunderstorms. AWPP notes that this FAA document "...states that the basic requirements for a thunderstorm and its hazardous effects such as wind shear are: (1) Unstable air, (2) an initial updraft, and (3) high moisture content as with 35 million gallons of water as vapor at approximately 112 degrees F rising rapidly."

This statement is not a quotation from AC-00-6; the document says nothing whatever about the amount of water vapor at any specified temperature constituting a high moisture content. What the document does say, on page 111 is:

> "For a thunderstorm to form, the air must have (1) sufficient water vapor, (2) an unstable lapse rate, and (3) an initial upward boost (lifting) to start the storm process in motion."

The FAA document also stresses the importance of wind shear as a flight hazard, and notes that such shear is often associated with thunderstorms (pp 114-115) (FAA Circular AC-00-6, pp 111-115 is designated Discovery 13, item pl).

The Applicant is aware of the conditions necessary for the generation of thunderstorms, and of the association between thunderstorms and wind shear. However, it is evident, both from the literature on the subject and from the research of MES, meteorological consultant to the Applicant, on cooling tower plumes that the possibility of these tower emissions creating thunderstorms is too remote to warrant additional study.

Meteorologists have long been aware that the generation of a thunderstorm requires a basically suitable atmospheric structure, by which is meant an unstable lapse rate of temperature and sufficient natural moisture, together with some initial impulse to cause the storm to form at a particular location. This initial "boost," as the FAA put it, usually results from (1) Upslope flow over rough terrain, (2) the lifting associated with

front, or (3) intense heating of the ground by the sun. Meteorologists have also been aware that especially intense sources of heat, such as forest fires, might set off thunderstorms. From such knowledge, it is a relatively short step to the speculation that cooling tower emissions might provide the required initial upward motion. Hanna and Gifford (1975) in a comprehensive review of this question undertaken at Oak Ridge National Laboratory (Hanna Steven R. and Franklin A. Gifford, Meteorological Effects of Energy Dissipation at Large Power Parks, National Oceanic and Atmospheric Administration, October 1975 - Designated Discovery 13, Item p2) concluded that there may be valid concern about thunderstorm generation if a large number of cooling towers (15-20) were located in a small area, as might be the case in a so-called "energy park." However, they did not see a significant risk associated with typical individual plants of the size of the Limerick Generating Station. An important basis for this conclusion is that the investigation of the possibility of concentrating vorticity (roughly translated as the possibility of generating the initial circular motion inherent in all thunderstorms) shows that the heat and moisture emissions from power plant cooling towers like those utilized by the Limerick Generating Station are too small to accomplish the task.

No thunderstorm generation due to the postulated phenomenon was ever observed by MES in the AEP field studies, either during the flight test themselves or at other times when its staff was on location at the various plants.

Participants in Preparation of Answer

Vincent S. Boyer Senior Vice President - Nuclear Power Philadelphia Electric Company 2301 Market Street Philadelphia, PA 19101

Maynard E. Smith President and Principal Consultant Meteorological Evaluation Services, Inc. 134 Broadway Amityville, NY 11701

Interrogatory No. (q)

Has P.E. contacted the operators of the twelve airports--in particular Pottstown-Limerick, Pottstown Municipal and Perkiomen Valley airports relative to the potential for carburetor ice and shear as a result of both visible (on marginal VFR days) and invisible plume, in particular on full VFR days?

Answer

No

Farticipants in Preparation of Answer

Vincent S. Boyer Senior Vice President - Nuclear Power Philadelphia Electric Company 2301 Market Street Philadelphia, PA 19101

Interrogatory No. (u)

I repeat this question since Applicant did not answer when submitted in September 3, 1982 Interrogatory. Did PECo. study the "chimney" effect caused by rising hot moist air from the cooling towers to cause descending air currents to create wind shear in the Pottstown-Limerick area to augment carburetor ice danger?

Answer

Philadelphia Electric Company did not undertake a specific study of the effects referred to because it has been established that there are no vertical motions or wind shear effects caused by the cooling tower emissions of sufficient intensity to constitute a hazard to aircraft.

Vertical motion and wind shear are both generated by rising plumes from hyperbolic cooling towers, but their magnitude is small. The staff of the Pennsylvania State University made a study of these motions, and the summary of their findings is presented in Response to Interrogatories 4 and 10 and Appendix A, thereto, entitled "Cooling Tower Plume and Air Navigation PEPCO Douglas Point, of Applicant's Answers to the United States Marine Corps' Interrogatories dated October 30, 1974 in the Matter of Potomac Electric Power Company (Douglas Point Nuclear Generating Station, Units 1 and 2) Docket Nos. 50-448, 449", (Designated Discovery 13, Item u).

These studies involved many flights of fixed-wing aircraft, as well as helicopters, in which the aircraft traversed hyperbolic cooling tower plumes. On 14 occasions the aircraft passed between 50 and 360 meters from the tower mouth. Their report states that:

> "In none of these cases did the pilot and crew experience anything that could even be called moderate turbulence and on most penetrations only a slight uplift was detected" (page 2, Appendix A of Discovery 13, Item u).

They summarized their findings with respect to turbulence by saying:

"...the turbulence in the plume at 500 feet or more above tower outlet when the proposed station is operating at full capacity will be similar to that at the base of or in a cumulus (not a cumulonimbus) cloud, irrespective of ampient temperature." Descending air currents would be so small as not to present any hazard to aircraft.

These findings are in accord with the pilots' experience in the AEP flight studies, although measuring such phenomena was not a major objective of the AEP program.

Participants in Preparation of Answer

Vincent S. Boyer Senior Vice President - Nuclear Power Philadelphia Electric Company 2301 Market Street Philadelphia, PA 19101

Maynard E. Smith President and Principal Consultant Meteorological Evaluation Services, Inc. 134 Broadway Amityville, NY 11701 COMMONWEALTH OF PENNSYLVANIA COUNTY OF PHILADELPHIA

V. S. Boyer, being first sworn, deposes and states:

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SS.

That he is Senior Vice President of Philadelphia Electric Company, the Applicant herein; that he has read the foregoing Applicant's Answers to Intervenor AWPP's (Romano) First Set of Interrogatories on Carburetor Icing Contention and knows the contents thereof; and that the statements and matters set forth therein are true and correct to the best of his knowledge, information and belief.

Senior Vice President

Subscribed and sworn to tefore me this **26** day of September, 1983.

Notary Public PATRICIA D. SCHOLL' Notary Public, Philadelphia Co. My Commission Expires February 10, 1986