UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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Before the Atomic Safety and Licensing Board

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In the Matter of	)	
	)	
Philadelphia Electric Company	)	Docket Nos. 50-352 50-353
	)	
(Limerick Generating Station, Units 1 and 2)	)	
	)	

OFFICE OF SECRETARY
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AFFIDAVIT OF JOHN D. WALSH IN SUPPORT OF MOTION FOR SUMMARY DISPOSITION OF CONTENTIONS V-3a and V-3b

John D. Walsh, being duly sworn in accordance with law, comes forward and states:

1. My name is John D. Walsh. I am a Science Specialist with Bechtel Group, Inc. In that position I was responsible for the preparation of the portions of Final Safety Analysis Report (FSAR) which deal with, among other things, the analysis of postulated transportation accidents, including the possible effect of accidents related to various pipelines that pass near the Limerick Generating Station (FSAR Sections 2.2.3.1.1 and 2.2.3.1.2). I have been requested by Philadelphia Electric Company to respond to the two contentions, Contentions V-3a and V-3b, related to postulated pipeline failure set forth below.

2. I have an undergraduate degree in meteorology from New York University and have taken a number of graduate courses in the sciences. I have recently completed the requirements for an M.S. degree in Environmental Management. I have been employed as a meteorologist and have performed numerous accident analyses for nuclear power stations during my employment with Bechtel. The statement of my professional qualifications is attached hereto and incorporated by reference herein.

3. In preparing the FSAR section on accident analyses and in responding to these two contentions, I have visited the Limerick site and viewed portions of the pipelines in question, examined topographic maps, researched the literature, and contacted the companies operating the pipelines. My response to these two contentions also utilizes information contained in Table 2.2-2, Figure 2.2-4 and Section 9.5.4.3 (page 9.5-34) of the FSAR, which were prepared by or provided to me by Philadelphia Electric Company.

The analyses described below, which I performed, were conducted in accordance with NRC Regulatory Guides 1.70 (Rev. 3), 1.91 (Rev. 0), 1.91 (Rev. 1). The analyses are extremely conservative and overestimate the effects of pipeline ruptures on the Limerick Generating Station. These conservatisms are discussed, along with the analyses which respond to the contentions.

Contention V-3a

> In developing its analysis of the worst case rupture of the ARCO pipeline, the Applicant provided no basis for excluding consideration of siphoning. Thus, the consequences from the worst case pipeline accident are understated.

4. The Atlantic Richfield Company (ARCO) refined petroleum products pipeline passes within about 1600 feet of the Unit 2 reactor enclosure, which is the nearest it approaches safety related structures. The pipeline is also approximately 1675 feet from the Unit 2 diesel generator building at its closest point of approach. The pipeline runs generally north-south in the vicinity of the plant with product being pumped in a northward direction. The routing of the pipeline and its relationship to

the facility is shown on the attached Figure 1, which is reproduced from FSAR Figure 2.2-4. The pipeline is nominally 8 inches in diameter, operates at 1200 psig pumping pressure and is 28 years old, according to ARCO. This pipeline is buried a minimum of three feet below grade, and is a dedicated carrier for refined ARCO petroleum products. Gasoline is carried in this pipe, as are diesel and home heating oil. Propane is not, and has never been carried, and, according to ARCO, could not be carried, without major modifications to the pipeline. Philadelphia Electric Company has obtained an agreement from ARCO that it will not transport propane through this pipeline.

5. The pumping stations for this ARCO pipeline are equipped with pressure sensors to detect a sudden rise or fall in pressure which could indicate a leak or break in the lines. The pumps would automatically be shut off in this event. Operators monitoring the pipeline and pump stations would also note a speedup of the pumps and could terminate pumping. Even small leaks would be detected through routine inventory procedures in a relatively short time. For purposes of analysis, it was assumed that a rupture occurs while gasoline is being carried since gasoline is the most volatile substance carried and has the highest energy content.

6. The analysis of the effect of this pipeline is failure postulated its complete rupture at a location which would cause the greatest effect on the Station. Ruptures of the pipeline at other locations in the vicinity of the Limerick Plant would either release less gasoline, because of the relative elevation

or would drain into other, less proximate drainage systems, and thus cause lesser effects. Therefore, the rupture of the pipeline was assumed to occur at the point at which it crosses Possum Hollow Run, which is the lowest point between the adjacent high points of the terrain. As discussed above, it was further assumed that pumping would stop due to detection of the sudden pressure drop in the broken line.

7. Following postulated pipeline rupture at Possum Hollow Run, it was assumed that the entire calculated gasoline content of the pipeline (4962 gallons) between the two adjacent high points of land, 1400 feet north and 600 feet south, flowed into the stream bed, and was distributed over the bed between the pipeline and the first downstream bridge in a pool 610 meters by one meter wide by approximately three centimeters deep. From personal observation, the pooling capacity of the creek bed is very small. Thus, even should the amount of gasoline be significantly larger than postulated above, the additional gasoline in excess of the conservative pool capacity utilized in this analysis would drain downstream away from the plant. Thus, even for large releases, the impact on the plant would not significantly change.

8. No siphoning effect would occur from beyond the high points. Air would enter the lines at the point of rupture and travel through the upper portions above the surface of the draining fluid until it reached the adjacent high points where it would accumulate and prevent further drainage by gravity flow. Liquid in the pipe beyond the adjacent high points would not

siphon because a siphon requires the presence of atmospheric pressure at both ends. Thus, to drain more gasoline than contained between the two adjacent high points would require that air at atmospheric pressure enter the line at a point which is higher than the postulated break at a location beyond the adjacent high points. Two separate openings of the pipe must be postulated to permit siphoning to occur.

9. Once distributed in the Possum Hollow Run stream bed, the gasoline was assumed to evaporate, forming a gradient of gasoline vapor at decreasing concentrations above the stream, and confined horizontally within the valley walls. It was conservatively assumed that winds are calm, and that the only mixing which occurs is due to the vapor pressure of the evaporating gasoline forcing vapor upward. If winds were not calm, greater dilution of the gasoline would occur, resulting in less gasoline vapor within flammable limits near the facility. Because of mixing, this would be true even if the wind were in the direction of the Station.

10. In accordance with accepted values the explosive limits of gasoline vapor were assumed to be 1.3 to 6.0 percent by volume in air. The amount of gasoline vapor within explosive limits was calculated, and the TNT-equivalent energy was determined. Detonation was assumed to occur, with the centroid of the explosion being approximately 800 feet from the Unit 2 reactor enclosure. This location was chosen based upon examination of the area topographic map. It represents a wide spot in the valley where direct exposure to safety related structures exists. No credit

was taken for intervening terrain at this location. The resulting peak reflected overpressure, as defined in Regulatory Guide 1.91, and using Regulatory Guide 1.91 methodology, was calculated to be 1.9 pounds per square inch. Even were the location of the centroid of the explosion selected as the closest approach of Possum Hollow Run to the Station, i.e., approximately 550 feet, the calculated peak overpressure at the critical station location would be approximately 3 psi, and would not affect these structures. No credit was taken for the shielding effects of the Possum Hollow Run valley walls. The design reflected average overpressure of the affected safety related structures is 12 psi.

11. Alternatively, the 5,000 gallons of the spilled gasoline was assumed to deflagrate in a 15-minute period. The 15-0 minute period was conservatively utilized to maximize the heat generation rate. Using American Petroleum Institute methods, it was then calculated that the heat from the resulting fire would produce a radiant heat load of 85 Btu per square foot per hour at the Unit 2 reactor enclosure. This level would not have any effect on the reactor enclosure other than a slight warming of the concrete surface, even for an extended period of deflagration. By comparison, a flat surface in the sun at mid-day would receive solar radiation at approximately 50 to 60 Btu per square foot per hour.

12. Neither the peak overpressure of 1.9 psi by detonation nor the radiant heat at 85 Btu per square foot per hour by deflagration of spilled gasoline vapors would affect safety related structures.

Contention V-3b

In discussing deflagration of gas and petroleum due to pipeline rupture, no specific consideration has been given to the effect of radiant heat upon the diesel generators and associated diesel fuel storage facilities.

13. The two Columbia Gas Transmission Company pipelines (Nos. 1278 and 1010) carry only natural gas and pass within 3500 feet of the Unit 2 reactor enclosure at their closest approach. Both pipelines share the same right of way and run south-southwest to north-northeast. The routing of these gas pipelines and their relationship to the facility is shown on the attached Figure 1. Based upon information from Columbia Gas, it has been determined that pipeline No. 1278 is 14 inches in diameter, operates at a maximum pumping pressure of 1000 psig, is 34 years old, and is buried a minimum of 3 feet below grade. Pipeline No. 1010 is 20 inches in diameter, operates at a maximum pumping pressure of 1200 psig, is 17 years old, and is also buried a minimum of 3 feet below grade.

14. In the case of the natural gas pipelines, it was conservatively assumed that the larger of the two lines (#1010) ruptures at the point at which the pipeline passes closest to Unit 2 reactor containment (approximately 3500 feet). It was further assumed to be a double-ended rupture (complete separation of the pipe at the point of rupture), and the two pipe ends thereafter are forced into a vertical orientation from pressure and whip. This assumption ignores the fact that the lines are buried, which would mitigate the whip effect. If the pipes

ends were not in a vertical orientation as was assumed in the calculation, the two opposed streams of gas would cause rapid mixing and dilution, and would cause the gas emitted to be a ground level source, resulting in an explosion centroid further from the plant than used in the conservative analysis.

15. It is possible that the entire contents of the pipeline between adjacent compressor stations at Eagle, 7.5 miles south, and at Easton, 37.6 miles north, would be released at sonic velocity (about 1100 feet per second) in a vertical jet. However, the calculations are dependent upon the rate rather than being affected by the total amount available for release.

16. It was conservatively assumed that the escaping gas rises in a column to about 500 feet above plant grade, where the momentum energy decays, and that the gas then travels horizontally, directly toward Unit 2 reactor enclosure. The mitigating effect of the height above plant grade was not used in the analysis for overpressure.

17. It was further assumed that the natural gas began dispersing downwind toward the Limerick plant from directly above the rupture point, at a low dispersion rate using Pasquill "F" stability with one meter per second wind speeds (approximately the 95th percentile meteorology). These conservative assumptions allow the plume to travel nearest the plant prior to reaching detonable concentrations. The explosive limits of natural gas are between 6.0 and 14.0 percent by volume in air. Using standard meteorological dispersion methodology, the amount of the gas within explosive limits was calculated. If

the wind were blowing in any other direction than directly towards the plant, the effects of a gas explosion on the facility would be less. Similarly, if the wind speed were higher, greater dilution would occur and the zone of explosive limits would be closer to the point of release and further from the Station.

18. Detonation under the conservative assumptions, using Bureau of Mines methodology, causes the peak overpressure at the Unit 2 reactor enclosure to be 10 psi, which is less than the design overpressure for the critical safety related structures. It should also be noted that natural gas clouds seldom detonate in the open air. Further, it would be difficult to hypothesize an ignition source to trigger a detonation in the elevated cloud.

19. An analysis was performed to evaluate the effects of the natural gas cloud on the facility if it were to deflagrate rather than detonate. This analysis made the very conservative assumption that the cloud continues to burn at the original point of ignition. In actuality, the flame front would probably move back and have negligible effect on the plant. The analysis utilized an upper flammable limit of 14% and a lower flammable limit of 6%. The conservative assumptions regarding transport and dispersion of the natural gas used in this calculation were the same as used for the detonation analysis. Using American Petroleum Institute methods, the radiant heat load at the Unit 2 reactor enclosure was calculated to be 70 Btu per square foot per hour.

This level would only cause slight warming of the outer layer of concrete, and would not cause noticeable or lasting effect, even for an extended period of deflagration.

20. It should be recognized that the diesel fuel storage tanks and associated piping are buried and would therefore not be affected by either the detonation or deflagration of the natural gas postulated in these analyses. See FSAR 9.5.4.3, page 9.5-34.

21. Thus, whether detonation or deflagation of natural gas released from either of the two Columbia Gas Transmission lines were postulated to occur, no adverse effects on safety related structures or equipment would result.

John D. Walsh

Sworn to me this 6th day of October, 1983

Betty L. Vasil
Notary

BETTY L. VASIL
NOTARY PUBLIC-CALIFORNIA
CITY AND COUNTY OF
SAN FRANCISCO
My Commission Expires May 25, 1984

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