UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

Helen F. Hoty, Chairman
Richard F. Cole, Administrative Law Judge
Dr. Jerry Harbour, Administrative Law Judge

In the Matter of :

Philadelphia Electric Company : Docket Nos. 50-352
(Limerick Generating Station, 50-353
Units 1 & 2) :

ERRATA SHEET
CITY STATEMENT NO. 3

REVISED STATEMENT	ORIGINAL	REVISED
p. 22, line 2	"unabailable"	unavailable
p. 19, line 4	"Peak Useage"	Peak Usage"
p. 29, line 5	"leves"	"leaves"
p. 29, line 17	"suply"	supply
p. 30, line 21	"with"	"water"
p. 31, line 3	"oblivate"	"obliviate"
p. 31, line 5	"interconnection currently exist between purveyors"	"inter connection currently exist between the Water Department's distribution network and suburban purveyors"

REVISED STATEMENT	ORIGINAL	REVISED
p. 31, line 16	"the accident.Under these conditions there are any other utilities with sufficient excess capacity to supply either or both of the high service districts. This must be researched immediately. If excess capacity is available, "	"the accident. It is not certain at this time whether there are any other utilities with sufficient excess capacity to supply either or both of the high service districts. If excess capacity is available",
p. 32, A.29, line 1	"estensions"	"extensions"
p. 32, A.30, line 4,	"PECo"	"PECO"
p. 33, line 14,	"plant"	"plan"

Respectfully submitted,

Martha W Bush

MARTHA W. BUSH,
Deputy City Solicitor

November 29, 1984

DATED

SERVICE LIST

NRC
Philadelphia Electric Company
(Limerick Generating Station
(Units 1 and 3)

Docket No. 50-352
50-353

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City Statement 3
November 2, 1984

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

Helen F. Hoyt, Chairman
Richard F. Cole, Administrative Law Judge
Dr. Jerry Harbour, Administrative Law Judge

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

TESTIMONY OF BRUCE APTOWICZ
CHARLES ZITOMER AND RICHARD WEISS
DISCUSSING SEVERAL ADDITIONAL CONSIDERATIONS
THAT NEED TO BE DEVELOPED IN GREATER DETAIL
AS PART OF AN IMPLEMENTATABLE WATER
SUPPLY EMERGENCY PLAN FOR THE CITY OF PHILADELPHIA

Q.1. Please state your names, addresses, positions with the City of Philadelphia and the purpose of your testimony.

A.1. My name is Bruce Aptowicz, Manager of Operations, Water Department, City of Philadelphia. My business address is One Reading Center, Third Floor, Philadelphia, Pennsylvania, 19102.

My name is Charles Zitomer, Chief of Load Control, Water Department, City of Philadelphia. My business address is One Reading Center, Third Floor, Philadelphia, Pennsylvania, 19102.

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My name is Richard Weiss, Project Manager of Planning and Research, Water Department, City of Philadelphia. My business address is One Reading Center, Second Floor, Philadelphia, Pennsylvania, 19102

The purpose of this testimony is to discuss several additional considerations that need to be developed in greater detail as part of any implementable water emergency plan for the City of Philadelphia.

Q.2. In general, what additional information is needed before a water supply emergency plan can be developed for the City of Philadelphia?

A.2. More information is needed on the types of accidents for which planning must be done. Specifically, in order to develop an emergency plan, the level, kind and nature of contaminants, the time frames involved, meteorological impacts and the expected impact on potability must first be estimated. Knowledge of the associated probabilities of the various accident types also would be useful for planning. Further information must be developed on the feasibility and effectiveness of treating each type of contaminants at our treatment plants in order to be able use the treated water as a potable supply. As indicated by Mr. Kulesza, we have two raw water supply sources - the Delaware and the Schuylkill Rivers. This information would therefore need to be developed for both sources.

Q.3. Why is this level of detailed information necessary to develop an emergency plan for the water supply?

A.3. As we understand it, there are many potential types of accidents with varying quantities and qualities of released contaminants. These types of accidents have projected frequencies of occurrence. Also, the impact of weather conditions, wind direction, and precipitation will need to be taken into account in developing a plan.

All of these variables would affect the precise nature of the emergency plan that would need to be developed.

Q.4. Could you elaborate further on why this information is necessary?

A.4. The actions that would need to be undertaken by the Water Department for different time periods of contamination will vary. Similarly, the level of contamination will determine what types of mitigation techniques will need to be employed. The degree of water contamination will determine whether or not either supply source will be available and, if available, at what capacity. The availability and extent of supply is the primary factor in determining what conservation measures and supply strategies will be necessary to provide every Philadelphia Water Department customer with potable water. Similarly, if the Schuylkill River raw water treatment plants' capacities or the Delaware River treatment plant's capacity has to be fully or partially subjected to repeat precipitation, the plans would vary. The development of each component of the plan will depend on supply constraints imposed by pumpage capacities and the configuration of the water distribution system.

Q.5. Have you reviewed any information that addresses emergency planning for the water supply of Philadelphia?

A.5. We have briefly reviewed the quantitative graphs presented by the NRC Staff and the Philadelphia Electric Company developed for the environmental impact statement ("EIS") with regard to the levels, types and the time periods of contamination associated with various accident types. The Commonwealth of Pennsylvania also provided the City with a booklet. The City has had several meetings with the Commonwealth and PECO with regard to these problems.

Q.6. Was that information sufficient to prepare a water supply emergency plan for the City of Philadelphia?

A.6. No. The EIS material seemed to focus on the broader, long-term measurements. For planning purposes one needs to know much more detailed information, e.g., short-term contaminants, the entire spectrum of contaminants, the time periods of various contamination levels, probabilities, the impacts on both rivers, etc. The material provided by the Commonwealth was also insufficient in addressing these issues.

Q.7. Please explain in more detail the water system constraints that are relevant for these purposes.

A.7. In designing any water supply system there are two major constraints that must be evaluated. The first is the demand for potable water supplies by all classes of customers (residential, commercial, industrial, institutional, wholesale). These demands should be evaluated both on a peak and average day basis. Distribution system demands for hydrant use and leakage must also be evaluated.

The second constraint that must be evaluated is the availability of potable water supplies. Factors that must be considered include raw water and finished water pumping capacities at each plant and in the service districts, available treatment processes and their effectiveness in treating water supplies at various levels of contamination, available raw and finished water storage basin capacities, transmission main capacities at average and peak daily demands and the ability of the system to supply all sections of the City from more than one supply source. The last factor, i.e., the interconnection of supply sources, is of particular concern to the City of Philadelphia since there are several sections of the City that can be supplied by only one of the two rivers.

Q.8. Why must peak day usage be considered in the development of an emergency plan?

A.8. The design of any water or sewer facility must be based on peak day usage in order to assure that adequate service is provided to all utility customers.

Q.9. In the case of a water supply emergency, what strategies must be employed to manage the situation?

A.9. To develop emergency planning strategy one must know the magnitude of the problem. Once this is known a number of measures, if properly developed, can be applied to minimize any potential health or safety impacts. It is assumed that the enormous media coverage of such an event will help the Commonwealth and the City of Philadelphia gain public cooperation. Although a number of measures should be implemented city-wide for all classes of customers to minimize exposure and reduce demand, there may be a number of emergencies which are so severe that the water supply constraints of Philadelphia's system would prevent certain districts of the service area to be supplied with potable water. Under these conditions, special measures would have to be implemented for those customers that reside in these severely impacted districts.

Q.10. Previously a number of types of accidents have been mentioned. If one possible water supply emergency is an event such that the Schuylkill River cannot be used as a source of water supply, describe what would be entailed in utilizing only the Delaware River as the sole source of water supply for the City and its suburban customers.

A.10. This would represent an emergency condition of a magnitude that has not been previously encountered by the City. In order to maintain water service for the City during such an event, three different operational

modes must be addressed. Chronologically these phases would coincide with 1) a notification period, during which the details of the emergency are made known to the City and a raw water intake termination time has been established, 2) the period of four to eight days after shutdown of the Schuylkill River raw water intakes during which certain areas of the City are supplied solely from storage reserves (of Schuylkill origin), while the majority of the City relies on the Delaware River as a supply source, and 3) that period after the depletion of storage reserves for the Roxborough/Manayunk sections, certain areas in Germantown, and the area known as the "Belmont High Service District," during which Delaware River water would be required to be utilized to the conveyance capacity limits of the system.

Q.11. Please elaborate on each of the three phases described above.

A.11. PHASE I: The planning and implementation of the procedures necessary to cope with this type of emergency are highly dependant on the availability of accurate notification of the nature and extent of the event. The possibility of the loss of a raw water source for periods of time longer than several hours necessitates implementation of a number of operational procedures that potentially could assure City-wide supply for at least several days. Implementation of these operations would be needed to replenish storage facilities and isolate treatment and conveyance routes to serve primarily areas that could not be ultimately supplied from the Delaware River. Any facilities that are out-of-service for repair or maintenance would also need to be reactivated, if

possible, during this time. Because these actions require mobilization of crews and sufficient raw and filtered water pumping time to refill storage structures, adequate advance notification is crucial. Adequate advance notification must allow approximately 12 hours to fill all storage facilities with potable water before the intakes are closed. A water conservation program must be implemented within 1.5 days of the intakes being closed. Since certain areas of the City must rely solely upon accumulated storage, the lifespan of their remaining supplies is directly proportional to their existing storage levels, consumption levels and the time of emergency readiness prior to the termination of Schuylkill River pumping.

In summary, inherent in development of required emergency measures are assumptions that define conditions prevalent at the outset of such an emergency as well as adequate advance warning. In addition, the following conditions must exist: no loss of electrical power during the emergency and average day consumption demands even during peak periods. (We present later an analysis of how emergency conservation measures may reduce consumption.)

PHASE II: Upon closure of the Schuylkill River raw water intakes, the Belmont High Service District ("BHSD") and the Roxborough, Manayunk, and Germantown areas could be serviced by water from the storage reserves accumulated in Phase I, assuming average day consumption levels. Under the above stated assumptions, it is estimated that these reserves will last approximately 8.0 days for these sections in Northwest

Philadelphia and 4.0 days in the Belmont High Service District. Since storage in addition to that available in the Belmont High Service Clear Well exists at the Belmont Treatment Plant, portable pumps could be used to supplement BHSD storage from lower basins. This additional storage could meet the BHSD demands for roughly 3 more days. Therefore, the longest possible self-sustained supply period for the Belmont High Service District would be 7.0 days. All other areas of the City could be adequately supplied from the Delaware River source if Delaware River Water can be utilized, all cricital components of the water system are operational, and a conservative plan can be implemented.

PHASE III: Upon depletion of the storage reserves as mentioned above, additional operations can be taken to attempt to distribute more Delaware River water to the western reaches of the City. However, due to various system constraints, certain areas of the City cannot be delivered Delaware River water and will remain out of service. These areas include the Belmont High Service District and Roxborough, as well as sections of Manayunk, Germantown, Mt. Airy and Chestnut Hill.

It should be noted that other sections of the last group would experience greatly reduced pressures and flow rates. Specific areas of outage and reduced level of service could be located only after additional detailed study; however, those areas which exist at high elevation or are serviced by older, smaller distribution mains (Germantown), will suffer the greatest loss. These effects will be felt immediately

upon the depletion of available storage reserves. In general, the only sections of Northwest Philadelphia that will continue to experience existing levels of water service will be the northernmost area bounded by Cheltenham Avenue.

If a conservative plan can be developed now and implemented as needed, and, if no critical outages affect a portion of the City's ability to be serviced, all other sections of the City could, from a distribution point of view, receive water supplies conveyed from the Delaware River source.

In summary, any type of emergency condition which would render the Schuylkill River useless as a source of potable water supply would impose a great hardship upon the City's water supply system.

Q.12. Have you evaluated a number of measures that might be effective in reducing consumption on a peak day in the event that the Schuylkill River could not be used as a source of water supply?

A.12. Yes.

Q.13. What measures did you review that might be implemented city-wide in the event that such an accident occurred?

A.13. I reviewed the use of rationing, non-essential water use bans, the

distribution of flow restrictors and the imposition of water use surcharges for all Philadelphia Water Department customers.

Q.14. Why is it important to evaluate the appropriateness of these various techniques?

A.14. A number of techniques must be implemented to reduce consumption quickly and for an extended length of time if the Schuylkill River is eliminated as source of supply for more than seven to eight days. Consumption must drop immediately to ensure that the Baxter plant will be able to supply as much of the Water Department service area as possible. The objective of these techniques should be to enable the Water Department to stretch its reservoir supplies of potable water as long as possible and to supply as many people as possible with water from the Baxter plant in the more likely situation that the Schuylkill River would be contaminated to a relatively more severe degree than the Delaware River.

Q.15. Which of the city-wide mitigation techiques that you evaluated were deemed appropriate?

A.15. Rationing, the use of non-essential water use bans and the distribution of flow restrictors were all deemed appropriate.

Q.16. Which of the city-wide mitigation techniques that you evaluated were

deemed non-appropriate and why?

A.16. The use of water use surcharges is not workable for the short term. The effectiveness of this measure depends on the use of quarterly billing to impose high usage charges on customers that do not comply with any mandated rationing provisions. Given the immediate nature of the emergency, this option would not reduce consumption immediately. In the case that the emergency was prolonged for more than one year, this measure might be effective since most customers' meters would be read in this time frame. Any customers not abiding by the other conservation measures would be assessed high surplus usage charges. This would help to reduce consumption.

Q.17. Have you made some preliminary estimates of the level of reduced consumption that might occur during a peak use day if the measures you deemed appropriate were implemented?

A.17. Yes.

Q.18. How were these estimations prepared?

A.18. The peak day usage of 480 MGD in Fiscal Year 1984 was used as a baseline. Reductions in consumption from this baseline were estimated for the non-essential water use ban, rationing and distribution of flow restrictor provisions. In order to make assumptions about the level of conservation or reduced consumption that could be expected for each

measure, a number of sources of information were consulted. The two major sources of reduced water consumption that were assumed are the imposition of fire hydrant controls and the reduction in customer water usage. These are discussed in greater detail below.

Fire Hydrant Controls

One type of non-essential water use provision that would have a major impact on consumption during an emergency is a ban on the use of water from a fire hydrant for any purpose except for firefighting or health protection purposes specifically approved by the City's health officials. An estimate of the amount of illegal recreational hydrant usage that could feasibly be reduced on a peak usage day was prepared using historical data. An assumption that seventy-five percent or 85 MGD of a possible 113 MGD of recreational hydrant usage would be reduced was made based on the success of the hydrant use control program during the 1981 drought. It was assumed that hydrant use reduction would be even greater in this case as a result of the intense publicity this event would command. In addition, greater public resources such as police enforcement activities, around the clock shutoff of hydrants, and the installation of hydrant locks will of neccessity be concentrated on reducing hydrant abuse to ensure sufficient water for firefighting purposes.

In addition to illegal hydrant usage, a number of legal hydrant uses would be banned during this emergency such as the use of hydrants for water main flushing, construction and commercial use and for cleaning and disinfecting new water mains. The estimates for each use were

based on previous studies on hydrant use in the Philadelphia Water Department FY80 Unaccounted-For-Water Report (1981). A total savings of approximately 5.0 MGD for these uses would be feasible.

Customer Water Use

The imposition of non-essential water use bans and rationing will affect each class of customers in Philadelphia and Bucks County differently. Five classes of customers were analyzed for feasible water use reductions: residential, commercial, industrial, public properties and Bucks County. Since any set of water use restrictions will impact each class of customers differently, any emergency plan implemented as part of the city-wide consumption reduction strategy must address each class of customer differently.

The table below presents average day and estimated peak day consumptions for each customer class. Average day consumption numbers were based on recent customer billing records. It is difficult to estimate the degree to which usage for each customer class will increase above this average on a peak day. The major reasons that each class increases usage during peak periods are greater outdoor water use, greater use of air conditioning, use of swimming pools, and greater frequency of bathing. The peak day occurs on a very hot summer day. During the summer in general industries may switch part of their supplies to groundwater sources for cooling water purposes. It is expected that Bucks County, since it has a suburban water population, will have a higher per capita water use due to greater outdoor water use. A ballpark estimate is that all customer classes will increase

consumption by ten percent on the peak day except for Bucks County (an assumed twenty percent increase).

	Average Day (MGD)	Peak Day (MGD)
Residential	104	114
Commercial	41	45
Industrial	50	55
Public Properties	10	11
Bucks County	13	16

Residential - Per capita residential usage was assumed to be able to be reduced by approximately 25 percent from 68 gallons per capita day ("gpcd") to 50 gpcd. This would represent a 30.2 MGD savings. It is assumed that these savings could occur through the distribution of flow restrictions (9.2 gpcd reduction), prohibition of outdoor water uses such as car washing, lawn watering, outdoor plant watering with fresh water and the use of swimming pools (5.0 gpcd reduction) and additional conservation efforts for dishwashing and laundry use, the elimination of many household leaks and the installation of toilet tank inserts by some households (3.8 gpcd reduction). An effective public relations programs as well as a network that can rapidly distribute the flow restrictors will be necessary for this goal to be realistic.

Commercial - Commercial usage includes water use by office buildings, institutions (school, hospitals, etc.) and commercial establishments (stores, engineering and other non-manufacturing businesses in the service sector). Conservation is more limited for commercial uses because many health and safety codes require the use of air conditioning during

the summer in buildings which do not have windows that open. It is also more difficult to reduce consumption since many commercial buildings have installed blowout fixtures (toilets and urinals) which use considerably more water per flush and cannot be easily modified. A five percent or 2.25 MGD reduction was assumed for outdoor water use (irrigation, ornamental water use and vehicle washing) during the maximum day. Another five percent reduction was assumed for the installation of flow restrictors, the reduction of timing of flush values, a water conservation employee education effort and the elimination of leaks.

Industrial - A goal of 25% reduction in industrial use would be established during such an emergency. The impact on industry would vary according to the type of operation and the ability of the firm to reduce water usage without shutting down. Some firms may be more flexible in switching to alternative supply sources (e.g., groundwater). Others may be able to reduce production without shutting down completely. Since this level of industrial conservation has never been attained in the Philadelphia region, it is difficult to say for certain what the economic impact of this reduction would be. As part of the emergency planning effort there should be a study in cooperation with the Chamber of Commerce and the Philadelphia Industrial Development Corporation ("PIDC") to assess this. Since certain industrial groups are better able to reduce consumption without affecting production or employment, a Commercial and Industrial Water Use Committee could be established through the Chamber of Commerce to

determine the best way for all industrial users to attain this goal. Perhaps certain industrial groups could save more than 25%, thus offsetting those with less than 25% without shutting down any firm's operations. A 25 percent reduction would reduce Philadelphia industrial water usage by 13.8 MGD.

Public Properties - Public properties are defined as buildings and parks owned by the City of Philadelphia. Public property accounts include public schools, public libraries and museums, city buildings, recreational centers, park facilities, etc. Prohibiting the use of public swimming pools, reducing the use of other public buildings (schoools, museums, libraries) and implementing various conservation measures mentioned in the commercial use section should result in a ten percent reduction (1.1 MGD). It was assumed that public property accounts and commercial accounts have similar usage patterns and therefore similar potential savings.

Bucks County - Bucks County Water and Sewer Authority customers will be impacted since the Authority is a wholesale customer of the Water Department. It is unclear to what extent conservation will succeed here since the City of Philadelphia does not have direct regulatory control over the customers. During the 1981 drought, consumption increased in Bucks County by 3.3 percent during February-May and then reduced 11.3 percent during June-August. Overall, the level of conservation was less than in the City of Philadelphia. For this reason a 15 percent reduction was assumed for a 2.4 MGD savings.

Q.19. What sources of information were consulted in the preparation of these estimates?

A.19. A number of analyses prepared following the 1981 drought in Philadelphia were reviewed to determine what levels of hydrant use reduction and customer conservation are feasible. Several articles were also reviewed which analyzed the effectiveness of various measures taken in northern California in 1977 and in northern New Jersey in 1981 during the severe droughts in those states. Metered consumption history records were obtained from the Revenue Department's Water Revenue Bureau. Water distribution records were obtained from the operations Division of the Water Department. The 1981 City of Philadelphia Drought Water Emergency Plan was reviewed to determine which non-essential water uses might be banned during the emergency. Many of the drought measures would need to be made more stringent as part of an implementable water emergency plan for Limerick. A number of estimates were prepared based on procedures referenced in the Water Department's FY80 Unaccounted-For-Water Report. A pamphlet entitled Water Conservation and Wasteflow Reduction in the Home (Special Circular 184) from Pennsylvania State University provided this information in per capita use and residential conservation measures.

Q.20. What are the results of this preliminary analysis?

A.20. If successfully implemented, the various conservation measures pre-

viously described would likely reduce the peak day consumption from 480 MGD to 338 MGD. This represents a thirty percent reduction in consumption. A breakdown of this reduction is as follows:

Peak Usage of 480 MGD

(85.0) illegal hydrant use
(5.0) other hydrant use
(30.2) residential
(4.5) commercial
(13.8) industrial
(1.1) public properties
(2.4) Bucks Counties

338.0 MGD

This projected reduction could lower consumption from the peak day usage to approximately the average day usage (342 MGD). If one subtracts out the 12.1 MGD average day demand of the Belmont High Service District (which currently cannot be supplied by Baxter without permanent pumping and piping improvements), the remaining 325.9 MGD represents the demand the Baxter plant would have to satisfy to supply the rest of the service area. This is below the 350 MGD peak day capacity of the Baxter plant.

Q.21. Are there any caveats that should be mentioned regarding the assumptions that were used in the preparation of these estimates?

A.21. First and foremost the applicability of each conservation measure will depend on the type and degree of accident assumed. The measures that were chosen and the conservation estimates that were made may change

radically for a different accident with different impacts. For example, an accident which is less severe may enable the Water Department to use at least part of the capacities of the Belmont and Queen Lane treatment plants assuming additional treatment remedial measures are undertaken.

Secondly, the assumptions that were used and the estimates that were prepared are not hard numbers - they rely on a good deal of guesswork since we do not have a previous accident history upon which to base our judgment. For example, any estimate of reduced residential consumption will be inexact in the case of a nuclear accident. It is difficult to approximate how the Philadelphia population will respond to such an emergency. Some people may decide to hoard water once an emergency is declared, especially in districts which are severely impacted. This would reduce the amount of conservation that is feasible. On the other hand, a number of people may decide to leave the area during any emergency. This would tend to increase the amount of conservation that is feasible. A third possibility may be the evacuation of number of people from one section of the city to shelters in another section. This may redistribute the consumption demands for potable water, thereby increasing or decreasing the feasiblity of various supply alternatives.

It is also difficult to estimate peak usage by customer class. There have not been any studies to date in the Philadelphia service area on the daily variation in demand for each type of customer throughout the

year. The ten and twenty percentage increases chosen were based on literature values reported for other communities, not on actual consumption data for Philadelphia. The peak usage estimates for industrial consumption are especially difficult to determine since industrial use tends to be less homogeneous in nature.

Q.22. During Mr. Kulesza's testimony it was mentioned that lime-soda ash softening might be used to remove SR-90 during the sedimentation process at the Baxter Treatment Plant. If the water treated at the plant was softened twice, what possible impacts would this have on the ability of Baxter to meet the City's average daily demand?

A.22. The use of lime-soda ash softening to remove SR-90 at the Baxter Treatment Plant may reduce the through-put by as must as one-half at the plant if the water is softened twice. If approximately 170 MGD is recycled then only 170 MGD would be available for distribution, which clearly is inadequate to satisfy demand.

Q.23. Beyond the imposition of city-wide rationing and non-essential use ban measures, are there any additional measures that might be necessary?

A.23. Yes, additional measures must be undertaken for a long-term accident in certain high pressure districts in the Philadelphia Service area to ensure that these customers do not run out of potable water. These people would be impacted most severely by such an accident. Specifically, the Belmont High Service district and approximately

thirty percent of the service area of the Roxborough High Service -West Oak Lane district would be impacted if the Schuylkill River was unavailable as a supply source for a long period of time. These measures would still be required even if the city-wide measures were successfully implemented to the maximum extent possible.

Q.24. Please summarize any information you have on the number of people that could be affected and the amount of consumption in these two districts.

A.24. The following table summarizes the consumption in the two districts that would affected by such an emergency. Consumption values for the affected areas of the Roxborough High Service - West Oak Lane District can not be extrapolated from known consumption values for the entire district due to the non-homogeneity of this service area. In order to fully evaluate various mitigation techniques for this district, consumption and population numbers will have to be prepared as part of the emergency planning process.

	(MGD) Average Day	(MGD) Max. Day	(MGD) Max. Rate	Population
Belmont High Service	12.1	14.9	22.3	65,500
Roxborough High Service W. Oak Lane (total service)	16.9	24.6	46.4	111,138
Roxborough High Service W. Oak Lane (affected portion only)	N/A	N/A	N/A	N/A

Q.25. What measures did you review that might be necessary for these two districts?

A.25. Four possible techniques were proposed to supply the two districts with potable water. The proposed techniques include 1) the use of tanker trucks or temporary storage tanks, 2) the installation of emergency pipes and pumps to provide additional capacity, 3) the permanent modification and improvement of the distribution system to enable residents in these two districts to be completely supplied by the Baxter plant and 4) the creation of permanent interconnection(s) with neighboring water supply purveyors who have excess capacity. The first two techniques represent temporary or stop-gap measures while the latter two techniques are more permanent in nature.

Q.26. What criteria were chosen to evaluate the appropriateness of these various measures?

A.26. Each measure must be evaluated in terms of the accident event that was presupposed. In the particular case we mentioned, they must be consistent with a situation in which the Schuylkill is unavailable as a supply source beyond the seven to eight days of available storage and the accident has occurred during a period of peak usage.

To properly evaluate these four techniques one must first assess the impact of this emergency on the distribution system in the two high service district affected areas. As potable water supplies are depleted in these districts, three possible impacts could occur.

The first possibility is that a decision is made not to pump any water into those mains. This decision could be disastrous for the integrity of the system. As air gets entrained in the mains it becomes more and more difficult to resupply the system without causing pipe collapses due to vacuum or water hammer. To prevent such damage, the resupply would take a number of days, retarding the reestablishment of service. In addition, the lack of water in these mains is unacceptable from a public safety standpoint due to the unavailability of water for fire-fighting purposes. This situation is especially acute in the case of the Belmont High Service District which would run out of water (assuming temporary remedial measures have already been taken) in approximately seven days if no Schuylkill River water or alternative water supplies were pumped into the system. The situation for the affected areas in the Roxborough High Service - West Oak Lane District is less straight forward. Although some water would probably remain in many of the mains in these areas (especially in lower elevation areas), it would be inadequate to meet water consumption demands. It is unclear, without a very detailed analysis, to what extent these mains would have water and in what quantity. It is assumed, especially at the higher elevations, that the available supply will be inadequate from a pressure standpoint for firefighting.

The second possibility is that contaminated Schuylkill River water is pumped through these mains to prevent the loss of supply. The problem with this option is that there is a potential that a number of people may ingest this contaminated water despite an intensive door to door

education effort. In a recent Pittsburgh area contaminated water case, a family ingested contaminated water in spite of such an education and media campaign. It is difficult to imagine a 100% effective campaign in reaching every person affected in the two districts. Given these drawbacks and the availability of alternatives, this option is not viable.

The third and only viable possibility available to the City of Philadelphia is the provision through the distribution system of alternative sources of potable water to these Districts.

Q.27. On the basis of these criteria, which measures that you evaluated for the two districts were deemed non-appropriate and why?

A.27. The first two possibilities presented in the previous response avoid the use of alternative water supplies, through the distribution system, for potable water uses. Both possibilities rely on the use of tanker trucks, temporary storage tanks, or bottled water to supply potable water for drinking, cooking and possibly bathing purposes. Additional water would be needed for sanitary purposes (toilets and bathing) if the no pumping first option was chosen. V.S. Boyer of PECO has indicated in his letter under date of August 1984 to Commissioner Marrazzo (City Exhibit "B") that the use of tanker trucks is a feasible option. Given the discussion in the previous response, the use of tanker trucks is not a viable option since there are ways to obtain potable water through the distribution system, which is the preferred alternative --

all water supply needs could be satisfied and health and safety hazards are minimized. This is especially true in the case of the Belmont High Service District which will run completely out of water in approximately seven days. One underlying reason behind the determination that tanker trucks are non-appropriate in this case is the opinion that mitigation techniques implementable in the case of a severe drought are not necessarily appropriate in the case of a nuclear accident. A nuclear accident is much more likely to have health impact considerations as well as supply considerations. During a severe drought, for example, water could still be pumped from the Schuylkill to these districts without the fear of people ingesting this water. This unfortunately is not the case with a nuclear accident.

The letter by Mr. Boyer also refers to the use of temporary pumps and piping to supply the Belmont High Service District from existing covered reservoirs supplied by the Baxter plant. Specifically, he refers to the supply of the Belmont High Service District Clear Well using a temporary pumping and piping scheme from the covered Monument Road Reservoir. The Monument Road Reservoir, which normally is used to supply the Belmont Gravity District, could be supplied from a transmission main that connects to the East Park Reservoir. The East Park Reservoir, in turn, could be supplied by the Delaware River. In order to supply the average daily consumption (12.1 MGD) to this district, sufficient temporary pumping and piping capacity connecting the Monument Road Reservoir and the Clear Well would be required to satisfy demand. Mr. Dick Lamison of PEMA has indicated that pipes and

pumps are available from that agency on an emergency basis. Mr. Boyer's transmittal does attempt to define the total pumping capacity and the discharge piping size that would be required.

The use of temporary pumps and piping is consistent with the alternative potable water supply criteria presented earlier. From this standpoint the measure is a viable alternative. This alternative may not be viable, however, for some degrees of accident. The accident that was assumed here was a contamination of the Schuylkill River for more than seven to eight days such that available potable water storage supplies would no longer be available to supply the impacted high service districts. Mr. Boyer's letter fails to address the fact that insufficient hydraulic capacity currently exists in the 48 inch transmission main that connects the East Park Reservoir and the Mountain Road Reservior to supply both the Belmont High Service and Belmont Gravity District on a peak usage day even if the conservation measures previously discussed were fully implemented. The temporary pumping and piping scheme will succeed in the extending potable water service to the Belmont High Service District from a four day supply to a seven day supply but this measure does not represent a long-term feasible response.

Q.28. The remaining measures that you mentioned earlier are 1) the installation of pumping capacity and piping to permanently modify Philadelphia's distribution system and 2) the construction of interconnections with adjoining water supply purveyors who might have an excess

capacity of non-contaminated water supplies. Have you studied either of these measures in more detail and, if so, were any possible supply options identified?

A.28. The first supply measure available to the Water Department would require several permanent modifications of Philadelphia's distribution system in order to supply the two high service districts. In the case of an emergency this measure represents the quickest and most effective response by the Water Department. This measure would require the installation of some combination of additional pumps and piping capacity. It should be mentioned that each design alternative identified for this measure would require additional studies to size the piping and determine the additional pumping capacity that will be required. Engineering cost estimates must be developed as part of this process.

The modification of the system in terms of this measure should be evaulated from two standpoints: 1.) increased transmission capacity from the Delaware River to the Baxter Treatment Plant and 2.) increased transmission capacity from the Baxter Treatment Plan to the two impacted high service districts.

Increased transmission capacity from the Delaware River to the Baxter Treatment Plant would have at least three possible benefits for the Water Department. The first benefit would be an increase in peak capacity at the Baxter Plant which currently is 350 MGD due to raw water pumping constraints. If these constraints could be eliminated, actual

peak capacity could increase to 423 MGD. This would improve the safety margin for the Water Department on a peak day assuming the Schuylkill River is unavailable as a supply source. Earlier it was projected that the peak demand could be reduced from 480 MGD to 338 MGD through various conservation measures. This only leaves a slight 12 MGD safety margin. If the raw water transmission capacity was increased and if the other intra-system transmission capacity modifications were implemented, the Water Department could safely supply its entire service area under the conditions assumed.

The second possible benefit this would present for the Water Department would be an increased flexibility in water supplies for the region. For example, assuming interconnection(s) were available in Northeast Philadelphia with the Philadelphia Suburban Water Company (PSWC), the Philadelphia Water Department could supply eastern sections of PSWC's capacity. PSWC's freed capacity could then be used at two other interconnections near the Belmont High Service and Roxborough High Service-West Oak Lane Districts to supply these two areas. The increased capacity of the Baxter Plant would therefore enable the City to "tradeoff" its water supplies with neighboring water purveyors. This supply option would eliminate the need for the previously mentioned intrasystem modifications. This raw water supply enhancement could also be scaled back to allow for PSWC or another water purveyor to supply one High Service District which would mean that the Water Department could lower its raw water transmission capacity increase requirements. The Department would, however, have to provide additional transmission capacity to the other High Service District.

The third benefit would be to increase potable water suplies available at the Baxter Plant in an event of partial contamination of the Delaware River, requiring the use of lime-soda ash softening for decontamination. Since this treatment process may require the Delaware River water to be softened twice, thereby reducing the throughput of the plant by as much as one-half, any increase in peak capacity will be highly beneficial in helping the Water Department attain its objectives of supplying as many people as possible with potable water during an emergency.

Increasing the transmission capacity from the Baxter Treatment Plant to the two high service districts can potentially be accomplished in a number of ways. Several modifications may be necessary given the current distribution network arrangement to effectively supply the two districts without the use of interconnections. The purpose of these modifications would be to supply the BHSD and sections of Germantown, Roxborough, Manayunk and Chestnut Hill with sufficient additional capacity to ensure adequate pressure for firefighting and potable water use in all areas, including the higher elevations.

The other supply measure available to the Water Department that should be further evaluated is the possibility of constructing interconnections with adjoining water supply purveyors such as the Philadelphia Suburban Water Company or the Chester Water Authority. This option was discussed in the previous paragraph for the situation where the raw water peak capacity of the Baxter plant is increased and supply tradeoffs through interconnections are implemented. Another possibility

that may be feasible is for one or more suburban water supply purveyors to supply the two high service districts without any water supply trade-offs. This would obliviate the need for any permanent Water Department distribution system modifications. Only one water supply interconnection currently exist between the Water Department's distribution network and suburban purveyors (with Bucks County Water and Sewer Authority.) It may be feasible to construct one or more additional interconnections with suburban areas if the purveyors might have excess uncontaminated supplies under these emergency conditions. This would be the case for purveyors which rely on ground water sources, adjoining supply basins or stretches of the Delaware River not contaminated. It is assumed in the case of a regional water supply emergency enforced by the Commonwealth that neighboring water supply purveyors would be requested to implement water conservation and rationing measures even if their supplies were not directly impacted by the accident. It is not certain at this time whether there are any other utilities with sufficient excess capacity to supply either or both of the high service districts. If excess capacity is available, further design studies will be required to determine the size and connection points of the transmission mains and the capacities of the pumps that will be needed as part of each interconnection. Simulation studies should be performed under a variety of emergency conditions and system demands prior to the selection of any design alternatives.

To evaluate the potential for regional interconnections, the emergency plan must include an analysis on a regional basis of various sources of

alternative water supplies that water purveyors might have available in excess supply in the event that the Schuylkill River was eliminated as a source of potable water for various time frames. Emergency planning should proceed with the objective of developing strategies in all affected water service areas so that the least number of people will not have an available non-contaminated water supply source. The emergency plan for Philadelphia should therefore be part of a regional emergency plan that could be implemented following an accident at Limerick.

Q.29. Have you evaluated the feasibility of these water supply options at this time?

A.29. No. Each water supply option will require extensions or modifications to the existing distribution system network. Some of these options may require significant capital expenditures to accomplish. Further research and detailed design work will be necessary to evaluate these alternative adequately.

Q.30. In summary, what needs to be done to have an implementable water supply emergency plan?

A.30. In order to have an implementable water supply emergency plan for the City of Philadelphia a number of steps need to be undertaken jointly by the City, suburban water purveyors, the Commonwealth and PECO. Firstly, PECO must develop various accident probabilities, risks and impacts as an input into the planning process. Secondly, each party

must review this information. Appropriate conservation and water supply measures for each level of accident must be developed. Institutional or organizational barriers to the implementation of these measures must be identified. For example, the City does not currently have a rationing plan for its customers. The legal framework for instituting such a plan must be developed. Organizational procedures to institute the distribution of flow restrictors city-wide and the rapid reduction in illegal hydrant usage may also need to be addressed. Thirdly, a detailed study of feasible potable water supply options for each severely impacted district that would be affected by one or more levels of accidents must be prepared. Detailed design, construction and cost information for each feasible alternatives must be prepared. This study should provide the basis for the development of a regional water supply emergency plan to fully explore the possibility of creating interconnections. This study should be funded jointly by all parties involved (regional water purveyors, the City, the Commonwealth and PECO). Finally, the plan must be adopted by all parties involved. Necessary water supply enhancements recommended in the third step must be funded and constructed. Institutional and organizational constraints to the implementation of various conservation measures must be overcome. The plan should be subject to a public hearing process prior to adoption.

Q.31. Does this conclude your testimony?

A.31. Yes it does.