

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

DOCKETED  
NRC

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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In the Matter of )  
 )  
CAROLINA POWER & LIGHT COMPANY )  
and NORTH CAROLINA EASTERN ) Docket No. 50-400-OL  
MUNICIPAL POWER AGENCY )  
 )  
(Shearon Harris Nuclear Power )  
Plant) )

AFFIDAVIT OF ROBERT D. KLIMM  
IN SUPPORT OF APPLICANTS' MOTION  
FOR SUMMARY DISPOSITION OF WILSON  
CONTENTION 12(b)(2)

County of Suffolk )  
 ) ss.  
Commonwealth of Massachusetts)

ROBERT D. KLIMM, being duly sworn, deposes and says:

1. I am an Associate of HMM Associates, Inc. My business address is 336 Baker Avenue, Concord, Massachusetts 01742. A summary of my professional qualifications and experience is attached hereto as Attachment A. I make this Affidavit in response to Wilson Contention 12(b)(2). I have reviewed this contention and am familiar with the substance of the allegations contained therein. I have personal knowledge of the matters stated in this affidavit and believe them to be true and correct.

2. HMM Associates is an engineering and planning firm specializing in emergency response planning for the nuclear

industry. HMM Associates offers services in the areas of evacuation studies, radiological emergency response plans, dose projection systems, training, and implementing procedures, among others. My responsibilities at HMM Associates include the management and supervision of evacuation time studies. I have served as either Project Manager or Principal Transportation Engineer for many of the more than twenty evacuation time analyses conducted by HMM Associates in connection with emergency planning for nuclear power plants. I am also responsible for all transportation-related computer analyses conducted by HMM Associates. I was involved in the system development of the NETVAC evacuation model, which is a state of the art computer evacuation simulation model. The NETVAC model has been used to estimate evacuation times for approximately 20 nuclear power plant sites. I co-authored the NETVAC model users manual. In addition, I have provided training to various groups on the use of the NETVAC model.

3. HMM Associates was contracted by Carolina Power & Light Company to develop evacuation time estimates for the Shearon Harris plume exposure Emergency Planning Zone ("EPZ") pursuant to NUREG-0654; FEMA-REP-1, Rev. 1, November 1980. The resulting time estimates developed by HMM Associates as well as the underlying analyses and assumptions are set forth in a formal study entitled "Evacuation Time Estimates for the Plume Exposure Pathway Emergency Planning Zone of the Shearon Harris Nuclear Power Plant" (October 1983) (hereinafter referred to as

the "ETE"). I was the Principal Transportation Engineer for the study responsible for the supervision and review of all technical analyses conducted as part of the study.

4. NUREG-0654, Appendix 4 and NUREG/CR-1745, Analysis of Techniques for Estimating Evacuation Times For Emergency Planning Zones, US NRC (November 1980) provide detailed guidelines to be used in the preparation of an evacuation time estimate study. They require estimates of the number of vehicles that will be involved in an evacuation, the capacity of the road network to handle these vehicles, and the total estimated time to evacuate under various conditions and assumptions. The total time to evacuate includes the time required to notify the population of the need to evacuate, the time required for each segment of the population to prepare to evacuate and the actual travel time to depart the area being evacuated. Federal guidance provides for considering these elements separately for permanent residents, transient populations and special facility populations.

5. An integral part of preparing a time evacuation study is the estimation of the number of vehicles that will be involved in an evacuation. The methodology used by HMM Associates in estimating vehicle demand took into account documented assumptions on vehicle occupancy and anticipated evacuation characteristics associated with each individual population category (i.e., permanent residents, transients and special facilities). The vehicle demand estimates were based

upon (1) federal guidance found in NUREG-0654, Appendix 4 and in NUREG/CR-1745; (2) knowledge and experience obtained by HMM Associates in conducting similiar evacuation time studies for more than 20 nuclear power plant sites throughout the country; (3) reviews by HMM Associates of empirical data on past evacuations, and (4) discussions with State and County emergency preparedness officials.

6. For permanent residents, HMM Associates assumed that for households with automobiles one vehicle per household would be used in evacuating the EPZ. This assumption was used and considered valid for all conditions including evacuation during day or night periods and evacuation during fair or adverse weather conditions. This assumption is consistent with the Federal guidance found in NUREG-0654, which states that:

The number of permanent residents shall be estimated using the U.S. Census data or other reliable data, adjusted as necessary, for growth. (See planning element J.10.b.). This population data shall then be translated into two subgroups: 1) those using autos and 2) those without autos. The number of vehicles used by permanent residents is estimated using an appropriate auto occupancy factor. A range of two to three persons per vehicle would probably be reasonable in most cases.

An alternative approach is to calculate the number of vehicles based on the number of households that own vehicles assuming that one vehicle per household is used in evacuation. Regardless of the approach used, special attention must be given to those households not having automobiles. The public transport-dependent population must, therefore, be considered as a special

case.1/

NUREG-0654, Rev. 1 at page 4-3. Identical guidance is found in NUREG/CR-1745 at page 21. Additionally, this assumption is consistent with documented public emergency response phenomena indicating that families generally seek to unite and to remain united in times of emergency and therefore, as explained in the affidavit of Dr. Dennis Mileti on Wilson Contention 12(b)(2) and Eddleman Contention 215(1), families are likely to evacuate in a single car from their place of residence instead of separating into two or three cars.

7. The estimate of one vehicle per permanent household is a simplifying assumption. Some households may in fact

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1/ As reflected in the quotation above, regardless of which of the two assumptions set forth in Appendix 4 is used, the public transport-dependent population is to be considered as a special case and a separate estimation of the vehicles to be used by this subcategory in evacuating the EPZ is required. HMM Associates did a separate analysis for this subcategory here. Following lengthy discussion with relevant state and local emergency preparedness officials, it was determined that one vehicle per household for this subcategory, under the local conditions expected to occur, was a reasonable assumption to account for the traffic generated by the collection and evacuation of the nonauto-owning population out of the EPZ. Accordingly, although the result of different analyses, it happens in this case that one vehicle per household was used for households that do not own automobiles as well as for those that do. Wilson Contention 12(b)(2) obviously focuses solely on the estimation of vehicle demand for the auto-owning population and therefore my statements in this affidavit are limited to that analysis. Accordingly, whenever this Affidavit makes reference to permanent residents or permanent households or one vehicle per household, or the like, the unstated limitation is permanent residents owning vehicles or households owning vehicles or the like.

evacuate with two or three vehicles. On the other hand, however, other residents may be out of the area at the time or may evacuate with relatives, neighbors or friends. Use of one vehicle per household produces a reasonable estimate, consistent with federal guidance, of vehicle demand associated with this population segment based upon what is known about public response to emergency situations. HMM Associates has used the assumption of one vehicle per household in a majority of its more than 20 evacuation time analyses conducted in connection with emergency planning for nuclear power plants. All of these studies, except for several currently in the review process, have been reviewed and found acceptable by the Nuclear Regulatory Commission.

8. In those instances where HMM Associates has used an estimate different from one vehicle per household, it used vehicle occupancy factors of between 2 and 3.2 persons per vehicle to estimate vehicle demand. The use of these factors, which are also consistent with the federal guidance quoted above, was reached after discussions with the relevant state and local officials to account for site specific characteristics.

9. Using this alternative approach for calculating vehicle demand in conjunction with the Shearon Harris facility produces a result virtually identical to the assumption of one vehicle per household. The average household size within the Shearon Harris EPZ is approximately 2.7 persons per household.

Accordingly, the assumption of one vehicle per household translates to approximately 2.7 persons per vehicle, which is in the range of that considered reasonable in NUREG-0654, Rev. 1 and NUREG/CR-1745.

10. The primary function of an evacuation time study is to provide a realistic estimate of the time to evacuate the EPZ for the purpose of aiding officials in determining the appropriate course of protective action to follow in an emergency situation. An overly conservative estimate of the time necessary to evacuate the EPZ may result in officials deciding not to evacuate the EPZ when evacuation may in fact be the appropriate protective action to undertake.

11. An assumption of more than one vehicle per household (such as 1.5 or 1.75) would be an overly conservative assumption that would tend to overestimate the number of vehicles used in the evacuation of the EPZ and therefore overestimate the evacuation time of the EPZ. There are several reasons why such an assumption would be unreasonably conservative.

a. First, an assumption such as 1.5 or 1.75 vehicles per household would greatly exceed that deemed reasonable by FEMA and the NRC as set forth in NUREG-0654, Appendix 4. The guidance set forth in Appendix 4 reflects NRC's and FEMA's regulatory judgment as to the assumptions that will in most circumstances

produce reasonable, realistic evacuation time estimates. There is nothing atypical with respect to the evacuation of the Shearon Harris EPZ that would suggest or dictate differing assumptions here.

b. Second, assuming that households with more than one car would utilize two or more vehicles in evacuating the EPZ is contrary to the documented public emergency response phenomena referred to above which indicate that families generally seek to unite and to remain united during times of emergency. As explained in the Affidavit of Dr. Dennis Mileti on Wilson Contention 12(b)(2) and Eddleman Contention 215(1), as a result families will in all likelihood use one vehicle to evacuate the EPZ, not two or three as alleged in Wilson Contention 12(b)(2).

c. Third, an assumption such as 1.5 or 1.75 vehicles per household is contrary to the experience gained by HMM Associates in the more than 20 evacuation time studies that it has undertaken for nuclear power plants throughout the country. In those situations, even though many households owned more than one vehicle (as is typical in the United States) the demand

estimate of one vehicle per household (or a vehicle occupancy factor that produced close to the same overall vehicle demand) was considered to be reasonable by federal and state emergency preparedness officials alike. These officials, who on the whole have had substantial experience both in emergency planning and emergency response, have found the vehicle demand estimates utilized by HMM Associates to be reasonable and to produce what they considered to be realistic evacuation time estimates.

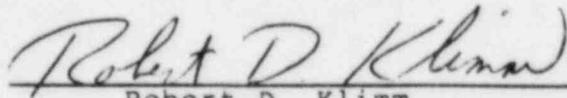
12. In his response to Applicants' Interrogatories on Wilson 12(b)(2), Dr. Wilson suggested that a worst case assumption, apparently such as 1.5 or 1.75 vehicles per household, should be investigated even though such a worst case need not be incorporated as the basis for planning protective actions. Utilizing vehicle demand estimates of 1.5 and 1.75 vehicles per household, HMM Associates has computed the evacuation time estimates for evacuating the full EPZ under the four conditions evaluated in the ETE: summer weekday (good weather), summer weekend (good weather), late fall weekday (adverse weather) and summer evening (good weather). The results of these computations in comparison with those for a vehicle demand estimate of one vehicle per household are set forth in the following table:

Evacuation Times in Minutes For The Entire  
EPZ Under Different Vehicle Demand Assumptions

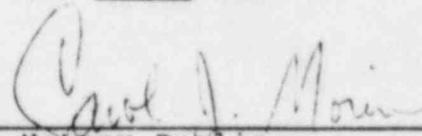
	<u>1 vehicle/ Household</u>	<u>1.5 vehicles/ Household</u>	<u>1.75 vehicles/ Household</u>
Summer Weekday (Good Weather)	193	226	247
Summer Weekend (Good Weather)	174	192	210
Fall Weekday (Adverse Weather)	236	272	290
Summer Evening (Good Weather)	172	175	191

As reflected in the table, the evacuation time estimates are sensitive to assumptions on the number of vehicles per household, particularly for the summer weekday good weather case (due to the peak population) and the late fall weekday adverse weather case (due to the reduced roadway capacities). Variances in the assumption of the number of vehicles per household, however, are less significant for the summer weekend and summer evening good weather cases where the total vehicle demand in the EPZ would be lower. However, for the reasons stated in paragraph 11, the evacuation times resulting from vehicle demand estimates of 1.5 and 1.75 vehicles per household are unreasonably conservative and should not therefore be used as the planning basis for determining the appropriate protective responses in the event of an emergency.

13. In summary, the assumption of one vehicle per household is used to give a realistic estimate of the evacuation time of the EPZ for use in determining the appropriate protective response in the event of an emergency. This assumption is in accordance with federal guidance and public response phenomena in emergency situations and has been used and accepted in numerous other evacuation time studies for nuclear power plants.

  
Robert D. Klimm

Sworn to and subscribed before me this 10<sup>th</sup> day of  
January, 1985.

  
Notary Public

My Commission expires:  
~~My Commission Expires April 12, 1985~~

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ROBERT D. KLIMM

Education

M.S. Civil Engineering (Transportation), Northeastern University, 1979  
B.S. Civil Engineering, Worcester Polytechnic Institute, 1975

Summary of Experience

Mr. Klimm specializes in transportation engineering and emergency preparedness/evacuation planning. He has served as Project Manager or Technical Advisor on most of the evacuation time estimate analyses conducted by HMM. He also has been responsible for numerous emergency preparedness tasks for nuclear power plants including: the development of school facility evacuation plans and procedures; the development of evacuation and population data for CRAC2 and CRACIT consequence modeling; and the development of evacuation routings and time estimates for special facilities.

Mr. Klimm was involved in the system development of the NETVAC evacuation simulation model, which has been used at 20 nuclear power plant sites throughout the country. He has provided training to groups that have been licensed to use the NETVAC model, and was responsible for conducting an Evacuation Time Estimate Workshop for Public Service Electric and Gas Company of New Jersey.

Professional Experience

1980 - Present HMM Associates. Mr. Klimm serves as Project Manager and/or Principal Engineer for projects involving emergency preparedness planning and emergency evacuation. Recent experience includes the following:

- o Principal Engineer for the development of evacuation time estimates for the Susquehanna Steam Electric Station (Luzerne County, Pennsylvania, 1981).
- o Project Manager for the preparation of supplemental evacuation time estimates for the Midland Nuclear Power Plant (Midland, Michigan, 1983).
- o Project Manager for the development of evacuation time estimates for the D.C. Cook Nuclear Plant (Berrien County, Michigan, 1984).

- o Project Manager for the development of an Evacuation Traffic Management Plan for the Midland Nuclear Power Plant Plume Exposure EPZ (Midland, Michigan, 1983).
- o Principal Engineer for the preparation of evacuation time estimates for the Shearon Harris Nuclear Power Plant (Wake County, North Carolina, 1983).
- o Project Manager for the development of an Evacuation Traffic Management Plan for the primary Plymouth Station Evacuation Relocation Center (Hanover, Massachusetts, 1983).
- o Principal Engineer for the development of population and evacuation data for CRACIT radiological consequence modeling within the Seabrook Station EPZ (Seabrook, New Hampshire, 1983).
- o Project Manager for the development of an Evacuation Traffic Management Plan for the Seabrook Station Plume Exposure EPZ, (Seabrook, New Hampshire, 1982).
- o Project Manager for the preparation of evacuation time estimates for the Grand Gulf Nuclear Station (Clairborne County, Mississippi, 1981).

1977-1980 Fay, Spofford & Thorndike, Inc. Transportation Engineer. Responsible for traffic operations analyses; traffic control design, specifications and cost estimates; transportation environmental impact analyses; highway safety analyses; truck circulation studies, and traffic circulation plans for private and public developments.

1975-1977 Central Massachusetts Regional Planning Commission. Transportation Engineer/Planner. Responsible for transportation corridor planning studies, transportation systems management, traffic operations analyses, and coordination of the regional transportation air quality control plan.

Other Professional Data

Affiliations: Transportation Research Board: National  
Academy of Sciences  
Institute of Transportation Engineers  
American Society of Civil Engineers  
Boston Society of Civil Engineers

- Papers/  
Publications:
- o Klimm, R., "Comparison of Optional Cycle Lengths for an Urban Arterial Signal System Using Maximum Bandwidth and Minimum Vehicle Delay Criteria," Northeastern University, 1979.
  - o Klimm, R., "Fringe Parking and Intermodal Transportation System--Feasibility Study," CMRPC, 1976.
  - o Klimm, R., Sheffi, Y., Mahnassani, H., Powell, W., NETVAC2 USER MANUAL," HMM Associates, 1982.