50-443, 444 OL

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APPLICANTS' REBUTTAL TESTIMONY No. 1

<u>Members of the Panel</u>:

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Contentions NECNP III.12 and .13

(Evacuation Time Estimates)

Rebuttal to the Testimony of Mr. Herr

This rebuttal is keyed to the numbered answers in Mr. Herr's testimony.

Response to A.04

Rain and other adverse weather scenarios can significantly reduce roadway capacity. Literature searches have been conducted on this matter. In general, there are few research studies which address this topic. The few references that have been identified deal with reductions in capacity due to rainfall. One such study (E. R. Jones, et al., "The Environmental Influence of Rain on Freeway Capacity"), the same reference cited by Mr. Herr, indicates a reduction in freeway capacity of between 14% and 19% during rainfall, compared to dry weather conditions. The 15% to 25% reduction stated by Mr. Herr is nowhere referenced in this study. From this study, it was judged appropriately conservative for the Seabrook adverse weather analysis to use a capacity reduction of 30% as an assumption. In the NETVAC model, the use of reduced roadway capacities during adverse weather directly affects travel speeds, and the effects are fully incorporated in the Seabrook analyses.

The reference cited above does not present data differentiating the type of adverse weather, such as "worst fog" or "rain or fog of small severity," as noted in the Herr testimony. In fact, the correlation of traffic flow for rain and dry weather conditions in the referenced article was developed based upon classifications of "dry" or "rain" weather only. Applicants are unaware of any research which supports the specific results quoted in Mr. Herr's testimony.

Contrary to Mr. Herr's statement that "Peak numbers of persons and adverse weather aren't at all mutually exclusive," there is a strong correlation between weather conditions and population in the beach area. The conditions which give rise to fog at the beach are not as ill-known as Mr. Herr implies. Both radio and television weather forecasts in the Boston metropolitan area commonly include information on conditions at the beaches, especially on weekends. Moreover, actual studies at the beach areas in question demonstrate that people apparently do take weather and weather forecasts into account when deciding whether or not to go to the beach: Applicants have been monitoring beach attendance through aerial photo-reconnaissance during the summers of 1979 through 1982 and have found that less than ideal weather conditions always result in less than peak attendance at the beaches in the vicinity of Seabrook Station.

While Mr. Herr may have experienced "sudden" rainstorms at the coast, the conditions that create the prospect for such weather are also commonly forecasted. The same quantitative reconnaissance studies show that these conditions are not coincident with peak attendance at the beach areas. Indeed, one of the goals of a specific traffic count program[1] undertaken by Applicants during the entire summer of 1982 was to obtain quantitative information regarding traffic flow during a peak attendance period at the beach area where a sudden, unexpected rainstorm occurred. No such event

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[1] HMM Associates, "Beach Area Traffic Count Program: Seabrook Station EPZ," December, 1982.

occurred during this period. The traffic count program has continued through 1983 and we have yet to observe the peak traffic/sudden storm combination. The joint occurrence of peak attendance at the beach area and a sudden thunderstorm coupled with an accident at Seabrook Station which warrants evacuation of the Seabrook Station Plume Exposure Emergency Planning Zone is a very low probability event. One factor which is overlooked by Mr. Herr is that strong winds that generally accompany thunderstorms would also result in rapid dispersion of airborne contaminents. Since the airborne exposure pathway would be of greatest concern, the improved atmospheric dispersion would mitigate the effects of any airborne radioactivity.

The Herr testimony also seems to contend that the Applicants should consider the situation in which a summer storm or a peak summer weekend initiates loss of off-site power, which in turn initiates a core melt, which in turn necessitates an evacuation. The scenario suggested by Professor Herr represents a highly improbable sequence of events. In support of his assertions, Professor Herr relies on core melt frequencies for the loss of off-site power initiating event as delineated in a document prepared for the Applicants by Pickard, Lowe, and Garrick, Inc., "Seabrook Station Probabilistic Safety Assessment, Phase 1, Preliminary Risk Model Development." Applicants feel that use of the above document for any purpose (i.e., providing "a sense of scale of significance of power loss") is improper. Table 1-5 of the above document from which Professor Herr develops a probability of loss of off-site power given a core melt is clearly stamped "PRELIMINARY RESULTS FOR PROJECT SCOPING PURPOSES;" Section 1.1 of the document states:

> "1.1 GENERAL
>
> This report presents the Phase I results of the two-phased Seabrook Probabilistic Safety Assessment (SPSA) project. Phase I represents a broad brush of most of the tasks associated with the planned full scope SPSA. It is an attempt to obtain results early in the project to serve as model for completion of the risk study, i.e., Phase II, and to provide timely information to impact plant design and operation. Phase I results are believed to be an upper bound statement of risk. During Phase II, the risk model will be refined and more accountable to the real world. Thus, on the basis

> of the analysis strategy adopted and extensive experience with other risk studies, <u>it is expected that the Phase II results will exhibit considerably less risk than portrayed in this Phase I report.</u>"

(Emphasis added.)

Notwithstanding Professor Herr's use of the Phase I portion of the Probabilistic Safety Assessment (henceforth PSA), Applicants perceive an important flaw in Professor Herr's statement that "loss of off-site power for alerting, communications, traffic control, drawbridge operation, gasoline pumping, and other emergency actions has virtually an 80% probability given a condition of core melt." Professor Herr doesn't consider that loss of off-site power to Seabrook Station and the EPZ could itself be initiated by many other potential events. Applicants contend that loss of off-site power initiated by a storm in the Seabrook EPZ has a probability of significantly less than 80% given the condition of core melt.

Professor Herr also manipulated the results of the Phase I PSA to cast a bright light on his assertion by failing to point out that Phase I of the PSA indicated that the fraction of loss of off-site power initiated core melts which result in an early failure of the containment is .034%,[2] and that Table 1-5 does not include the effects of operator recovery which would tend to cast an even less risky/more improbable light on his scenario when the real world probabilities are considered.

In summary, Professor Herr should not have relied on the Applicants' Phase I PSA in his testimony and even if Phase I were not preliminary, his arguments are flawed and manipulative.

The assertion by Mr. Herr that the Applicants in the ER-OLS (page 7.4-3) and the NRC Staff in the FES (page 5-39) indicate that rain or fog conditions result in "rapid deposition of radioactive material" is incorrect. Rather, both cited references of the environmental impact documents simply offer an explanation of how meteorological conditions are

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[2]That is, only 1 in 2900-odd core melts yields an early failure of the containment.

considered and generally affect the behavior of accidental releases. The fact is the effect of rain or any other meteorological condition (e.g., fog) on offsite radiation dose would depend greatly on the chemical species of composition of the radionuclides being released. This composition distribution is highly dependent on the accident sequence assumed -- especially the assumed failure mode of the containment. The point is that radioactive material of a form that can be depositied on the ground surface by rain is present in only certain accident release sequences, not all of them.

The potential for flooding of the major roadways providing access to the beach areas of Salisbury, MA, Seabrook, NH, and Hampton, NH, was not separately considered in the evacuation scenarios for the Seabrook Station EPZ, since the occurrence of such an event is considered unlikely without ample warning. Potential causes for such an event would include hurricanes or severe winds and rain. Ample warning would most likely precede such an event, and it can be concluded that transient population levels in the area would be significantly lower than those evaluated for the Applicants' evacuation time estimate study. In addition, the meteorological conditions which would accompany a flooding condition would also promote rapid atmospheric dispersion. Any evacuation that might be ordered in such weather, therefore, will probably not be radiologically motivated.

Response to A.05 and A.06

A report entitled "Evacuation Clear Time Estimates for Areas Near Seabrook Station" (updated 1981, revised July 1983) has been prepared in response to the Board's order of June 30, 1983. This is in essentially the same format as, and uses the same data and computer program as, Appendix C to the emergency plan included with the FSAR, and contains an estimate of the time required to evacuate the Seabrook Station EPZ under a peak summer weekend, adverse weather scenario. The "entire EPZ" scenarios for the original summer cases produce evacuation clear times of 6 hours, 5 minutes for the summer weekend-fair weather scenario and 4 hours, 10 minutes for the summer weekday-fair weather scenario.

The "entire EPZ" case for the summer weekend-adverse weather scenario yields an evacuation clear time of 9 hours, 15 minutes.

All of the "entire-EPZ" cases account for an evacuation of the beach area from NE to SSE, plus all other areas of the EPZ, at the same time.

While the time required to evacuate under a peak summer weekend, adverse weather condition has been estimated, it is reasonable to assume that this estimate overstates the time that an evacuation would take under peak population, adverse weather conditions. The reason for this is that, in order to model this scenario, it was assumed that none of the people at the beach areas began to depart -- notwithstanding the degrading weather -- until the signal to evacuate was given. In actuality, one of two things would like happen: either (1) the weather would begin to degrade before the notification was given, in which case some people would begin to leave before the signal was given, or (2) the weather would not begin to degrade until after the evacuation notification was given, in which case the effects of adverse weather upon evacuation would not appear until the evacuation was underway and at least partially completed. Either of these situations would produce lower evacuation times than the case actually modeled. See also our discussion above.

Response to A.07.1

See Response to A.08.

Response to A.07.2

The consequences of potential roadway accidents and breakdowns have not been separately considered for Seabrook evacuation time estimate analysis. The effect of such incidents on evacuation times would depend on many variables, such as the number of vehicles involved, the location of the breakdown, the time at which the breakdown occurred, etc. Obviously, one cannot issue broad generalization about the effect on evacuation flows and clear times of potential accidents (Refer to Response to A.09.1).

Response to A.07.3

The Applicants' evacuation time estimate studies assumed that the permanent population will evacuate from their residences. All transient populations will evacuate from their respective work place, beach area, etc. That is, both home and non-home based traffic was considered in the analyses.

Although the analyses did not separately analyze the effect of travel impedance from non-evacuationg traffic, a time distribution for vehicle loading was utilized. That is, an instantaneous loading of vehicles, subsequent to notification, was not assumed. This time distribution was utilized to take into account varying mobilization and preparation times associated with the time required to prepare to evacuate, drive from work to home, pick up family members, etc. This factor, coupled with maintaining inbound travel lanes clear during the evacuation, implicitly allows the types of activity identified to occur without significantly affecting the overall evacuation time. (Refer to Response to A.10.1). In order to hypothesize substantial non-evacuationg traffic impedence, one would also have to hypothesize that normally two-way roads have been converted (either *de jure* or *de facto*) to one-way, outbound-only use. In such circumstances, the baseline estimates (*i.e.*, the numbers to which the impedence effect would be added) would be much lower than what we have presented. In short, the net effect of our methodology is to increase the evacuation time required.

Response to A.07.4

The matter of planning arrangements for evacuation of the transport-dependent populations within the EPZ is currently being addressed. As State and local emergency planning considerations specific to the Seabrook area are developed, arrangements for the transport-dependent population will be specified. However, for estimating purposes it was assumed that all people would evacuate via automobile. To the extent that buses replace automobiles in a ratio of about 1 to 15, fewer vehicles would be involved in the overall evacuation which would probably reduce the evacuation time.

Response to A.07.5

See Response to A.05 and A.06.

Response to A.07.6

Of the five evacuation time estimates which have been prepared for the Seabrook Station plume exposure

EPZ, one estimated a peak summer weekend, full EPZ fair weather evacuation time approximately 12% higher than that prepared by the Applicants. This first study, conducted in 1974 by Wilbur Smith and Associates, is considered somewhat outdated at this time. A second estimate, prepared for a similar peak population case and geographical area by Alan M. Voorhees & Associates for FEMA in 1980 was approximately 1% higher than that estimated in the Applicants' study. A third estimate for a similar geographic area and population, prepared for the NRC in 1982 by Pacific Northwest Laboratory (PNL) was approximately 92% higher than that estimated in the Applicants' study. The PNL study, however, utilized a static, fixed-route simulation model (Clear[3]) which would be expected to produce results

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[3]Clear (Calculate Logical Evacuation and Response): A Generic Transportation Network Model for the Calculation of Evacuation Time Estimates, NUREG/CR-2504

significantly different than those estimated using the methodology employed by the Applicants.

The fourth, and most recent, time estimates for evacuation of peak population, fair weather, full EPZ case, was prepared for the New Hampshire Civil Defense Agency in 1983 by C.E. Maguire, Inc. This estimate was approximately 4% lower than that estimated in the Applicants' analysis.

In summary, the Voorhees estimates (prepared for FEMA), the C.E. Maguire estimates (prepared for the State of New Hampshire) and the Applicants' estimates are all reasonably close for similar geographic areas and evacuation scenarios. The Wilbur Smith and Associates estimates, prepared in 1974, are considered outdated. The PNL estimates prepared for NRC are considered to be unreasonably and unrealistically conservative, due to the methodology employed in developing those estimates.

PNL-3770, Prepared for USNRC by Texas Transportation Institute and Pacific Northwest Laboratory, March, 1982.

The methodology employed by Applicants for developing the Seabrook Station EPZ evacuation time estimates involved the use of a computer-based evacuation simulation model -- NETVAC. The NETVAC model is a state-of-the-art program which was developed specifically to provide evacuation time estimates and related information for use in emergency planning. The evacuation time estimates developed for the Applicants, using the NETVAC model, provide site-specific input which can be used to evaluate the overall state of emergency preparedness for the area. The Applicants' evacuation time estimate analysis also provides a reasonable basis for emergency response decision-making as noted in the NRC's staff testimony on Evacuation Time Estimates for Seabrook Station.

> "The [Applicants'] methodologies use accepted and proven transportation planning techniques. The methodologies represent years of experience in transportation planning, modeling and operating transportation systems, and are

consistent with NUREG-0654/FEMA-REP-1, REV. 1, Appendix 4."[4]

In summary, the set of "entire EPZ" evacuation time estimates is as follows:

Wilbur Smith	6 hours 50 minutes
Applicants	6 hours 5 minutes
FEMA (by Voorhees)	6 hours 10 minutes
NHCD (by C.E. Maguire)	5 hours 50 minutes
NRC (by PNL)	11 hours 40 minutes

This clearly shows that for the estimate of time for the entire EPZ, it is the PNL analysis which is inconsistent with the others.

Response to A.3

It is true that day-trip and overnight visitors to seasonal housing during weekend periods within the beach areas of Salisbury, Seabrook and Hampton do increase the occupancy of these units. A 1978 survey of beach area housing, conducted by HMM, indicated weighted average weekday and weekend occupancy of seasonal residences of 5.4 persons and 7.6 persons,

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[4]NRC Staff Testimony of Dr. Thomas Urbanek, II on Restated NECNP III.12/III.13: Evacuation Time Estimates, Docket Nos. 50-443 OL, 50-444 OL.

respectively. For the Applicants' evacuation time estimate analysis, two vehicles per seasonal housing unit were used for both weekday and weekend evacuation scenarios. Although similar characteristics (i.e., day-trip or overnight visitors) may apply to permanent residences within the immediate beach area, this was not specifically considered for the Applicants' evacuation time analysis. Nevertheless, the vehicle demand estimates developed by the Applicants are considered to be conservative estimates. For the summer weekend condition, peak (or capacity) estimates of vehicle demand were used for the seasonal resident and daily transient population sectors. This included the assumption that all seasonal residences within the area were fully occupied, and that beach area parking lots and on-street parking spaces, the Seabrook Greyhound Park parking lot, and the major Route 1 shopping facility parking lots were all at capacity. Use of the parking lot capacity estimates is considered conservative, based upon general surveillances conducted during the summer months from 1979 through 1982.

In addition to the use of peak values for each of the individual population components, the resultant aggregate demands used for the evacuation time estimate analysis did not consider the extent of double-counting between the various population sectors. That is, it is logical to assume that a portion of the Route 1 shoppers are also permanent residents, and that a portion of the beach-goers are either permanent or seasonal residents. Accordingly, although the exact extent of double-counting inherent in the methodology has not been established, it is reasonable to conclude that the total population and vehicle demand estimates used for the analysis are conservative.

The number of vehicles assumed to be within the beach area will obviously have an effect on the evacuation time. However, Mr. Herr is in error in attributing the difference in evacuation times solely to differences in the demand estimate. The most significant factor accounting for differences between Applicants' estimate of evacuation time and NRC's estimate is due to the methodology employed in the respective computer programs.

Applicants' estimates are based on results using NETVAC[5] while NRC's estimates are based on the use of CLEAR.[6] The NETVAC model more accurately represents the dynamic conditions which would exist during an evacuation. The CLEAR model requires a priori assignment of vehicles onto the transportation network. Thus, in order to obtain an accurate estimate of evacuation times using CLEAR, the analyst must know in advance the paths which vehicles will follow.

Mr. Herr then proceeds to speculate on why all previous demand estimates are too low. The bases for Applicants' estimates are presented in FSAR section 2.1.3. These estimates are believed to represent reasonable predictions of peak populations. It is

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[5]Y. Sheffi et al, NETVAC 2 - A State of the Art Computer Evacuation Simulation Model - Software Description, Rev. 1, April, 1982.

[6]CLEAR (Calculate Logical Evacuation and Response): A Generic Transportation Network Model for the Calculation of Evacuation Time Estimates, NUREG/CR-2504 PNL-3770, Prepared for USNRC by Texas Transportation Institute and Pacific Northwest Laboratory, March, 1982.

obvious that additional vehicles could be present in the beach area but, in fact, all available spaces are not used at the present time. A continuing program of aerial surveillance (1979 - 1982) of the beach areas indicates that all available parking spaces have never been simultaneously occupied. The peak day for parking lot use during the four-year period was July 22, 1979. On this day, 10,541 vehicles were counted in parking lots within 10 miles of Seabrook compared to a total capacity of these lots of 13,895. On July 17, 1983, a set of aerial photographs was taken which indicated that these same parking lots contained 10,518 vehicles, or about the same as the peak day of July 22, 1979.

The July 17, 1983, aerial photographs were further analyzed to determine the total number of vehicles in the beach area between about Great Boar's Head on the north and the Merrimac River to the south. All visible vehicles were counted and the results indicate that a total of 21,000 vehicles were in the area at mid-day, the peak attendance time. This figure is less than the more than 25,000 vehicle demand estimate (for the same area) used in the Applicants' estimates of evacuation times for the peak weekend case. Applicants believe that this indicates that the demand estimate which has been made for estimating evacuation times is reasonable and, in fact, conservative.

The most recent 1980 United States Census Bureau data were reviewed to assess the seasonal housing unit trend from 1970 to 1980. Applicants agree with Mr. Herr that the Census category "held for occasional use" may include seasonal residents who should not be excluded from a demand estimate. The Census Bureau has defined the category "held for occasional use" as follows:

> "This category consists of vacant year-round units which are held for weekend or other occasional use throughout the year. Shared ownership or time-sharing condominiums are also classified as held for occasional use. Homes reserved by the owners as second homes usually fall in this category, although some second homes may be classified as seasonal."

Seasonal and migratory housing units are defined by the Census Bureau as follows:

> "Seasonal units are intended for occupancy during only certain seasons of the year. Included are units intended for recreational use, such as beach cottages and hunting cabins; units offered to vacationers in the summer for summer sports or in the winter for

> winter sports; and vacant units held for herders and loggers. Migratory units are vacant units held for migratory labor exployed in farm work durig the crop season."

Table 2 summarizes 1970 and 1980 "Seasonal and Migratory" and "Held for occasional use" categories for the States of New Hampshire and Massachusetts and representative coastal towns within each state.

COMPARISON OF 1970 AND 1980 CENSUS DATA

U.S. Bureau of Census Category: Vacant Seasonal & Migratory	1970	1980	% Change 1970-1980
New Hampshire			
State Total	33,954	37,166	+9.5%
Hampton	2,820	2,581	-10.7%
Northampton	76	50	-34.2%
Seabrook	672	532	-20.8%
Rye	519	495	-4.6%
Massachusetts			
State Total	54,202	68,005	+25.5%
Newburyport	354	232	-34.5%
Amesbury	150	82	-45.3%
Salisbury	1,655	1,459	-11.9%

U.S. Bureau of Census Category: Held for Occasonal Use	1970	1980	% Change 1970-1980
New Hampshire			
State Total	3,037	8,718	+187.1%
Hampton	-	73	-
Northampton	-	8	-
Seabrook	-	13	-
Rye	-	42	-
Massachusets			
State Total	11,611	13,950	+20.1%
Newburyport	10	31	+210.0%
Amesbury	14	7	-50.0%
Salisbury	-	1	-

Two major conclusions are apparent:

1. The use of state trends (for either New Hampshire or Massachusetts) to estimate "Vacant Seasonal and Migratory" housing in the areas around Seabrook Station would lead to exactly the wrong conclusion. As indicated on the table, an increase in both states occurred, while there was a decrease for all the towns along the coast within the EPZ for Seabrook Station.

2. The stock of housing categorized as "Held for Occasional Use" within the EPZ is negligible as far as demand estimates are concerned.

For these reasons, the Applicants reject the demand estimate provided in the footnote on page 9 of Mr. Herr's testimony as unreasonably high and not consistent with area-specific data collected by the Applicants. As discussed above with respect to statewide versus local trends, attribution of characteristics of one area, such as Cape Cod, to the Seabrook vicinity is at best uncertain.

Notwithstanding the inadequacy of the demand estimate provided by Mr. Herr, the Applicants have performed an analysis of the evacuation time using Mr. Herr's suggested value of 38,572 vehicles (NRC value of 34,572 on <u>Herr</u> p. 8 plus 4,000 vehicles from <u>Herr</u> p. 9

n.). The evacuation time for the entire EPZ using this demand estaimte is 7 hours 45 minutes.

Response to A.09

The Applicants do not believe there is a reasonable way to take into account the effect of potential roadway accidents or breakdowns. Sufficient documentation of statistical probabilities of occurrence for such events during the course of an evacuation is not available, based upon our literature searches.

Mr. Herr's estimation of the probability of accident occurrences during the course of an evacuation can certainly be questioned due to the use of average urban accident rates for all categories of roadways, and breakdown incidence research conducted along a freeway facility.

In any event, given Mr. Herr's estimation of the probability of an accident, the impact of such occurrences cannot be adequately assessed without identification of the location and times of such an incident.

Applicants do not disagree with the wisdom of anticipating problems, whether due to accidents or breakdowns, in establishing detailed plans for evacuationg the EPZ. Traffic control personnel and assistance vehicles could be dispatched as needed to handle situations on an *ad hoc* basis. Potential solutions would include routing traffic around the breakdown or pushing the disabled vehicle off the road surface.

Response to A.10

The Seabrook Station evacuation analysis incorporated vehicle demand associated with evacuation trips only. It was assumed that permanent residents would evacuate from their place of residents, daily transients from the beach area, campers from the campgrounds, etc. Traffic flow which would be associated with non-evacuation trips such as travel from work to home, or assembling family members prior to evacuation was not specifically included.

The resultant aggregate demands used for the evacuation time estimate analysis also did not consider the extent of double-counting between the various components. That is, it is logical to assume that a portion of the Route 1 shoppers are also permanent residents and that a portion of the beach-goers are either permanent or seasonal residents. Accordingly, although the exact extent of double-counting inherent in the methodology used to develop the evacuation time estimates has not been established, it is reasonable to conclude that the total population and vehicle demand estimates used for the analysis are conservative.

It is important to point out that the entire network capacity was not utilized in the Applicants' evacuation time estimate analysis. Only those roadways and directions of travel which were considered appropriate for a general "radial dispertion" evacuation were utilized. For instance, for the four major roadways providing access to and from the beach area (Exeter Hampton Expressway, and Route 1A in Hampton, Route 286 in Seabrook and Route 1A in Salisbury) the inbound lanes (i.e., those providing access to the beach areas) were assumed to be open, but were not utilized for evacuationg vehicles. In addition, normal traffic control was assumed at all intersection locations, such that, for instance, inbound flow could occur along the roadways providing access to the beach area without significantly affecting the flow of vehicles as simulated for the Seabrook analysis.

For these reasons, and as stated above, it is our professional opinion that, while no separate item for non-evacuationg traffic was modelled, our analytical methodology sufficiently accommodates any effect on overall clear times that any such traffic might have.

Response to A.11

The matter of planning arrangements for evacuation of transport-dependent populations within the EPZ is currently being addressed. As State and local emergency planning considerations specific to the Seabrook Station area are developed, arrangements for the transport-dependent population will be specified. These matters can be handled independently from the issue of evacuation of the general populace. In recognition of the need to permit evacuation of a transport-dependent segment of the population, Applicants' analysis did not utilize inbound lanes for evacuation traffic but left these lanes available for emergency vehicles and other vehicles (e.g., school buses) which might require access to the EPZ during the course of the evacuation to pick up people who require transportation.

Response to A.12.1

In addition to the evacuation analyses for Seabrook Station conducted by HMM Associates, there have been four independent estimates prepared. These are:

(1) "Roadway Network and Evacuation Study," Wilbur Smith and Associates, December, 1974.

(2) "Seabrook Station Evacuation Analysis, Final Report," prepared for FEMA by Alan M. Voorhees Associates, August, 1980.

(3) "An Independent Assessment of Evacuation Times Estimates for a Peak Population Scenario in the Emergency Planning Zone of the Seabrook Nuclear Power Station," NUREG/CR-2903, PNL-4290, November, 1982.

(4) "Emergency Planning Zone Evacuation Clear Time Estimates, Seabrook Nuclear Power Station," prepared for the New Hampshire Civil Defense Agency by C.E. Maguire, Inc., February, 1983, Draft.

The 1974 Wilbur Smith and Associates Report estimated an evacuation time of 6 hours 50 minutes for simultaneous evacuation of the Seabrook EPZ under a peak population condition. This first report is considered somewhat outdated at this time. The Alan M. Voorhees Report, conducted for FEMA in 1980, presented an estimate of 6 hours 10 minutes for evacuation of a peak population within the EPZ. This latter report did state that:

> "An ineffective evacuation, with resources not properly mobilized and with uncontrolled traffic flow, will require from 10 hours 30 minutes to 14 hours 40 minutes for completion."

The development of the Voorhees evacuation time estimate of up to 14 hours 40 minutes was based on the application of capacity loss factors reported in Highway Research Record No. 349. The reference cited was reviewed to determine the appropriateness of the application. This article focused on quantifying the frequency of vehicle incidents (disabled vehicles) along freeways and the magnitude of motorist delay created from them. Although the article does document potential reductions in freeway capacity which may be expected from vehicular incidents (or accidents) along freeways, it is in our judgment questionable whether this relationship can be related to a "disregard of normal traffic control devices" as applied in the Voorhees Report. From our research, documentation of causal relationships and statistical probabilities of occurrence of traffic flow "behavioral" problems is limited. Based upon a review of the documentation used to generate the 10 hours 30 minutes to 14 hours 40 minutes presented in the Voorhees Report for evacuation of the Seabrook Station EPZ under a condition in which traffic control is generally ineffective, it is our opinion that these estimates are unrealistic.

An independent evacuation time estimate report for the Seabrook Station EPZ was prepared for the USNRC in November 1982. That report used a computer simulation model, CLEAR,[7] to estimate the evacuation clear times for a peak population scenario in Seabrook Station EPZ, and reported evacuation times of up to 11 hours, 40

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[7] CLEAR (Calculate Logical Evacuation and Response): A Generic Transportation Network Model for the Calculation of Evacuation Time Estimates, NUREG/CR-2504 PNL-3770, Prepared for USNRC by Texas Transportation Institute and Pacific Northwest Laboratory, March, 1982.

minutes. In our opinion, the higher time estimates produced by the CLEAR model would be expected for such a methodology utilizing fixed, and limited, evacuation routing. That is, application of the CLEAR model assumes complete knowledge of, and conformity to, pre-selected evacuation routings for all evacuees. The model is static and does not permit utilization of alternative routings if severe traffic congestion were to occur during the evacuation. Accordingly, the time estimates produced by the CLEAR Model are most sensitive to these identified routings, and imply a significant extent of forced evacuation routing and traffic control management. For these reasons, the evacuation time estimates developed by use of the CLEAR model would be expected to produce unrealistically conservative estimates of the time required to evacuate the Seabrook Station EPZ. They do not, in our judgment, model a real-life situation as accurately as does NETVAC.

The most recent evacuation time estimate analysis was conducted for the New Hampshire Civil Defense Agency by C.E. Maguire Inc. A 1985 peak summer weekend, full EPZ evacuation time estimate of 5 hours 50 minutes was developed as part of the Maguire study.

Each of the above-referenced estimates were for evacuation of the entire Seabrook Station plume-exposure EPZ. For each of the studies the defined EPZ was roughly comparable. Independently developed vehicle demand estimates, evacuation assumptions, and methodologies, however, varied for each study.

As noted by Mr. Herr, off-season weekday, adverse weather, 10-mile evacuation estimates developed by C.E. Maguire were 5 hours 30 minutes, versus estimates of 4 hours 30 minutes by the Applicants. What Mr. Herr failed to acknowledge is the fact that the Maguire report assumed a conservative estimate for reduction in capacity of 50% for the off-season weekday, adverse weather condition (for a winter snow storm condition). There was no referenced source for use of this factor presented in the Maguire report. The Applicants' estimate used a roadway capacity reduction of 30%, based upon literature search of relevant empirical data (refer to Response to A.04.1). Consequently, given the difference in assumptions regarding capacity reduction, it should come as no surprise that the Maguire estimate is higher.

Mr. Herr also makes reference to differences between the Applicants' and Maguire estimates for the 90° southwest quadrant, summer weekend, good weather condition. The primary reason for differences in the southwest analysis cases is due to differences in definition of the analysis area. Table 1 summarizes the area definitions for the Applicants and Maguire 90° southwest cases. The Applicants' analysis considered two 90° south cases (southeast and southwest), whereas the Maguire analysis only considered one (90° southwest). The Maguire analysis incorporated a significantly larger area for their 90° southwest evacuation case than did the Applicants. As indicated in Table 1, the Applicants' 0-10 mile 90° southwest quadrant analysis case incorporated a portion of the Town of Seabrook, whereas the Maguire analysis included the entire Town; portions of Hampton Falls and Hampton were included in the Maguire analysis for this case, but excluded from the Applicants' analysis (Note: Hampton and Hampton Falls were included in the

Applicants' 90° northeast and northwest analysis cases); the entire Towns of Amesbury, Merrimac and West Newbury were included in both the Applicants' and Maguire analysis cases; a portion of the Town of Salisbury was included in the Applicants' analysis for this case, whereas the Maguire analysis incorporated the entire Town; the entire Town of South Hampton was included in the Applicants' analysis for this case, but excluded from the Maguire analysis (Note: the Maguire analysis incorporated the Town of South Hampton in their 90° northwest case); the entire Towns of Newbury and Newburyport were included in the Maguire analysis for the 90° southwest case, whereas the Applicants' analysis incorporated these towns in their 90° southeast case. Consequently, given the significant differences in geographic area for the 90° southwest analysis case, it is obvious that the Maguire and the Applicants' estimates for this case are not comparable. On the other hand, a comparison of Applicants' and Maguire's estimates for comparable areas shows that the estimates are quite consistent.

The bounds on the error associated with the Applicants' evacuation time estimates are believed to be small, based on the work done on validating the NETVAC model. In other words, for the situations which have been modelled, the estimates are

TABLE 1

90° Southwest Quadrant Summer Weekend, Fair Weather

Evacuation Time Estimates (Hours: Minutes)

		0-5 Miles	0-10 Miles
Applicant	=	3:40	3:45
Maguire	=	5:30	5:40

0-5 Miles 90° Southwest Quadrant Areas

Applicant	Maguire
Seabrook: portion	Seabrook: all
-	Hampton Falls: portion
-	Hampton: portion
Amesbury: all	Amesbury: all
Salisbury: portion	Salisbury: all
South Hampton: all	-

0-10 Mile 90° Southwest Quadrant Areas

Applicant	Maguire
Seabrook: portion	Seabrook: all
-	Hampton Falls: portion
-	Hampton: portion
Amesbury: all	Amesbury: all
Salisbury: portion	Salisbury: all
South Hampton: all	-
Merrimac: all	Merrimac: all
-	Newbury: all
-	Newbury: all
West Newbury: all	West Newbury: all
Newton: portion	

believed to be as reliable as can be made at this time. Applicants strongly disagree with Mr. Herr's contention that "The confidence limits of the Applicants' evacuation time estimates are unstated, but clearly are too wide for those estimates to be of operational utility." On the contrary, the methodology applied in Applicants' analysis provides planners with highly detailed information regarding the dynamics of various evacuation scenarios. This results in an ability to anticipate the locations of friction points and assign available traffic control personnel to those locations where they will do the most good.

Rebuttal to the Testimony of Mr. Shaheen

Mr. Shaheen's testimony implies that nighttime, particularly on Fridays and Saturdays, represents the peak population condition in the Salisbury beach area. Applicants do not necessarily disagree with the point that the amusement park area is crowded on Friday and Saturday nights.

However, the Applicants believe that the perception of crowds may be more pronounced during evening hours complared to the daytime because the daytime crowds are more widely dispersed. During fair weather daylight hours, a substantial number of people are on the beach, as compared with the concentration of people at the amusement park area during the evening hours.

While the parking lots in the amusement park area may be filled during the evening hours, this situation is no different from the condition assumed in Applicants' evacuation times analyses. In fact, the nighttime occupancy is likely to be smaller due substantially to the fact the parking lot at Salisbury Beach State Park (with a capacity of approximately 2,000 vehicles) is too far away from the amusement area to be used for extensive nighttime parking. Furthermore, this lot is closed after 8 p.m., which limits its use. Although four summers of aerial photo-reconnaissance indicate that this lot never fills up and is rarely more than half full, Applicants' analyses assume that this lot, as well as all other parking lots, is filled to capacity at the initiation of the evacuation.

The bumper-to-bumper traffic until 11:00 p.m. leaving the beach on Fridays and Saturdays as noted by Mr. Shaheen is consistent with data developed from the Applicants' evacuation traffic flow simulation, which indicates that subsequent to the initiation of the evacuation, queueing and significant vehicle delays would be prevalent along Route 1A from the Amusement Park area to the Salisbury Beach State Park for a period of up to three hours. Additionally, traffic count data recorded during the summer of 1982[8] do

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[8]HMM Associates, "Beach Area Traffic Count Program: Seabrook Station EPZ," December 1982.

indicate signficant traffic volumes along Route 1A westbound during weekend nighttime periods. These data also show that although congestion is prevalent during these weekend nighttime periods along this corridor, vehicles do progress along Route 1A at rates which are consistent with roadway capacity and operational relationships used for the Applicants' simulated evacuation analyses.

Rebuttal to the Testimony of Chief Mark

This rebuttal is keyed to the numbered answers in Chief Mark's testimony.

Response to No. 4

Chief Mark states: "There are definitely more people coming to the beach now than in 1978. The traffic is considerably heavier now than it was then." Applicants have two sources of quantitative data that are at odds with Chief Mark's perceptions about the magnitude of traffic in the area.

The first is traffic data recorded by the State of New Hampshire. As stated in Applicants report on beach area traffic,[9] data from two state-operated automatic traffic recorders were reviewed in addition to data collected for Applicants' 1982 summer program. Data from the two state-operated recorders were obtained for the summers of 1979, 1980, 1981 and 1982. As we stated in that Report:

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[9]HMM Associates, "Beach Area Traffic Count Program: Seabrook Station EPZ," December 1982.

"Historic traffic volume data along Route 1A in Hampton (N.H. State Traffic Count Station No. 34502) and along the Hampton Harbor Bridge (N.H. State Traffic Count Station No. 19702), obtained from the State of New Hamsphire Department of Public Works and Highways, were reviewed in an attempt to identify any trends in beach area traffic volume levels from 1979 to 1982. Table 2.4 [reproduced following this quotation] present average weekday and weekend data for the months of June, July, August, and Septembr for these four years.

"A review of these data indicates that, for the four-month period, 1980 traffic volume levels were higher than 1979 levels along Route 1A in Hampton, for both average weekday and weekend period. Average weekeday levels in 1981 were higher than 1980 volumes at this location. However, 1981 average weekend levels were slightly lower than 1980 flows. At the Hampton Harbor Bridge, 1980 traffic flows were less than 1% different from 1979 flows for the four-month period, for both average weekdays and average weekends. However, 1981 traffic vlumes along this brdidge dropped by over 4% from 1980 levels.

"For the four month period there was a decrease of 4.4% in traffic volume levels along Route 1A in Hampton from 1981 to 1982 for average weekday periods. An increase of 4% was observed from 1981 to 1982 for average weekends at this location. Differences in aveage weekday and average weekend periods from 1981 to 1982 were +4.2% and -3.8%, respectively, along the Hampton Harbor Bridge."

TABLE 2.4 - HISTORIC TRAFFIC VOLUME DATA*

Location	Month	1979 AWD Volume	1979 AWE Volume	1980 Avg. Weekday Volume	1980 Avg. Weekday % Change from 1979	1980 Avg. Weekend Volume	1980 Avg. Weekend % Change from 1979	1981 Avg. Weekday Volume	1981 Avg. Weekday % Change from 1980	1981 Avg. Weekend Volume	1981 Avg. Weekend % Change from 1980	1982 Avg. Weekday Volume	1982 Avg. Weekday % Change from 1981	1982 Avg. Weekend Volume	1982 Avg. Weekend % Change from 1981
North Hampton, Route 1A, #34502	June	4,711	8,041	4,698	-0.3%	8,162	+1.5%	5,173	+10.1%	8,852	+8.5%	4,757	- 8.0%	7,146	-19.3%
	July	6,652	9,112	7,158	+7.6%	10,242	+12.4%	7,437	+3.9%	9,110	-11.1%	7,549	+ 1,5%	11,191	+22.8%
	August	6,282	8,101	6,634	+5.6%	9,619	+18.7%	6,702	+1.0%	9,147	-4.9%	6,536	- 2.5%	9,864	+ 7.8%
	September	3,540	6,214	3,532	-0.2%	5,940	-4.4%	3,540	+0.2%	6,622	+11.5%	3,014	-14.9%	6,878	+ 3.9%
	Total	21,185	31,468	22,022	+4.0%	33,963	+7.9%	22,852	+3.8%	33,731	-0.7%	21,856	- 4.4%	35,079	+ 4.0%
Hampton Harbor Bridge, #19702	June	11,659	21,677	10,932	-6.2%	19,965	-7.9%	9,173	-16.1%	18,929	-5.2%	10,736	+17.0%	15,577	-17.7%
	July	17,644	24,122	17,965	+1.8%	24,607	+2.0%	16,916	-5.8%	22,440	-8.8%	18,430	+ 8.9%	22,667	+ 1.0%
	August	14,671	20,123	15,474	+5.5%	22,073	+9.7%	14,785	-4.5%	19,710	-10.7%	13,838	- 6.4%	19,499	- 1.1%
	September	6,278	12,229	6,123	-2.5%	10,807	-11.6%	7,381	+20.5%	13,082	+21.1%	7,264	- 1.6%	13,572	+ 3.7%
	Total	50,252	78,151	50,494	+0.5%	77,452	-0.9%	48,255	-4.4%	74,161	-4.2%	50,268	+ 4.2%	71,315	- 3.8%

*Source: 1979, 1980, 1981, 1982 "Automatic Traffic Recorder Reports," State of New Hampshire Department of Public Works and Highways

(I need a clean master for this)

These data show that traffic volume varies up and down from year to year but a longer term trend isn't apparent. Although Applicants' have not attempted an analysis of the data to explain variations, we strongly suspect that general weather conditions are a major factor in traffic volume.

Additional data which indicate beach use trends are the results of aerial photo-reconnaissance which has been conducted for the summers of 1979, 1980, 1981 and 1982. The results of the analysis of the photographs dealing with parking lots are summarized in a report prepared for the Applicants.[10] Table 2.4 from that report (reproduced on the following page) presents data for the four summers. As indicated therein, the single peak day count on July 22, 1979 was the highest of the

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[10]HMM Associates, "1982 Aerial Phtographic Surveillance of the Beach Area Daily Transient Population: Seabrook Station EPZ," October 1982.

TABLE 2.4

BEACH AREA PARKING LOT CAPACITIES AND OBSERVED PEAKS

Sector	Estimated Total Parking Lot Capacity*	Observed Single Peak Day Count 7/22/79	8/10/80	6/28/81	7/5/82
ESE 1-2	317	289	192	195	227
E 1-2	2,551	1,914	1,299	1,687	1,649
ENE 1-2	2,502	2,283	2,123	2,243	2,289
SE 2-3	202	188	123	186	206
ENE 2-3	914	875	719	679	812
SSE 3-4	1,011	461	426	331	420
ENE 3-4	35	13	12	18	21
NE 3-4	614	547	501	570	576
SSE 4-5	1,614	1,207	1,306	710	1,018
NE 4-5	312	190	159	177	141
SSE 5-6	1,921	1,130	630	937	937
NE 5-6	151	151	122	151	120
SSE 6-7	425	389	337	565	338
SSE 7-8	599	396	301	381	448
NE 7-8	247	247	145	247	237
SSE 8-9	71	13	12	30	23
NE 8-9	409	248	254	261	304
0-10 Mile Total	13,895	10,541	8,661	9,368	9,766
NE 10-11	684	591	482	585	603
SSE 11-12	58	6	5	21	10
NE 11-12	127	93	68	108	78
SSE 12-13	30	16	11	11	17
NE 12-13	146	137	98	145	123
SSE 13-14	50	22	11	35	36
SSE 14-15	80	33	24	46	32
SSE 16-17	2,261	1,817	1,668	1,910	2,047
10+ Mile Total	3,436	2,715	2,367	2,861	2,946
GRAND TOTAL	17,331	13,256	11,028	12,229	12,712

Peak Day	% of Parking Lot Capacity* (0-10 miles)	(10+ miles)	Total
7/22/79	75.9%	79.0%	76.5%
8/10/80	62.3%	68.9%	63.6%
6/28/81	67.4%	83.3%	70.6%
7/5/82	70.3%	85.7%	73.3%

* Capacity includes marked and unmarked parking lot spaces. Leased spaces are included.

Therefore, while individuals may have perceptions of substantially increased use of the beach area, this impression is not supported by data collected by Applicants and by the State of New Hampshire.

Response to No. 5

Chief Mark states that, "On summer weekends, the Town's municipal lots are always packed full by 9:00 a.m. or 10:00 a.m. at the very latest." Our data suggests that this observation will not hold up when measured against the facts.

First of all, observations for the past several years indicate that the parking lots in the central section of Hampton Beach (the area from the Hampton-Exeter expressway south to the state park) tend to be more popular than lots in other areas. These lots also tend to be occupied earlier in the day than many others. However, Applicants' studies indicate that the time of peak attendance for the entire beach area occurs in the early afternoon, from about noon until 2:00 p.m.

In particular, three sets of aerial photographs were taken on July 31, 1983 at about 10:00 a.m., noon, and 4:00 p.m. Automobiles in eight parking lots in Hampton were counted from each set. The estimated capacity of the eight lots is 4603 vehicles. The results are show below:

Time	Total Vehicles	Fraction of Capacity
10:00 a.m.	1721	37%
Noon	3283	71%
4:00 p.m.	2400	52%

These July 31st results are consistent with prior observations both with regard to variation during the day and availability of some parking at all times.

Response to No. 7

The implication of Chief Mark's comments is that traffic is standing still for substantial periods of time. Results of the beach area traffic count program indicate that substanial numbers of cars are moving in the beach area throughout the day.

For example, one counter was located on Route 1A in Seabrook between the Hampton Harbor Bridge and Route 286 (Location No. 4 on Figure 1.1 in the report referenced in note 9, supra). The traffic volumes between 10:00 a.m. and 5:00 p.m. on July 5, 1982 are presented in the following table. This date was selected becasuse it represented the peak attendance at area parking lots for the summer of 1982. As indicated, although attendance at the beach area represented a peak condition for the summer of 1982, traffic does move throughout the day. On the assumption that traffic was congested during the entire period, the implied travel speed is at least 5 miles per hour. For comparison, during the most congested conditions simulated by the NETVAC computer model, a vehicle would require more than 40 minutes to travel a mile on Route 1A southbound between the Hampton Harbor Bridge and Route 286. The point is that slow movement of vehicles is anticipated during any evacuation under peak population conditions to an even grater extent than during bumper-to-bumper weekend traffic, and has been fully recognized in the Applicants' evacuation time estimates.

TRAFFIC DATA ON

ROUTE 1A IN SEABROOK ON JULY 5, 1982

Time Period	Vehicles Northbound	Vehicles Southbound	Total Vehicles
10-11:00 a.m.	916	533	1449
11-12:00 noon	982	571	1553
12-1:00 p.m.	930	790	1720
1-2:00 p.m.	874	1027	1901
2-3:00 p.m.	748	1290	2038
3-4:00 p.m.	666	1037	1703
4-5:00 p.m.	590	897	1487

On Sunday July 31, 1983, a time-of-travel study was conducted. Sunday July 31, 1983, was a sunny day with temperatures in the 80's; generally speaking, it was a good beach day. The study was undertaken to determine representative travel times to get into the beach areas during the morning and out of the areas during the 3-5:00 p.m. period indentified as the peak by Chief Mark. The study was performed by driving a vehicle at the rate of speed and in the general manner of the average driver along the prescribed routes. This is the so-called "floating technique."[11]

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[11] Pignataro, L.J., "Traffic Engineering," Prentice-Hall, 1973.

The results of the study are included on the following table. The outbound times are shorter than those predicted by the Applicants' evacuation time estimates for peak population conditions.

TIME OF TRAVEL STUDY

July 31, 1983

INBOUND

Route Description	Time Period	Elapsed Time (Minutes)	Average Travel Speed (mph)
Ocean Blvd (Rte 1A) in Hampton - from Route 101D to Hampton Beach State Park	10:15-10:29	14	21
Exeter-Hampton Expressway (Rte 51) in Hampton - from Route 101D to Hampton Beach State Park	9:00-9:13	13	35
Route 286 in Seabrook From I-95 at Rte 113 to Hampton Beach State Park	9:29-9:48 10:44-11:01	19 17	27 30
Route 110/Route 1A in Salisbury - from I-95 at Rte 113 to Hampton Beach State Park	10:30-10:49	19	31

OUTBOUND

Route Description	Time Period	Elapsed Time (Minutes)	Average Travel Speed (mph)
Ocean Blvd (Rte 1A) in Hampton - from Hampton Beach State Park to Route 101D	3:15-3:39	24	12
Exeter Hampton Expressway (Rte 51) in Hampton - from Hampton Beach State Park to Rte 101D	3:18-3:44	26	17
Route 286 in Seabrook from Hampton Beach State Park to I-95 at Route 113	3:58-4:36	38	14
Route 110/Route 1A in Salisbury - from Hampton Beach State Park to I-95 at Route 113	4:00-4:35	35	17

Response to No. 8

The characterization of the beach as being "saturated with traffic" is somewhat misleading. It is acknowledged that some traffic will move slowing during an evacuation. In fact, Applicants' analyses indicate that the "last" vehicle leaves the EPZ after 6 hours and 5 minutes. This hypothetical vehicle originated in the beach area and most of the time was spent waiting to enter the transportation network and in queues at various points along the way.

It is also acknowledged that accidents could result in delays. However, during an evacuation under peak population conditions, vehicles would be traveling at slow rates of speed, a few miles per hour on the most congested links in the road network. It does not seem likely that accidents under such conditions could be anything but "fender-benders." Traffic could be slowed by certainly not "indefinitely."

As far as accidents on the "Seabrook Bridge" (assumed to refer to the drawbridge across the Hampton Harbor inlet) are concerned, Applicants' analyses indicate that a sound traffic management principle for evacuation under peak conditions would be to block this bridge. This prevents traffic from the Seabrook and Hampton areas from interfering and actually speeds up the evacuation.

Although Applicants analyses do not presume that traffic controllers would be available, it does seem logical that at a peak condition, e.g., a Sunday afternoon, that several police officers would already be in the area. Therefore, it seems reasonable to assume that these police officers would help to assure and orderly traffic flow.

Response to No. 9

It is not clear that experience in prior evacuations is relevant to the situation of an evacuation as a result of an accident at Seabrook Station. For example, Applicants are not aware of the existence of a system which would provide prompt notification to the populace at the time these prior evacuations occurred. Such a prompt notificiation system will be in place before Seabrook Station is in operation. Similarly, a public information program is required to be conducted advising the public of actions which should be taken in case of an emergency at Seabrook Station. Applicants are not aware that any such programs are in place with regard to the other emergency situations such as those cited by Chief Mark.

The fact that it may take families some time to regroup after an evacuation advisory is given is not expected to affect overall evacuation times. Parking lots in the beach area take up to four hours to clear due to demand exceeding capacity of the transportation network. This should allow sufficient time for family groups to assemble. It also seems unlikely in view of the congestion that automobile travel would be the preferred method of assembling the family unit. A concerned parent should recognize that more time is likely to be lost if one tries to gather the group in the automobile.

Flooding is an issue which does not seem to be consistent with peak conditions. A flood would not be expected to occur without substantial warning. It is highly unlikely that a flood would occur during an evacuation under peak conditions.

CERTIFICATE OF SERVICE

I, Robert K. Gad III, one of the attorneys for the Applicants herein, hereby certify that on August 8, 1983, I made service of the within Applicants' Rebuttal Testimony No. 1 by mailing copies thereof, postage prepaid, to:

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