Testimony of Philip B. Herr

before the Atomic Safety and Licensing Board

in the matter of Public Service Company of New Hampshire, et al.,

(Seabrook Station, Units 1 and 2), Docket Nos. 50-443 OL and 50-444 OL.

RE: NECNP Contentions III.12 and III.13

July 15, 1983

Q.01 Please state your name, your position, and your business address.

A.01 My name is Philip B. Herr. I am the principal in Philip B. Herr & Associates and an Associate Professor in the Department of Urban Studies and Planning at M.I.T. The Herr Associates address is 261 Newbury St., Boston, MA., 02116. My M.I.T. address is Department of Urban Studies and Planning, room 10-485, M.I.T., Cambridge, MA. 02139.

Q.02 Please summarize your background as germane to this testimony.

A.02 A statement of my qualifications is attached to this testimony as Exhibit A. Recent relevant professional involvements in emergency planning have included serving on the Steering Committee for Radiological Emergency Response Planning for Suffolk County, N.Y., in relation to the Shoreham Nuclear Power Station. In that capacity I participated in the drafting of plans for evacuation and other emergency responses and the critique of such plans by others, and testified as an expert before the (New York) Governor's Shoreham Commission and before the Suffolk County legislature. Earlier I gave expert testimony before the Atomic Safety and Licensing Board in the construction permit proceeding for the proposed Pilgrim II Nuclear Power Station, in conjunction with which I prepared and analyzed evacuation time estimates for the area surrounding that station, and analyzed such estimates prepared by others.

Since 1944 I have lived no further than 60 miles from the Seabrook site, and have frequently visited that vicinity, especially the adjacent beach and recreational areas: as a day-trip transient, hotel patron, guest of cottage owners, nighttime amusement participant, and off-season beachwalker.

Q.03 Have you reviewed the Applicants' submitted time estimates in order to examine analyses of simultaneous evacuation of beaches both north and south of the Seabrook facility, and to examine analyses of effects of adverse weather in the summer?

A.03 Yes, I have reviewed the "Preliminary Evacuation Clear Time Estimates for Areas Near Seabrook Station" contained in Appendix C to the Applicants' Radiological Emergency Response Plan, (Reference 1). Finding no estimates for simultaneous beach evacuation or summer adverse weather in that material, I also reviewed other materials, including the following:

2. "Additional Evacuation Clear Time Estimates," submitted July 31, 1981 by John DeVincentis of PSNH to Mr. Robert L. Tedesco, USNRC.

3. "Emergency Planning Zone Evacuation Clear Time Estimates, Seabrook Nuclear Power Station," prepared by CE Maguire, Inc. for the New Hampshire Civil Defense Agency, February, 1983.

4. "Seabrook Station Evacuation Analysis, Final Report, Estimate of Evacuation Times," prepared by Alan M. Voorhees & Associates for FEMA, July 1980.

5. "An Independent Assessment of Evacuation Time Estimates for a Peak Population Scenario in the Emergency Planning Zone of the Seabrook Nuclear Power Station," NUREG/CR-2903, prepared by Pacific Northwest Laboratory for the USNRC, November, 1982.

6. "Review of Seabrook Station Evacuation Anaysis; Final Report," review of item 4 above prepared by HMM Associates for Yankee Atomic Electric Co., January, 1981.

Q.04 Why is it important to analyze summer adverse weather conditions?

A.04 NUREG-0654 calls for such analysis (at IV-A, pg 4-6). In the Seabrook case it is possible that the greatest threat to safety could come in the summer when the summer-swollen number of nearby people can be coupled with adverse weather, such as fog or a sudden thunderstorm. Fog and rain reduce travel speeds and road capacity through reducin visibility and reducing braking effectiveness, as has been documented in many studies*. That literature makes clear that different storm severities have a range of effects, from complete immobilization in the worst fog to the 15-25% capacity reduction resulting from rain or fog of small severity. Those capacity reductions in turn lengthen the time required for evacuation of areas such as the beaches.

Peak numbers of persons and adverse weather aren't at all mutually exclusive. Coastal fog is quite common, resulting when winds are onshore on a hot humid day. On such days people considering day trips have no way of knowing that the beach will be in fog since only a few miles inland it is clear, and often the foggy weather is warm enough that people remain on the beach hoping the fog will burn off, as it often does. Exactly those conditions were observed by me to have prevailed on the Sunday of the 1983 Fourth of July weekend along the entire beach zone from Portsmouth to the Merrimack River: beaches, parking lots, and streets full, but my vehicle and others moving slowly through fog with headlights on.

In my experience sudden rainstorms along this coast are also not uncommon, and if quickly developing can occur before beach patrons leave. My family and I have experienced exactly that at Salisbury Beach. Sudden rain or thunderstorms have an even more ominous potential than fog. The loss of power which sometimes accompanies such storms exacerbates the weather limitations on evacuation by disabling any notification, communications, or traffic control systems which are dependent upon areawide power.

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* See, for example, E. Roy Jones <u>et al.</u>, "The Environmental Influence of Rain on Freeway Capacity," <u>Highway Research Record</u> #321, 1970, Highway Research Board.

That combination of peak population and weather- and power-loss -limited evacuation capability is more serious where loss of off-site power is a signifigant contributor to the probability of a core melt accident, and Seabrook evidently is such a case. Applicants treat loss of off-site power as a potential initiating event of a core-melt accident. (See Chapter 7 of the ER-OLS, particularly pp 7.3-1, 7.3-8, and 7.3-13).

In fact, preliminary results of a probablistic risk assessment commissioned by the Applicants indicate that loss of off-site power is the highest ranked contributor to risk of death or injury from an accident at the Seabrook plant. See Pickard, Lowe, and Garrick, Inc., "Seabrook Station Probabilistic Safety Assessment, Phase 1, Preliminary Risk Model Development," (PLG-0242), pp 34-36, 176, & 178. Table 1-5 in that reference, while preliminary, provides a sense of the scale of significance of power loss. Pickard, Lowe and Garrick estimate that loss of off-site power is an initiating event with frequency of $3.5 \times 10^{-3}$ per plant year, while <u>all</u> core melts together are estimated to have a frequency of $4.4 \times 10^{-3}$ per plant year, indicating that loss of off-site power is an initiator in 80% of all cases of core melt.

Based on those estimates, 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. The circumstances where off-site power <u>would</u> be available, given core melt, would be in the 20% of cases where loss of power is not an initiating event plus the fraction of cases where loss of power to the plant does not affect the vicinity.

A frequent cause of loss of electric power is the wind accompanying adverse weather. Because of that link, in a large fraction of the cases where loss of off-site power is an initiator of core melt it can be anticipated that adverse weather will prevail.

We are not dealing with core melt, loss of power for emergency response, and adverse weather as three independent low-probability events. Their joint probability is <u>not</u> the product of their individual probabilities, and thus negligibly small. We are dealing with three <u>related</u> events having powerful causal links. Clearly, there is a very strong likelihood that adverse weather and power loss will prevail in the event of a core melt accident, gravely handicapping emergency response.

The summer/adverse weather concern is compounded by the rapid deposition of radioactive materials which takes place under rain or fog conditions, as acknowledged by the Applicants in the ER-OLS (see pg. 7.4-3) and the NRC Staff in the FES (see pg. 5-39). The resulting elevated dose levels make rapid emergency response more important exactly when the capability for notifying or evacuating people has a high probability of being impaired by power loss and adverse weather.

Flooding, suggested as a potential adversity for examination by NUREG-0654 (at 4-6), is a critical contingency at Seabrook. Hampton Beach, Seabrook Beach, and Salisbury Beach are all developed on barrier beaches separated from the mainland, except at the north of Hampton Beach, by either rivers or wide marshes. Only four roads, three on fill just higher than marsh level, provide connections between those three beaches and the mainland (see Exhibit 1). Evacuation time estimates, to be useful tools for emergency planners and protective action decision-makers, must consider the possibility that one or all of those roads could be flooded when evacuation is being attempted. Again there is a continuum of possible effects on travel and thus on evacuation time, ranging from small reductions in speed as a result of casual water on the road to complete interdiction when water depths make the road impassable.

Severe flooding in coastal New England has always been accompanied by severe winds and rain, in fact, sometimes by hurricanes, gales, or blizzards. Hurricanes, gales, or even strong winds greatly increase the likelihood of area power loss; so power loss is an expectable accompaniment to severe flooding. As discussed earlier, this causes flooding to have a higher probability of prevailing given a core melt accident than it otherwise would because of the causal links among flooding, high winds, power loss, and accident initiation.

In short, adverse summer weather is a <u>very</u> serious consideration, and demands careful study.

Q.05 Did you find that the Applicants have adequately considered the contingency of summer adverse weather?

A.05 None of the materials submitted by the Applicants examine the combination of summer population and adverse weather. Neither the August 4, 1980 set of ten scenarios (Reference 1) nor the July 31, 1981 set of seventeen scenarios (Reference 2) examine summer adverse weather. There is <u>no</u> analysis of flooding in any of those materials, regardless of season.

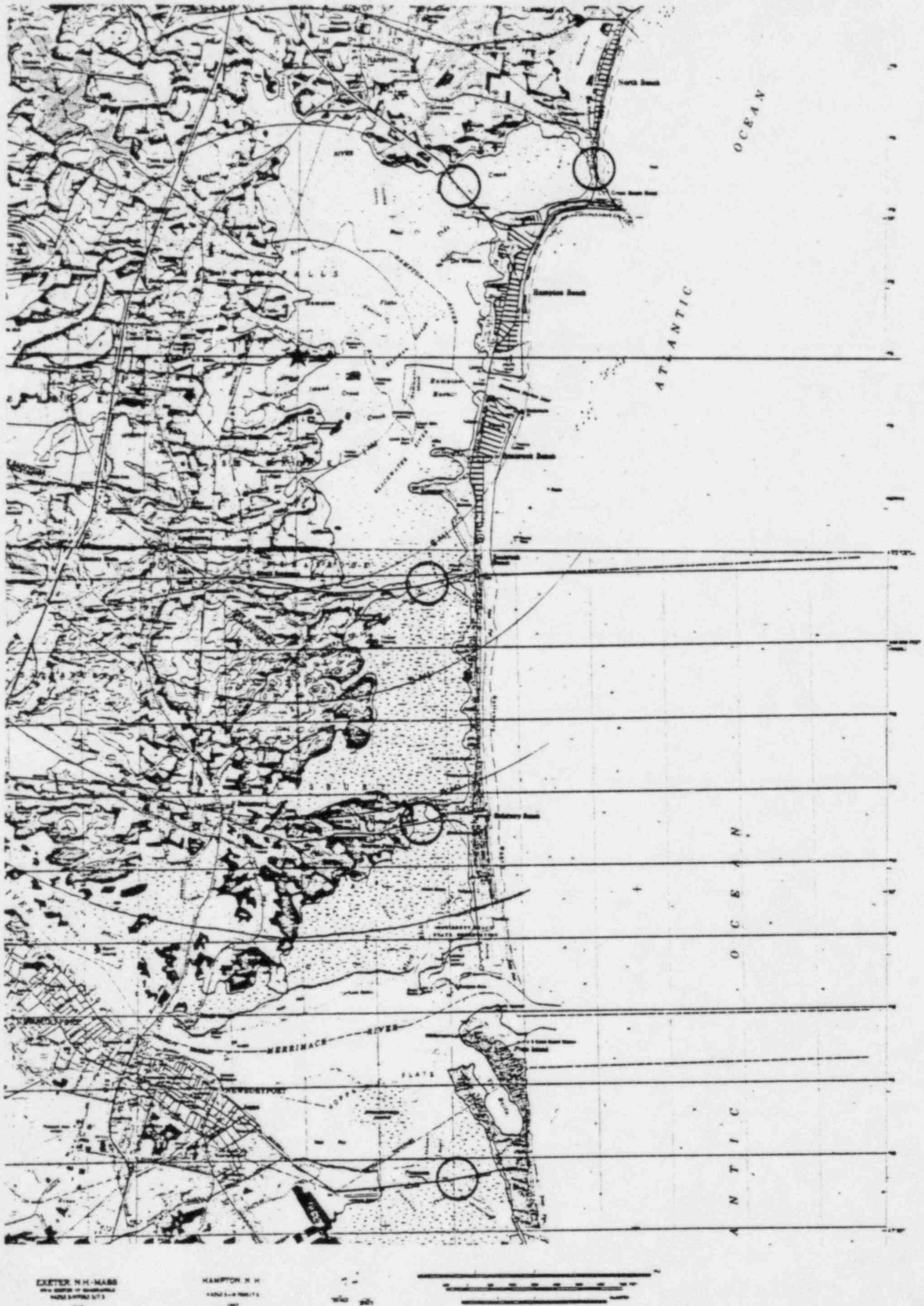
Q.06 Why are simultaneous beach evacuation estimates important?

A.06 Given the configuration of the Seabrook vicinity, a protective action order is quite likely to include beaches both north and south of Seabrook, regardless of projected wind direction. A "keyhole" area for emergency response action can be expected (as illustrated at NUREG-0396, page 12). If the central circle of such a keyhole is two miles in radius, it encompasses most of Hampton Beach to the north and Seabrook Beach to the south. At five miles it encompasses all of Hampton's and Seabrook's beaches, and all except the State Reservation at Salisbury.

In planning for or deciding upon the appropriateness and content of a protective action order it is important to have reliable estimates of the time required for evacuation of that central circle.

Exhibit 1

EGRESS CORRIDORS: BEACHES NEAR SEABROOK




Base map from USGS. Plant location and distances, critical egress points, and shoreline enhancement by Philip B. Herr & Associates

◯ Critical egress location

Q.07 Did you find estimates for simultaneous beach evacuation in the documents you reviewed?

A.07 The August 4, 1980 estimates (Reference 1), the only ones formally under consideration, include ten scenarios, none involving both north and south beaches. The July 31, 1981 submittal (Reference 2) includes time estimates for 360° evacuations for both two miles and five miles on both peak summer weekend and peak summer weekday, assuming normal weather conditions. However, before those estimates could be relied upon for planning or management, a number of serious deficiencies in them must be resolved.

1. The demand forecast from transient population is understated by a margin so wide as to render the estimates unreliable.

2. The characteristics of the road network in the beach area make movement singularly vulnerable to the consequences of accidents and breakdowns, yet no analysis of the time effects of such incidents has been made.

3. The estimates fail to reflect the travel impedance in the beach area resulting from non-evacuating traffic, such as persons returning to homes within the EPZ, milling about, or passing through the area.

4. There is no substantial analysis provided of the methods or time demands for evacuating the transit-dependent population, including beach visitors.

5. As evidenced as recently as this Fourth of July weekend, the beach areas are peculiarly subject to weather limitations to mobility even at times when the larger region is generally clear. Yet, as earlier testified, no analysis of the effects of adverse weather on beach evacuation has been provided by the Applicants.

6. The wide variances in evacuation time estimates as developed by the Applicants and by others, including consultants to the NRC and the New Hampshire Civil Defense Agency, give evidence that the predictive ability of the Applicants' simulations is too poor to be relied upon as a planning and management aid.

Q.08 Please expand upon your findings regarding the demand forecast.

A.08 The Applicants' estimate of transient demand is deficient. I totalled the Applicants' estimates of 1983 transient vehicle demand for the central two-mile ring plus beach areas within 5 miles relying on Figure 14 in Reference 1 (all segments 0-2 miles plus NE to SSE 2-5 miles).* We compared that figure with the estimates developed for the New Hampshire Civil Defense Agency (Figure 3.9 in Reference 3) and the estimates developed by the NRC staff (table 43 in Michael Kaltman, Siting Analysis Branch, "Demographic and Vehicular Demand Estimates for an Evacuation Analysis of the Seabrook Station," February, 1982, hereafter Reference 7). These are the results:

Applicants: 30,199 vehicles

State CD: 32,531 vehicles

NRC: 34,572 vehicles

The disparity between Applicants' and NRC demand estimates, 15% in this case, is reflected in important differences in evacuation time estimates. Pacific Northwest Laboratory found that use of the NRC staff's rather than Applicants' demography while keeping everything else constant produced differences in ten-mile 360° evacuation times for various sectors ranging from 5 minutes less time to 90 minutes more time (Reference 5, page 18, table 7). That is a very large difference for such a critical consideration.

The NRC staff analysis of demand is clearly the most thorough of those made, yet it results in low estimates for a number of reasons.

1. One component of seasonal population is omitted altogether: increased summer occupancy in year-round occupied dwellings. Such increased occupancy results from two phenomena: winter occupants are displaced by higher-paying summer occupants whose numbers are systematically larger than those they displace, and summertime guests for overnight or longer are accommodated by occupants of year-round dwellings. Having been a guest for several weeks in a year-round occupied beachfront home, I have personal knowledge of this phenomenon. A recent survey of seasonal areas on Cape Cod revealed an increase in year-round occupied dwelling occupancy rates from April to August averaging one additional person per year-round occupied dwelling unit.** The Applicants estimate 4,200 year-round households within the area described above. At

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*We have concern over reliance on Figure 14 as the basis for the calculated time estimates since there is clearly an error and we don't know where if ever it was corrected. Note, for example, that Figure B-3 shows 982 spaces in parking lots 3-4 miles NNE of the plant, but Figure 14 reveals only 68 vehicles transient demand from that same area. We have assumed that Figure B-3 is rotated one sector, and that entries for NNE are really meant to be NE, but we cannot be certain. That error may or may not have been reflected in the Applicants' analyses.

**Herr Associates, "Occupancy Survey Results," for APCC, Rev. 10/13/82, attached hereto as Exhibit B.

the Cape Cod experience rate, increased summer occupancy of these units adds 4,000 persons and a substantial number of vehicle trips in an evacuation, perhaps exceeding 2,000, depending upon how many guests utilize their own vehicles.

2. The related but different phenomenon of transient parking at year-round occupied dwellings is underestimated. I have been a day-guest at a home at Seabrook Beach (which is south of Hampton Harbor), parked in their sandy yard, and walked to the beach. That is commonplace in this area, but the staff excludes all such parking south of Hampton Harbor (see Reference 7, Figure 30) because lots are said to be too small. That error clearly understates the number of persons and, more importantly, the number of independent vehicles, at the beach.

3. The premise that the 1978 and 1979 parking lot capacity remains unchanged to 1985 is mistaken. NRC staff accepts the Applicants' parking lot and on-street spaces estimates (Reference 7, pg 18), which are based on 1978 and 1979 surveys. In fact, parking lot capacity in the beach area has been substantially expanded since 1978. See Testimony of Robert Mark and Anthony Kuncho.

4. The Applicants, in determining transient population, assume that, except at Hampton Beach, the maximum walking distance to the beach is 600 feet. (See Reference 7 at pg 17). That assumption is unfounded. In touring the beach areas on July 3, 1983, I observed numerous persons apparently walking to and from cars substantially more than 600 feet from the beaches in all vicinities.

5. The staff's reliance on outdated pre-census estimates of seasonal housing and confusion over the term "seasonal" introduces a major source of potential error. NRC staff, like the Applicants, mistakenly equates the US Census category "seasonal dwelling" with "seasonally occupied dwelling." (See Reference 7, page 12.) It is probably true, as asserted, that the number of "seasonal dwellings" is declining if one uses a structural definition (lack of winterization), but that omits the US Census category "year-round, held for occasional use," which is an important and possibly growing component of the seasonal population bulge. In Newburyport, for example, the number of year-round units reported "held for occasional use" tripled between 1970 and 1980.

The above-cited deficiencies taken together could easily add another 10% or more to the staff estimate of vehicle demand*, perhaps bringing it close to 40,000 vehicles, or approximately one-third above the Applicants' estimate. Such a disparity is intolerably large.

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* Adding 2000 vehicles for non-seasonal home guests, 1000 additional day-trip vehicles parked at non-seasonal homes south of Hampton Harbor, 500 added parking lot spaces, 500 parked beyond 600 feet.

The Applicants attempt to substantiate their transient demand estimates through directional traffic counts (HMM Associates, "Beach Area Traffic Count Program: Seabrook Station EPZ," pp 3-4 to 3-7 hereafter Reference 8), suggesting that the excess of inbound versus outbound trips between midnight and the peak was an appropriate measure of transient parking. That ignores the reality of <u>this</u> beach area at midnight, when it is still very actively peopled with transients. In fact, using Applicants' figures, the <u>real</u> increase in transients was from 4:30 AM to 9:00 PM, some 7,500 vehicles increase, not 4,000. Furthermore, even at 4:30 A.M. there remain (or already are) transients partying or fishing, so the actual number of transients present at peak certainly exceeded 7,500. One <u>cannot</u> infer from that data that earlier transient estimates are conservatively high. Use of 4,000 from the traffic counts as an indicator of transient accumulation was a serious misuse of data.

Q.09 Please expand upon the question of accident and breakdown analysis.

A.09 The Applicants' analysis takes no account of accidents or breakdowns. See Reference 1, Appendix A. For the beach areas that is unjustifiable. Note on Exhibit 1 that the beaches are virtually an island, with only four connections to the mainland. Each of those connections has only one outbound lane, and in places each of those corridors lacks enough shoulder to accommodate a disabled vehicle. One accident or breakdown closing one lane decreases capacity of the network serving the beaches collectively by virtually 25%. The effects of that stoppage are not immediately removed upon removal of the obstructing vehicle. Published research indicates a "ripple effect" lasting as much as three hours.* Given 40,000 inner-zone vehicles evacuating for, say, two miles over such critical egress corridors, there is a probability of approximately one accident if the national urban average accident rate is doubled under such circumstances, as suggested by EPA for evacuation traffic deaths.** The incidence of stalled vehicles is similar to that of breakdowns, and the traffic-disabling effects of the two are similar.*** That means a likelihood of two disabling incidents in the critical corridors in an evacuation. Expectation of accidents in the critical corridors is consistent with area experience. See Testimony of Robert Mark and Anthony Kuncho. Time estimates which ignore those incidents are deceptive.

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*Goolsby, "Influence of Incidents on Freeway Quality of Service," <u>Highway Research Record</u>, No.349, Highway Research Board, 1971 and Transportation Research Board, <u>Transportation Research Circular</u>, No.212, January 1980, "C. Analysis of Breakdown Conditions," pp 256-258.

** Urban accident rate of 600 per 100 million vehicle-miles from Clarkson H. Oglesby, <u>Highway Engineering</u>, 3rd Ed., John Wiley & Sons, NY, 1975., pg 105. EPA "doubling" from Hans and Sell, "Evacuation Risks - An Evaluation," USEPA, June 1974, at pg. 18.

*** Goolsby, <u>loc.cit.</u>

Q.10 Please expand upon the question of non-evacuating traffic.

A.10 The Applicants err by assigning no demand for trips other than evacuation trips. Concurrent with people evacuating there will be demand for trips for other purposes: returning from work, assembling family members who may be scattered up and down the beach, getting equipment or supplies, and checking in with friends. Those "extra" trips have not been estimated, nor has there been an estimate of the degree to which they utilize network capacity which in this analysis is assumed to be available exclusively for evacuation.

Note that under normal summer conditions trips of the kind I am describing clog the street network, even at midday when there is little net inflow or outflow (see Reference 8, table 3.2). This evidences the substantial demands which such trips make upon capacity. The "clear network" assumption used by the Applicants is unrealistic for beach areas.

There is a special category of non-evacuating traffic at these beaches, that is the pedestrians returning to their cottages, hotels, houses, or cars. On a normal summer day, they occupy a major portion of street capacity near the beaches and under evacuation orders would certainly also do so. They not only cross roadways at intersections but they walk along the roadsides carrying bundles and children. Their effect on travel time should not be ignored.

Q.11 Please expand upon the question of transit-dependent population.

A.11 Applicants' submittals References 1 and 2 almost wholly ignore the time necessary to evacuate special facilities such as schools and those who have no cars. See Reference 1, page 13, and transmittal letter for Reference 2. At the beaches this could be the constraining time estimate, for the following reason.

A studies prepared for the New Hampshire Civil Defense Agency indicates that a substantial transit-dependent population exists in the beach areas. For example, within the 0-5 mile radius from NE to SSE a non-auto owning population of 1,131 persons is estimated (Reference 3, Figure 3.3). That same study indicates a need for twice as many buses for such evacuation as the total number of buses existing within the EPZ (Reference 3, page 68). That means a 50% shortfall even if <u>all</u> those buses and their drivers were willing to participate.

For the beaches, the issue is especially severe. For bus drivers to get to the beaches they must drive against evacuating traffic to a virtual "island" within sight of the presumptively threatening power station (unless, of course, it is foggy). Each trip will be slow, and either multiple trips will have to substitute for an adequate number of buses or buses must come from great distances. Evidence from a Suffolk County, L.I. survey indicates that volunteer bus drivers cannot be relied upon to always resolve conflicts between public and family responsibilities favoring the public*. Instead, in many cases they will attend to their families first before reporting for emergency duty, if they report at all, again considerably increasing the time which will elapse before they even reach the beach area residents and transients dependent on public transport.

Q.12 Please expand upon the variations in evacuation time estimates.

A.12 Comparisons among studies cause concern over the reliability of current understanding of evacuation phenomena. Unfortunately, there is only one full-beach estimate, that of the Applicants' in Reference 2. However, other comparisons between the Applicants' estimates and those of others are illustrative. Some results of the Maguire study closely parallel those submitted by the Applicants, despite different study years (1985 versus 1983). However, in crucial areas there are serious disparities between the studies. For example, both studies provide an off-season weekday adverse weather 10-mile evacuation estimate, 4 hours and 30 minutes by the Applicants (Reference 1, page 12) versus 5 hours and 30 minutes by Maguire (Reference 3, page 77), a 22% disparity. Disparities between the two studies could be expected to be (and are) greater among smaller-area estimates. For example, the 90° southwest quadrant summer weekend good weather estimate by Maguire is 5:30, (Reference 3, page 77) while the Applicants' submitted figure is 3:45 (Reference 1, following page 12), indicating a 47% disparity. The PNL study (Reference 5), on the other hand, prepared as an independent evaluation, indicates for that same quadrant and the same conditions an estimate of 10:25 (Reference 5, page 18, tree 7B), 180% above the Applicants' figure and 90% above the Maguire figure.

The confidence limits of the Applicants' evacuation time estimates are unstated, but clearly are too wide for those estimates to be of operational utility.

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* Social Data Analysts, Inc., "Responses of Emergency Personnel to a Possible Accident at the Shoreham Nuclear Power Plant," November, 1982.

EXHIBIT A

PHILIP B. HERR

## EDUCATION

Massachusetts Institute of Technology, Masters in City Planning, J.C. Nichols Fellowship.

Rensselaer Polytechnic Institute, Bachelor of Architecture, Tau Beta Pi, Sigma Xi honoraries, Thesis Prize.

## CURRENTLY

Associate Professor of City Planning, M.I.T., Department of Urban Studies and Planning. Courses and research in growth, land use, participation, coastal zone management, design, impact analysis.

Principal, Philip B. Herr and Associates, consultants in land use planning, development control, impact analysis, participatory design.

Registered Architect, Commonwealth of Massachusetts.

Member, American Planning Association, Urban Land Institute, Suffolk County (NY) Radiological Emergency Response Plan Steering Committee, Massachusetts Audubon Society Water Resources Advisory Committee.

## RESEARCH PARTICIPATION

Microcomputer Impact Estimation System, funded through both multiple private clients and M.I.T. Design of microcomputer software and procedures for impact assessment. Publication: forthcoming.

Development Impact Evaluation, funded by Massachusetts Department of Community Affairs, through Herr Associates, 1975-1976, and Rockefeller Foundation, through M.I.T. Design of methods for local analyses of development consequences. Publication: Evaluating Development Impact, M.I.T. Laboratory for Architecture and Planning, August, 1978.

Environmental Impact Assessment, funded by Rockefeller Foundation and others through M.I.T. Laboratory for Architecture and Planning, 1976-1978 (with Lawrence Susskind and others). Studies of institutional considerations in assessing comprehensive consequences of infrastructure systems design, case study of coastal zone management.

Maine Development Strategy, funded by Rockefeller Brothers Foundation and Maine Bureau of Public Lands, through M.I.T. Department of Urban Studies and Planning, 1974 (with Lloyd Rodwin and others). Design of an approach to utilization of state-owned lands through new organizational approaches. Publication: Economic Development and Resource Conservation: A Strategy for Maine.

RESEARCH PARTICIPATION (continued)

Cambridgeport/Ecologue, funded by U.S. Office of Education, Office of Environmental Education, and others, through M.I.T. Department of Urban Studies and Planning, 1969-1972 (with Stephen Carr and others). Development of innovative methods for enabling community residents to develop neighborhood plans. Publication: article in Progressive Architecture, December, 1976.

Mobility for the Poor, funded by U.S. Department of HUD, through the M.I.T.-Harvard Joint Center for Urban Studies, 1968-1970 (with Aaron Fleisher). Analysis of travel patterns and disabilities of the poor, and of possible remedies, based on survey data from Boston, Memphis, St. Louis, Milwaukee, and Baltimore.

CONSULTING

Participatory planning and design. Program design and technical assistance for a variety of communities and regional planning agencies, including a large number of Massachusetts towns; Hanover, New Hampshire; Anchorage, Alaska; and Cape Cod Planning and Economic Development Commission.

Innovative development control. Techniques designed have included incentive bonus systems (Bourne, MA and Anchorage, AK); growth timing (Bourne, Falmouth, Franklin, Greenfield, Sandwich); performance zoning (Clinton, Franklin County, Gay Head, Sandwich); transfer of development rights (TDR) (Sunderland); critical resource zoning (Sherborn, Sunderland); regional land use control (Franklin County, Martha's Vineyard Commission).

Other development control. Over twenty zoning bylaws and ordinances have been written and adopted, numerous other controls designed and adopted in more incremental fashion.

Impact analyses. Lebanon, N.H. airport and air industrial park (for FAA), Cape Cod National Seashore (for National Park Service, growth and open space acquisition (for Association for Preservation of Cape Cod), dog track (for Blackstone), PUD (for Natick), resort development (for Franklin County), nuclear power plant (for Franklin County).

Emergency planning. Involved at Montague, Pilgrim I, Pilgrim II, Seabrook, and Shoreham nuclear power stations. Flood hazard management strategies in numerous municipalities.

Regional efforts have included "208" Water Quality Management planning for Cape Cod, creation of a regional housing authority and regional building inspection system for Franklin County, model cluster zoning legislation for Cape Cod.

PUBLICATIONS

Book chapter, "Urban Revitalization" in John Mullins, ed., A Massachusetts Profile, Commonwealth Books, N.J., in press.

Book chapter, "Anticipating Citizen Response", in Keyes and Leaning, eds., Survival in the Nuclear Age: Crisis Relocation Reviewed, Ballinger Publishing Co., in press.

Descriptions of Herr's community work have appeared in Progressive Architecture, November and December, 1976; Journal of the American Institute of Planners, January 1975; The Land Use Controversy in Massachusetts (L. Susskind, Ed., 1975); Journal of Housing, May, 1980; Land Use Law & Zoning Digest, March, 1980; PAS Memo, March, 1980; Performance Standards: A Technique for Controlling Land Use, Oregon State University Extension Service; Farmland Preservation Survey, September 1982.

American Institute of Planners, Planners Notebook, October, 1973, "Performance Zoning: The Small Town of Gay Head, Massachusetts, Tries It", with Kevin Lynch.

Eno Foundation, Traffic Quarterly, April, 1962, "Timing of Highway Impact".

Small Towns Institute, Small Town, (forthcoming), "Small Town Emergency Response: Too Little, Too Late".

Urban Land Institute, Urban Land, February, 1960, "Regional Impact of Highways".

PREVIOUS EXPERIENCE

Chairman, Planning Subcommittee, Massachusetts Governor's Task Force on Coastal Resources. (Governor's appointee).

Member, Steering Committee, Massachusetts Coastal Zone Management Program.

Member, Revere Beach Design Review Board (appointed by Secretary of Environmental Affairs).

Director of Planning (subsequently, President), Economic Development Associates, Inc., Boston, MA.

Research Associate, Greater Boston Economic Study Committee.

Consulting Associate, Adams, Howard and Greeley, Cambridge, MA.

Planner, City of Berkeley, California.

Instructor, Boston University, Wentworth Institute, Boston Architectural Center.

Architectural draftsman/designer, George W.W. Brewster, Warren C. Obes, Boston, MA.

EXHIBIT B

**Philip B. Herr & Associates**

COMMUNITY AND REGIONAL PLANNING CONSULTANTS
261 NEWBURY STREET, BOSTON, MASSACHUSETTS 02116 PHONE: 617 536-5620

# O C C U P A N C Y  S U R V E Y  R E S U L T S

APCC Growth Study
October 1, 1982; Rev. 10/13/82

The seasonal cycles in Cape Cod's population dip lower in winter and are less elevated in summer than previously estimated, as revealed by a survey conducted this summer by the Association for the Preservation of Cape Cod (APCC).

Volunteers interviewed over 800 households in the first week of August, 200 by telephone, the others door-to-door. The surveys were taken in each town by volunteers from that town. The surveyors sought such information as how many people then occupied each housing unit, how many occupied it in other times of the year, and where summer occupants winter. The result is the most extensive information ever available on seasonal patterns of occupancy on Cape Cod, and quite possibly the most systematic such study ever carried out on that large a scale in <u>any</u> resort area, making the findings a valuable resource for other areas of the country as well.

Consistent with 1980 U.S. Census findings and subsequent trends, the survey indicates an April, 1982 Barnstable County population of just under 150,000 persons. The April population is normally used by analysts as the "year-round" or winter population, but the survey indicates that it is far from that. The February 1982 population was only about 133,000 persons, fully 10% below the April figure, reflecting population absent and dwellings vacant in the depths of winter but occupied at census time.

On the other hand, Cape Cod's 1982 peak summer population (including those in motels and campgrounds) is estimated at just over 390,000 persons, far under the 430,000 persons which would have been estimated using previous "standard" estimating techniques, such as those used in CCPEDC's benchmark 1976 study, <u>Development Projections for Cape Cod</u>*. Those earlier techniques failed to reflect the population added by "extra" guests in year-round occupied dwellings. However, as a result of using unrealistically high estimates of how many persons occupy the average summer home, that underestimate of summer population in year-round dwellings was more than offset.

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* By Philip B. Herr & Associates, April, 1976

In April, 1982, about 62,000 dwellings were occupied on Cape Cod, 62% of the 101,000 occupied in August. In February, under 55,000 dwellings were occupied, with April residents in many cases away wintering in Florida or other warmer areas. The number of persons per occupied dwelling unit is about the same in February and April, under 2.5 persons, but it jumps in August to 3.25 persons, reflecting both large numbers in summer homes (4 persons per unit) and the "extra" people in year-round units. In dwellings occupied all year-round, for example, the average number of inhabitants jumps from 2.4 persons in April to 2.85 persons in August, the result of house guests added to year-round households and year-round families moving out to make room for summer rentals to families larger, on average, than those moving aside for them.

The result of the survey is an estimate of summer-home population only two-thirds as large as that estimated on the basis of earlier judgements, plus a new appreciation of the importance of house-guests and other "extra" summer house occupants (27,000 persons in 1982, nearly equal to the winter population of the Cape's largest town, Barnstable), and documentation of the extent of annual population drop below the April census benchmark.

Where the Cape's summer residents winter also contained some surprises. Over half (52%) of the summer-only residents come from elsewhere in Massachusetts, predominantly from elsewhere in the southeast. The second-place winter-residence state is Florida (11%). Connecticut (9%), New York (7%), and New Jersey (6%) were the next most common winter states. Virtually all non-resident summer people were found to come from northeastern states.

Responses to questions about utilities indicated that about 75% of all dwelling units were served by public water, 25% by wells, with essentially no difference in that figure between seasonal and year-round units. Only 1% of the units had public sewerage, all others relying on on-site systems.

More than three-quarters of the units which are vacant except in summer were occupied at the time of the survey by their owners rather than by renters, a strikingly high figure which probably would have been lower had the survey been taken in July.

The survey was one part of an overall study of Cape Cod's growth and its environmental impacts being undertaken by APCC as a basis for designing environmental policy for the '80s. Survey design, tabulation, and analysis were done by Philip B. Herr & Associates of Boston, consultants to APCC for the growth study. Over the next year, these and other analyses will be used in formulating a strategy of actions for assuring balanced use of Cape Cod's resources.

The survey findings will immediately be useful in a number of ways. First, they will provide a better basis for understanding and projecting the Cape's population, leading to revised town-by-town population projections. Second, they will be useful for studies of water consumption, solid waste disposal, transportation, and other topics where the cyclical nature of the Cape's population is an important consideration.

Weather during the week of the survey was good, though earlier in the summer it was not. Weather was judged not to have impacted results. Economic conditions nationally were at that time difficult, which might have had these effects:

- a larger proportion of summer residents from nearby as opposed to distant winter homes,

- a smaller proportion of April households having wintered in the South,

- a higher vacancy rate (though no vacancy rate was measured, it was observed to be miniscule despite that, suggesting little impact), and

- a larger number of persons per dwelling unit in the summer, both for year-round and seasonal units, as a result of "doubling up". However, the observed number of persons per unit and overall number of persons is so markedly below earlier estimates that it is doubtful that this economic effect was large, if present at all.

Surveys in August rather than July unquestionably revealed more owners and fewer renters than would otherwise have been found.

DWELLING OCCUPANCY ANALYSIS
APCC Growth Study
September 30, 1982

| | Unit Occupancy | | | |
|---|---|---|---|---|
| | Summer only | Spring & Summer | Year-round | Total |
| **Estimated 1982 dwelling units, April** | | | | |
| Total | 37900 | 7800 | 54800 | 100500 |
| Seasonal area | 18950 | 2340 | 2740 | 24030 |
| Mixed area | 15160 | 1560 | 16440 | 33160 |
| Year-rd. area | 3790 | 3900 | 35620 | 43310 |
| **Surveys with complete data** | | | | |
| Seasonal area | 125 | 24 | 40 | 189 |
| Mixed area | 94 | 17 | 208 | 319 |
| Year-rd. area | 5 | 5 | 104 | 114 |
| Total | 224 | 46 | 352 | 622 |
| **Persons/dwelling unit, February, 1982** | | | | |
| Seasonal area | 0.00 | 0.00 | 2.39 | 0.27 |
| Mixed area | 0.00 | 0.00 | 2.57 | 1.27 |
| Year-rd. area | 0.00 | 0.00 | 2.38 | 1.95 |
| Total | 0.00 | 0.00 | 2.44 | 1.33 |
| **Persons/dwelling unit, April, 1982** | | | | |
| Seasonal area | 0.00 | 2.15 | 2.37 | 0.48 |
| Mixed area | 0.00 | 2.54 | 2.57 | 1.39 |
| Year-rd. area | 0.00 | 1.85 | 2.37 | 2.11 |
| Total | 0.00 | 2.08 | 2.43 | 1.48 |
| **Persons/dwelling unit, August** | | | | |
| Seasonal area | 4.07 | 2.92 | 3.32 | 3.87 |
| Mixed area | 4.05 | 3.27 | 3.27 | 3.63 |
| Year-rd. area | 2.88 | 2.06 | 2.61 | 2.59 |
| Total | 3.95 | 2.56 | 2.85 | 3.24 |

Percent occupancy, surveyed units

| | August | April | February |
|---|---|---|---|
| Seasonal area | 100 | 21 | 11 |
| Mixed area | 100 | 54 | 50 |
| Year-rd. area | 100 | 91 | 82 |
| Total | 100 | 62 | 55 |

| | Unit Occupancy | | | |
|---|---|---|---|---|
| | Summer only | Spring & Summer | Year-round | Total |
| **POPULATION IN HOUSING UNITS** | | | | |
| Total Persons, February, 1982 | | | | |
| Seasonal area | 0 | 0 | 6562 | 6562 |
| Mixed area | 0 | 0 | 42252 | 42252 |
| Year-rd. area | 0 | 0 | 84666 | 84666 |
| Total | 0 | 0 | 133479 | 133479 |
| Total Persons, April, 1982 | | | | |
| Seasonal area | 0 | 5021 | 6491 | 11512 |
| Mixed area | 0 | 3970 | 42170 | 46140 |
| Year-rd. area | 0 | 7231 | 84313 | 91544 |
| Total | 0 | 16222 | 132974 | 149196 |
| Total Persons, August, 1982 | | | | |
| Seasonal area | 77137 | 6829 | 9102 | 93068 |
| Mixed area | 61463 | 5104 | 53812 | 120378 |
| Year-rd. area | 10930 | 8034 | 93133 | 112097 |
| Total | 149530 | 19967 | 156046 | 325543 |

| POPULATION COMPONENTS, 1982 | Summer | Spring | Winter |
|---|---|---|---|
| Survey basis | | | |
| Total | 393000 | 149000 | 133000 |
| Year-rounders | 150000 | | |
| Summer homers | 151000 | | |
| Non-dwelling | 65000 | | |
| Extra guests | 27000 | | |
| Previous basis | | | |
| Total | 430000 | 149000 | 149000 |
| Year-rounders | 149000 | | |
| Summer homers | 216000 | | |
| Non-dwelling | 65000 | | |
| Extra guests | 0 | | |

| MONTHLY ESTIMATES 1982 Population in housing units | Number |
|---|---|
| January | 132700 |
| February | 132900 |
| March | 141100 |
| April | 149200 |
| May | 149500 |
| June | 238300 |
| July | 327500 |
| August | 328100 |
| September | 239700 |
| October | 151000 |
| November | 143300 |
| December | 135600 |

WINTER PLACE OF RESIDENCE
APCC Growth Study
September 20, 1982

| PLACE | HOUSEHOLDS Number | Percent |
|---|---|---|
| Massachusetts | 200 | 52 |
| Florida | 41 | 11 |
| Connecticut | 36 | 9 |
| New York | 28 | 7 |
| New Jersey | 21 | 6 |
| New Hampshire | 12 | 3 |
| Rhode Island | 10 | 3 |
| Pennsylvania | 6 | 2 |
| Canada | 5 | 1 |
| Ohio | 4 | 1 |
| Michigan | 3 | 1 |
| Vermont | 3 | 1 |
| Virginia | 3 | 1 |
| Arizona | 2 | 1 |
| California | 1 | 0 |
| Delaware | 1 | 0 |
| Illinois | 1 | 0 |
| Louisiana | 1 | 0 |
| Maine | 1 | 0 |
| New Mexico | 1 | 0 |
| Texas | 1 | 0 |
| TOTAL | 381 | 100 |

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