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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

Before Administrative Judges:
Ivan W. Smith, Chairman
Gustave A. Linenberger, Jr.
Dr. Jerry Harbour

In the Matter of PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE, ET AL. (Seabrook Station, Units 1 and 2	Docket Nos. 50-443-OL 50-444-OL (Off-site Emergency Planning Issues) May 19, 1988

MASSACHUSETTS ATTORNEY GENERAL JAMES M. SHANNON'S PROPOSED FINDINGS OF FACT AND RULINGS OF LAW

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6. EVACUATION TIME ESTIMATES AND TRAFFIC MANAGEMENT PLAN

6.1. Findings of Fact

A. Basic Principles

6.1.1. At the outset, the Board sets forth certain basic principles of emergency planning that arise out of the NRC regulations and case law and are applicable to the Board's assessment of the NHRERP's Evacuation Time Estimates ("ETEs") and traffic management plan.

6.1.2. Offsite emergency response plans must meet the sixteen standards set forth in 10 C.F.R. § 50.47(b). Long Island Lighting Company (Shoreham Nuclear Power Station, Unit 1), LBP-85-12, 21 NRC 644, 652 (1985).

6.1.3. But a finding of reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency goes beyond a checklist determination whether a plan meets the standards at 10 C.F.R.§ 50.47(b). Southern California Edison Company (San Onofre Nuclear Generating Station, Units 2 and 3), LBP-81-36, 14 NRC 691, 699 (1981).

6.1.4. One of the planning standards which must be met before offsite emergency plans can be approved is as follows:

> A range of protective actions have been developed for the plume exposure pathway for emergency workers and the public. Guidelines for the choice of protective actions during an emergency, consistent with Federal guidance, are developed and in place . . ..

10 C.F.R. 50.47(b)(10).

6.1.5. Pursuant to NUREG-0654, among the criteria that must be met in order to demonstrate the achievement of this planning standard is that there be: time estimates for evacuation of the various sectors of the EPZ and that these estimates be based on a dynamic analysis (time-motion study under various conditions), NUREG-0654 II.J.10.1; projected traffic capacities of evacuation routes under emergency conditions, NUREG-0654 II.J.10.i; a means of relocation, NUREG-0654 II.J.10.g; control of access to evacuated areas and organization responsibilities for such control, NUREG-0654 II.J.10.j; and identification of and means for dealing with potential impediments to use of evacuation routes, and contingency measures, NUREG-0654 II.J.10.k.

6.1.6. Appendix 4 of NUREG-0654 continse guidance for the preparation and presentation of an evacuation times assessment study. NUREG-0654, Appendix 4 at 4-1.

6.1.7. Other ASLB's have interpreted this guidance to indicate that the general criteria set forth in Appendix 4 of NUREG-0654 should be followed but local conditions that might affect the evacuation time estimates should also be taken into account. See, e.g., Metropolitan Edison Company (Three Mile Island Nuclear Station, Unit No. 1), LBP-81-59, 14 NRC 1211, 1579 (1981).

6.1.8. Evacuation Time Estimates ("ETEs") are "to be determined on a case-by-case basis upon a consideration of all relevant conditions prevailing on the specific locality."

Cincinnati Gas & Electric Company (Wm. H. Zimmer Nuclear Power Station, Unit No. 1), ALAB-727, 17 NRC 760, 770 (1983)(emphasis supplied).

6.1.9. The primary purpose for having evacuation time estimates is to assist responsible governmental officials in making informed decisions regarding what protective actions are appropriate in a given radiological emergency in order to maximize dose savings. See Cincinnati Gas & Electric Company (Wm. H. Zimmer Nuclear Power Station, Unit No. 1), ALAB-727, 17 NRC 760, 770-771 (1983). To make these decisions the government officials must have available to them evacuation time estimates that are realistic appraisals of the minimum period in which, in light of existing local conditions, evacuation could reasonably be accomplished. Id. The nearer to plant the area that might have to be evacuated, the greater the importance of accurate time estimates. Id.

6.1.10. Dr. Urbanik testified that "implicit in the guidance [of NUREG-0654] is considering all factors that reasonably impact evacuation time. *** It's intended to have you do the best possible job; so you should consider all things that . . . have a reasonable expectation of affecting the evacuation time." Tr. 7645 (Urbanik). He admitted that in the Shoreham proceeding he probably said: "Implicit in the guidance [NUREG-0654], however, is the need to consider all relevant factors on a site-specific basis, in order to derive reliable time estimates." Tr. 7652-7653. He said he does not dispute this statement or have any prblem with it now. Id.

B. Background

6.1.11. The Seabrook Station nuclear plant has been a subject of controversy for many reasons, and among the most controversial issues has been whether during the summer months, and especially when the beach areas adjacent to the plant are crowded the population in the beach areas can be evacuated safely and in a reasonable enough time to afford them adequate protection were a serious radiological emergency to occur.

6.1.12. The critical facts which have given rise to these evacuation concerns are set forth below. These facts are known to the Board from many sources including, inter alia, maps of the areas, the visits the members of the Board have made themselves to the beach area, the videotapes presented by Dr. Adler (Mass AG Ex. 9) and Mrs. Fallon (SAPL Ex. 7), and the descriptions of the beach area roads and traffic conditions presented during the hearings by Dr. Adler, Detective William Lally and Sergeant Victor DeMarco from the Town of Hampton, and Police Chief Edwin Olivera of Salisbury.

1. Description of the EPZ Beach Areas and Road Network in New Hampshire

6.1.13. First, there is the basic geography. Although Seabrook Station is commonly referred to as being located on the New Hampshire seacoast, in fact it is located on the western edge of a harbor which is protected from the Atlantic Ocean by a series of low-lying barrier beach islands. These islands are from 1/4 to 1/2 mile wide and run from Hampton south through Seabrook and the Massachusetts towns of

Salisbury, Newburyport and Newbury. At various points tide marsh, instead of harbor water, separates the New Hampshire and Massachusetts mainland from these islands. The main inlet to this harbor is located about 1.7 miles directly to the east of the plant, and the state line between Massachusetts and New Hampshire is about 2 miles to the south. The chief problem confronting evacuation planners is that very few roads lead onto and off the islands yet some of New England's most beautiful sandy beaches north of Boston are located on these islands, and these beaches attract tens of thousands of transient visitors during the summer. The barrier islands have also become quite developed and now contain a sizeable permanent population. There are also hundreds of beach houses and rental units which are populated only during warm weather, as they are not winterized. Many stores, shops, restaurants and arcades are found concentrated in beach areas of Hampton and Salisbury. There are also two major state parks on the islands which attract thousands of beach-goers: Hampton Beach State Park and Salisbury Beach State Reservation.

6.1.14. An understanding of the limited road network in the beach areas is critical to any assessment of the evacuation concerns. Coastal Route 1A is the one road which traverses the barrier islands in New Hampshire from north to south. It is a two-lane road. DeMarco and Lally, ff. Tr. 3659, at 5. This road, also known as Ocean Boulevard, extends north across the state line out of Salisbury Beach and runs for about 1 1/2 miles through Seabrook's beach area. Heading further north, it then crosses the Hampton Harbor Bridge and passes through the crowded beach area in Hampton. Id.; Adler ff. Tr. 7109, at 2. After winding about 4-5 miles through Hampton, it then winds along the coast to the north, through the EPZ towns of North Hampton and Rye, and finally ends in downtown Portsmouth. Adler, ff. Tr. 7109, at 2.

6.1.15. The other major north-south routes in the EPZ are Route 1, which is on the mainland and parallels Route 1A about 3 miles to the west of the coast, and Interstate 95, a limited-access multi-lane expressway, which is about 4 miles west of the beaches. Adler, ff. Tr. 7109, at 2. The obvious traffic strategy for an evacuation when the beaches are crowded is to get those in the beach areas onto I-95 as quickly as possible. The problem is that there are only 5 roads connecting coastal Route 1A with Route 1 over the 10-mile stretch between Seabrook and Portsmouth and each one is a two-lane road (one lane in each direction), and (outside of Portsmouth) there are only 3 access points onto I-95 from roads leading west from Route 1: at Route 110 in Amesbury; at Route 107 in Seabrook; and at Route 51 in Hampton.

6.1.16. The concerns about evacuation arise when one considers this limited road network in light of the size of the population that frequents the beach areas on summer days. As we have observed, both in visits to the beach areas and on various video tapes, especially those taken by Ms. Fallon, SAPL Ex. 7, on busy beach days the crowds are so large that the few beach area roads experience frequent slow-moving traffic queues that last for hours. These long lines of bumper-to-bumper, stop-and-go vehicles typically form whenever the beach area day-trippers leave the area in substantial numbers. The queues extend, typically, all the way west on the beach exit roads to where those roads intersect Interstate 95. The access ramps onto I-95 are constraining elements (what laymen call "bottlenecks") in the roadway system leading from the beach areas. On busy beach days, traffic backs up all the way east to the beaches from these access ramps, and the queues move very slowly. Consequently, there is simply no way for all the day-trippers in the beach areas to leave at once. The downstream traffic bottlenecks keep thousands of day-trippers from getting off the barrier islands quickly. An analogy which has been used to describe this traffic situation is that of a large water bucket which has a couple of small leaks: the bucket itself is the islands, and the tens of thousands of vehicles in the beach areas are each a drop of water in the completely-filled bucket; the four key exit roads (Rt. 1A north out of Hampton Beach, Rt. 51 northwest out of Hampton Beach, Rt. 286 west out of Seabrook Beach, and Rt. 1A west out of Salisbury Beach) are each a small hole in the bottom of the bucket. Like the water in this large bucket, the vehicles in the beach areas can flow out only at a limited rate.

6.1.17. Individual beach area day-trippers are normally able to leave the beach areas in a few hours at most on busy beach days. But because they leave at different times of the day, it is logical to assume that if all the day-trippers on days when the beaches are crowded tried to leave simultaneously, a much larger traffic jam than normal would occur, and the average exit times would grow substantially. See Adler, ff. Tr. 7181, at 14. The Salisbury Chief of Police said that such situations occur -- almost all the day-trippers try to leave at once -- when there are sudden rainstorms when the beaches are crowded. Olivera, ff. Tr. 9483, at 3. He described the tremendous traffic congestion that develops in such instances. Id. at 3. Many of the cars in the big parking lots can not even get out of those lots and onto a road "for hours." Id. Bottleneck traffic jams occur whenever two or more streams of traffic try to merge onto one of the single-lane egress roads. Id. And whenever traffic back-ups of this kind and length develop, he describes how drivers get frustrated and "try all kinds of things to get out of or avoid the traffic jams." Id. at 4. He has seen drivers trying to pass traffic by driving on the right shoulder or even crossing the double yellow center line to drive west on the eastbound lane of an egress road. Id. Others look for side roads as a way to "beat the traffic," but such roads are few and often lead to other points of congestion. Id.

6.1.18. One sociological fact is important to recognize as well. Chief Olivera and others have described the population in the beach areas as consisting of a high percentage of young people in the 17-25 age range. Id. at 5. According to Chief Olivera, this group probably comprises half or more of the population in Salisbury. Id. The concern the police have with these drivers is that they typically drive in a more disorderly fashion that older drivers. Id.

6.1.19. If there were an evacuation of the beach areas in response to a radiological emergency, and the beaches were crowded, the traffic congestion is expected to be even worse than it gets in a sudden rainstorm. Not only all the day-trippers but everyone else on the barrier islands as well (all the parmanant residents, seasonal residents, weekly and overnight transients, campers, merchants, and employees) would be attempting to drive off the islands at roughly the same time. The average exit time will no doubt be much longer than that which is experienced on a normal busy day. Evacuation times are, by definition, longer yet, as they describe the time it takes from an order to evacuate (or "OTE") for the last car out of an area to pass through a given distance ring (2, 5, or 10 miles or the EPZ boundary). See Volume 6, pp. 10-12, 10-13.

6.1.20. From the foregoing overview, key issues in the Seabrook Station evacuation debate arise: Just how long are the ETEs for the beach area? What kind of traffic Management plan will best serve to minimize the ETEs? Will an evacuation from Seabrook even be possible, given the traffic jams that will undoubtedly occur and the relatively small number of traffic guides that will likely be available to ensure orderly traffic flow in the early stages of an evacuation? Will people in the beach areas stay with their cars if they find the traffic to be gridlocked or moving slower than they can walk? Given the highly variable size and distribution of the population in the beach areas from hour to hour over the course of each day of the summer months, how can emergency planners ever have any realistic estimate of the evacuation times for the population at hand when an evacuation may need to be called? These are the key issues that the NRC needs to resolve before it can answer whether there is reasonable assurance that adequate protective measures can and will be taken to protect the people in the New Hampshire plume EPZ.

2. The NHRERP's Solution: Volume 6

6.1.21. Offsite emergency response plans for the New Hampshire portion of the Seabrook Station plume exposures EPZ have been prepared and submitted by the State of New Hampshire and have undergone a series of revisions since their first submission. The version offered into evidence for these bearings, Revision 2, was published in August 1986, and it contained in Volume 6 a Final Report describing the Seabrook Station Evacuation Time Estimates and Traffic Management Plan Update. All of Revision 2, including Volume 6, was admitted into evidence as Applicants' Exhibit 5.

6.1.22. Volume 6 of the New Hampshire Radiological Emergency Response Plan, Revision 2 (the "NHRERP"), includes a series of evacuation time estimates for the general population for nine different regions and ten different evacuation scenarios. Volume 6, 10-6 to 10-10. It also contains the traffic management plan which the State of New Hampshire has chosen to rely upon, see Volume 6, sections 7-9 and Appendicies I-L, and a description of the study done to estimate evacuation times based on that traffic management plan. See Volume 6, Sections 1-6, 10 and Appendicies A-H, M and N. Section 11 describes the ETEs for transit dependent persons, and Section 12 describes surveillance procedures for spotting road blockages caused by disabled vehicles and recommends locations for positioning tow trucks during an evacuation. All the work reflected in Volume 6 was prepared by KLD Associates, Inc., under the direction of Edward B. Lieberman. Tr. 5638. The work was done over the 12-month period from August 1985 to August 1986, when Revision 2 was published. Volume 6 at 1-1.

3. The ETE/Traffic Management Plan Contention Topics

6.1.23. A number of contentions admitted for litigation in this proceeding challenge the adequacy of various aspects of the NHRERP's evacuation time estimate (or "ETE") study and the traffic management plan update on which it is based. Both the ETE study and the traffic management plan update are contained in Volume 6 of the NHRERP, Revision 2.

6.1.24. These contentions are summarized in Applicants Dir. No. 7, ff. Tr. 5622 at 1-11.

6.1.25. These contention contain a number of bases which generally fall in one of the following four (4) major categories:

(a) Bases which assert that, for one reason or another, the ETEs contained in the NHRERP are not realistic for 1987-88;

(b) Bases which assert that Volume 6 provides insufficient information upon which to make prudent judgments about protective actions in an actual emergency;

(c) Bases which challenge the workability of the traffic management plan itself, the sufficiency of the number of traffic control personnel who will implement that plan, or the assumptions about human behavior on which the workability of the traffic management plan is premised; and

(d) Bases which challenge the adequacy of the evacuation plans for transit dependant persons.

6.1.26. These contentions and bases challenge only the ETEs and the traffic management plan for New Hampshire EPZ communities. In fact this Board specifically refused to consider NHRERP contentions which challenged assumptions made in the Volume 6 ETE study about such variables as the locations and staffing of traffic and access control posts in Massachusetts, even though the NHRERP's traffic management plan is designed to send some New Hampshire evacuees into Massachusetts EPZ communities during an evacuation. See Volume 6 at I-13 (the instructions for this traffic control post at Rt. 1A and Rt. 286 -- the state line -- direct New Hampshire traffic guides to send evacuees south on Rt. 1A, into Massachusetts, when Rt. 286 becomes congested). In the course of permitting Intervenors to litigate the ETEs for New Hampshire evacuees, we did, however, permit some limited inquiry into how fast New Hampshire's evacuees could pass through Massachusetts EPZ communities. But this inquiry was permitted only under the yet-to-be-tested assumptions (1) that the only traffic control posts in Massachusetts were those suggested by KLD in Volume 6, (2) that those posts were established and in place at the beginning of an evacuation of New Hampshire's beach areas, regardless whether Salisbury and other Massachusetts towns were simultaneously engaging in an evacuation; (3) that non-professional traffic guides, if present pursuant to the utility plan, could set up these posts and direct traffic flow just as efficiently and effectively as experienced state and local police; (4) that no road blockages in Massachusetts would impede these New Hampshire evacuees; and (5) that the passage of these New Hampshire evacuees through Salisbury Beach and Salisbury Center would not be blocked by gridlock from massive congestion and abandoned and disabled vehicles. These issues we have reserved for litigation concerning the SPMC. One issue which concerned Massachusetts, met all of our restrictions, and was litigated by the parties was whether, assuming that the traffic control measures at the intersection of Route I-95 and Route 110 in Amesbury were put in place _just as described in Volume 6_ (at I-19), evacuating traffic (which contains New Hampshire evacuees) would flow through this intersection at the rate assumed in the Volume 6 ETE study. We acknowledge, however, that we can have no reasonable assurance that the New Hampshire ETEs are reasonably realistic without considering a host of other important issues about traffic control, staffing, congestion, and impediment removal in Massachusetts. Thus, we can give no _final_ approval to the New Hampshire ETE study until we have reviewed these Massachusetts issues.

C. The Witnesses

6.1.27. The Applicants' ETE witnesses were Anthony M. Callendrello, Manager of Emergency Planning for New Hampshire Yankee; Gordon Derman, President of Avis Airmap Company; Paul R. Frenchette, Jr., a Senior Emergency Planner for New Hampshire Yankee; Edward B. Lieberman, President of KLD Associates, Inc.; Dr. Dennis S. Mileti, Professor of Sociology and Director of the Hazards Assessment Laboratory, Colorado State University; and (on rebuttal only) Dr. Bruce Spencer, and Assistant to Associate Professor of Statistics and Education, Northwestern University.

6.1.28. Among these, Mr. Lieberman and Dr. Mileti are the critical witnesses on which the Applicants' ETE testimony, Applicants' Dir. No. 7, was based. That testimony is divided into two parts, the first dealing directly with the evacuation time estimates and the second dealing with a number of human behavior issues (only some of which relate to evacuation, traffic management, or ETE issues). Mr. Lieberman wrote the bulk of the first part of the testimony, Tr. 5634-5635, and he contributed very little to the second part, the original draft of which was written by Dr. Mileti, Tr. 5653.

6.1.29. The Board finds that because Mr. Lieberman has a direct and sizeable financial interest in the outcome of this very proceeding, his credibility and objectivity as a witness cannot be assumed. Mr. Lieberman is now the president of KLD Associates, Inc. Tr. 5636 (Lieberman). For producing the ETE study contained in Volume 6, New Hampshire Yankee paid KLD between a quarter and a half of a million dollars. Tr. 5650-5652. In the year that followed the publication of Volume

6, KLD did additional work assessing evacuation times for which New Hampshire Yankee paid KLD another quarter of a million dollars or so. Tr. 5652 (Lieberman). Mr Callendrello, the Manager for Emergency Planning at New Hampshire Yankee, testified that KLD would be the logical choice to do further ETE up-date work if Seabrook Station were to be licensed and operated over the next 40 years. Tr. 5655 (Callendrello). Mr. Lieberman admitted that it was possible that, were Seabrook Station to be licensed to operate, KLD could be called on to do seven or eight updates of the ETEs and traffic management plan over the lifetime of the plant and that for each update KLD could receive another quarter of a million dollars. Tr. 5656 (Lieberman). Thus KLD is likely to obtain over two million dollars in future ETE work if we approve the NHRERP, including Volume 6, and Seabrook Station goes on to receive an operating license. See Tr. 5657-5658 (Lieberman). In light of these facts and the fact the Mr. Lieberman in his testimony is essentially commenting on and defending his own work, this Board cannot recognize Mr. Lieberman as an "expert witness." He does not meet the requisite test of objectivity to be given this recognition. At best he is strictly a fact witness, and one the Board cannot assume to be credible.

6.1.30. In this regard, the Board has examined Mr. Lieberman's testimony very carefully and has found ample evidence to conclude that he is not always a trustworthy witness. Although this evidence is found throughout the record, and exists in many direct forms (see, e.g., an occasion in which he was impeached using his own deposition, Tr. 5638-5640) it is typically manifested in the form of clever but specious reasoning, i.e., sophistry, in Mr. Lieberman's determined effort of defend his ETE work against each and every Intervenor challenge. Many of his specious arguments will be discussed in the following findings which discuss specific contention topics. Here is just one example, not discussed elsewhere. In Volume 6, Mr. Lieberman writes that he examined 9 sets of "color-slides containing aerial views of the entire coastal area within the Seabrook EPZ, from southern Plum Island on the south to the Portsmouth area on the north." Volume 6 at E-4. He then states that the set of films taken on Sunday, August 11, 1985, contained the most vehicles of any of the available sets and that "[t]he weather that day was described as clear, with temperature approximately 90 degrees -- ideal conditions for attracting day-trippers to the beaches." Id. at E-5. Mr. Lieberman then used that set of slides from August 11, 1985, to make an estimate of parking capacity in the beach areas. Id. at 2-8, 2-10 and E-4. There is no question that Mr. Lieberman wanted the Volume 6 reader to conclude of these slides that (1) the coverage of the coast was complete and (2) the weather was great. By contrast, this is how he described those same slides at the hearings:

> First, that set of slides that we had available to us in 1985 were, in my view, marginally acceptable, and had some flaws in them to the effect that the slides did not overlap in many cases. The film was shot from an oblique angle, from a flight line that extended over the water. And in fact important areas of the beach area were completely missed, and that we had some problems in that respect.

Tr. 6072-6073 (Lieberman).

> I looked at those [August 1985] films, and the weather just wasn't all that good that year. There were some clear days, but clearly the beach wasn't fully utilized. And as I explained earlier, even on the best day, which was August 11th, comparison of what I took of the films and what I observed on the ground indicated that day, also, was not the best day.

Tr. 6102-6103 (Lieberman).

Thus, it now appears that in describing these photos to us in Volume 6, Mr. Lieberman intentionally presented a less-than-complete description of these slides in order to mislead the reader.

6.1.31. Mr. Lieberman also tended, in the manner of a partisan litigant, to uncompromisingly inflate the importance, accuracy, and logic of the work he did using the IDYNEV computer model. And when he was questioned about this work, he occasionally became notably adversarial and defensive. For example, in his statement of personal qualifications he notes that his activities for Seabrook included, <u>inter alia</u>, "optimization" of evacuation strategies. ff. Tr. 5617 at 3. At his deposition of June 29, 1987, he admitted that use of the term optimization "might be an overstatement, because its not a formal optimization." Tr. 5647-5648 (Lieberman). Yet, when asked at the hearings to acknowledge this mischaracterization of his work as "optimization" of evacuation strategies, he refused to do so and instead combatively challenged the questioner to "define for me how you perceive it to be an overstatement." Tr. 5645 (Lieberman).

6.1.32. The Mass AG's ETE witnesses included Dr. Thomas Adler, the president of Resource Systems Group, Inc.; Dr. Colin High, Research Associate Professor of

Engineering and Environmental Studies, Dartmouth College; Dr. William Befort, Assistant Professor of Forest Resources, University of New Hampshire; Dr. Avishai Ceder, Visiting Professor of Civil Engineering and principal-in-charge of traffic engineering and network optimization projects at Massachusetts Institute of Technology; Dr. Albert Luloff, Associate Professor of Rural Sociology and Community Development, University of New Hampshire; Dr. Stephen Cole, Professor, Department of Sociology, State University of New York at Stony Brook and president of Social Data Analysts, Inc., a consulting firm engaged in conducting applied sociological surveys and polls; Dr. Donald Zeigler, Associate Professor and Director of the Geography Program, Old Dominion University; James Johnson, Jr., Associate Professor of Geography, University of California, Los Angeles; and (on rebuttal) Edwin Olivera, the Chief of Police in Salisbury, Massachusetts; and Thomas Moughan.

6.1.33. Intervenors' primary ETE witness was Dr. Thomas Adler, and we find that he was extremely well qualified and knowledgeable to critique the Volume 6 ETE study. He has a Ph.D from Massachusetts Institute of Technology in Transportation Systems. Adler, ff. Tr. 7181, at 2 and Attachment 1. Over the period 1976 to 1986 he was a professor in the Resource Policy Center, an academic and research program of the Thayer School of Engineering at Dartmouth College. Id. At Dartmouth he taught graduate and undergraduate-level courses in the areas of transportation systems analysis, transportation engineering, transportation planning, computer/mathematical modeling techniques, statistical analysis, and computer science. Id. He also directed a program of research for clients such as the U.S. Department of Transportation, U.S. Department of Energy, and others in the general area of computer modeling of transportation systems. Id. A more complete description of his work at Dartmouth, where his central focus was on the science of computer modeling of complex systems, is contained in his direct testimony, ff. Tr. 7181, at 2-3. Dr. Adler also has been involved in the actual development and application of transportation-related models. Id. at 3. He was co-author of a manual distributed by the Urban Mass Transportation Administration which describes new techniques for using behavioral intentions data in transportation models. Id. Since 1986, Dr. Adler has been the president of Resource Systems Group, Inc., a private consulting firm, where he has maintained research and project activities similar to those he pursued while at Dartmouth. Id.

6.1.34. Dr. Adler conducted a review and evaluation of the validity and reliability of the Seabrook Station ETE study and traffic management plan incorporated into Volume 6 of the NHRERP. Id. at 6. In doing this work he obtained from KLD a compiled version of the IDYNEV computer program and the computer tapes of the input files KLD used for the ETE study documented in Volume 6. Id. at 7. In other words, he got the IDYNEV model up and running, and he examined all of KLD's input data. He then conducted over 75 separate model runs and sensitivity tests using IDYNEV. We find that Dr. Adler, with his knowledge and experience, and equipped with a copy of the

IDYNEV model, was extremely well qualified and equipped to comment on the adequacy of the ETE study and the accuracy of the ETEs it produced. We also find that his testimony was extremely clear, forthright, and convincing.

6.1.35. The sole NRC witness was Dr. Thomas Urbanik. Dr. Urbanik has an M.S. in Transportation Engineering and a Ph.D in Civil Engineering, Urbanik, ff. Tr. 7372, Curriculum Vitae, but his credentials generally do not place him in the same league with Dr. Adler, not to mention those of Dr. Ceder.

6.1.36. Dr. Urbanik's primary field of work is in applied traffic engineering and transportation engineering and planning. Tr. 7417A (Urbanik). He admits he is not an expert in the theoretical development of computer models for complex systems or in the field of computer science generally. Id. Dr. Urbanik has been at Texas A & M since 1977, Tr. 7417, but he is not yet a tenured professor there. Id. He teaches undergraduate courses and no graduate courses. Urbanik, ff. Tr. 7372, Curriculum Vitae. He is, however, the program manager of the transport operations program, which is "one of 20 or so programs within the [Texas Transportation] Institute." Tr. 7417-7417A. Dr. Urbanik insists that he is "no hack." Tr. 7442 (Urbanik).

6.1.37. Dr. Urbanik claims he provided "input" to the current guidance for evacuation time estimate studies which appears in Appendix 4 to NUREG-0654. Urbanik, ff. Tr. 7372, at 2. There is no indication in the record, however, what that input was. He also was actively involved in reviewing ETE studies for the NRC in the late 1970's and early 1980's. Id.

6.1.38. By the mid-1980's, however, rapidly developing computer modeling technology changed the nature of the disputes over evacuation time studies. Mass. A.G. Ex. 10. In May 1985, Dr. Urbanik wrote to the NRC to inform staff there that he did not believe that he could continue to be an effective witness for the NRC unless he was "able to move forward concerning the state-of-the-art relative to evacuation time estimate studies." Id. at 1. He noted how it was more difficult to defend the absolute magnitude (or accuracy) of ETE assumptions than it had been to defend their "reasonableness." Id. What he proposed to the NRC, therefore, was as follows:

> My proposal is to develop NRC capability relative to IDYNEV in order to accomplish two objectives. First, development of the capability protects NRC's position relative to the evacuation time estimates. Second, development of that capability will allow informed revision of Appendix 4 in a manner that can be defended. Id. at 2.

6.1.39. This letter is noteworthy in a number of respects. First, it makes it clear that Dr. Urbanik is not an objective, independent expert; he views his role as that of an advocate for the NRC staff position relative to ETEs. Second, he makes it clear that historically he and the NRC staff have defended ETE studies, not challenged them. Third, he viewed FEMA's involvement into these ETE disputes as an exasperating problem for the NRC staff. Fourth, he felt that he was not going to be able to "function effectively on behalf of the NRC" unless he too had the "capability" FEMA and other parties would have to test ETE assumptions using the IDYNEV model. And finally, it indicates that Dr. Urbanik felt that NUREG-0654,

Appendix 4, needed revision, apparently in light of the developing technology.

6.1.40. At the hearings Dr. Urbanik was asked these questions and gave these answers:

Q. Dr. Urbanik, you have written and said before, in evaluating evacuation time estimate studies, the model itself is not as critical as the assumptions that go into it, haven't you?

A. (Urbanik) Absolutely.

Q. And isn't the thrust of this letter, the notion that in the future, with IDYNEV, the fights are going to be over the assumptions that go into the model, isn't that correct?

A. (Urbanik) Yes, I believe that is correct.

Q. And in order to be able to participate effectively in that debate, you are going to need to have IDYNEV in order to be able to test those assumptions, as other parties would likely be doing, so that you could compete in that debate, at a a level of sophistication, those other parties were at, isn't that true?

A. (Urbanik) Certainly you had to know the answers to those kinds of questions to be a credible witness, yes.

Tr. 7442-7443.

6.1.41. For this very reason, we find Dr. Urbanik not to be a credible witness with respect to many of the issues in this proceeding, which concern input assumptions to the IDYNEV runs and the impact small or large changes in those inputs will have on the NHRERP's ETEs. Dr. Urbanik admits that, even though he now has a copy of the IDYNEV model, Tr. 7431-7432, he did not even obtain copies, as Dr. Adler did, of KLD's inputs and outputs for the Volume 6 runs, Tr. 7432, and he did not use IDYNEV in his evaluation of the KLD ETE study. Tr. 7432-7433. Essentially all he did to examine the ETE study was to read Volume 6, Mr. Lieberman's deposition, his previous studies of evacuations from Seabrook, and some other documentary materials. Tr. 7424-7429. He did make another "field trip" to the EPZ, but it lasted only a couple of days and he did no data collection while he was there. Tr. 7431. This appears to the Board to be the same kind of ETE review effort Dr. Urbanik used to do in the late 1970's and early 1980's, prior to the revolution in computer modeling technology for ETE studies. Dr. Urbanik's prediction in his 1985 letter to the NRC is correct: when both the Applicants and the Intervenors use IDYNEV to assess ETE studies, and he does not, he is no longer "able to function effectively on behalf of the NRC." See Mass. AG Ex 10 at 1.

D. The Findings on the Contention Topics

6.1.42. The Intervenors' so-called "ETE contentions" generally contain challenges to the adequacy of the Volume 6 evacuation time estimates ("ETEs"), the ETE study from which those ETEs were derived, and the NHRERP's Traffic Management Plan for a controlled evacuation from the Seabrook Station EPZ. Most of the ETE contentions and bases fall into one or more of the following four categories: (1) those which assert that for the reason stated, the Volume 6 ETEs as calculated by

KLD Associates using the IDYNEV computer model are unrealistically short; (2) those which assert that with respect to the beach areas, for which the size and distribution of the population is highly variable from day to day and over the course of even a single day, the ETE study has an inadequate factual basis to permit decision-makers at any point in time to make reasonable projections of size of the vehicle population and the ETEs; (3) those which assert that the Traffic Management Plan itself is inadequate because it will not result in a vehicular evacuation which will be completed as efficiently and as quickly as could reasonably be accomplished; and (4) those which assert that for special facilities and those in the general population who are transit dependent the Volume 6 ETEs are unrealistically short and/or the evacuation plans are inadequate.

6.1.43. Rather than addressing each of these categories one by one, we choose the discuss a few of the major overarching problems with the ETE analysis and traffic management plan. Each of these major problems falls into more that one of these four contention/basis categories. This format avoids the repetitious references to the the facts that would otherwise be necessary if we proceeded laboriously to discuss each of the bases, or even each of the four categories of bases, one by one. The selection of these key problems does not mean that the Board has found insufficient evidence to support the other challenges raised by the Intervenors to the ETEs and/or the evacuation plans. To the contrary, we find that in almost every instance the other challenges raised by the Intervenors to the accuracy of the ETEs, or the workability of the Traffic management plan, leave us with at least substantial uncertainty as to the adequacy of the planning contained in Volume 6. The major problems we choose to address here, however, concern critical inadequacies in the planning with respect to (a) returning commuters; (b) vehicles in the beach areas; (c) the late staffing of traffic and access control posts; and (d) the IDYNEV model.

1. Returning Commuters

6.144. TOH III(D) and SAPL 31(7) raised the issues pressed by the Intervenors at the hearings, whether the Volume 6 ETE study adequately considered the effects on the ETEs of the thousands of returning commuters whose vehicle trips home would occur simultaneously with the evacuation trips of others.

> TOH III(D)--KLD "grossly underestimates the adverse impact on ETE of 95 percent of workers returning home, within 30 minutes, to prepare for evacuation following notice of radiological emergency."
>
> SAPL 31(7)--"the effect of almost 95 percent of the commuting population attempting to return home with-in 30 minutes of each other (Vol. 6, p. 4-9) would be a massive rush hour even without an evacuation in progress. The assumption that commuting workers can return home in their normal time frames defies common sense and is unsupportable from an analytic standpoint."

6.1.45. In order to address this issue, one must understand, at least in a basic way, how the IDYNEV computer model calculates ETEs. Essentially it performs these calculations by simulating or "modeling" all the vehicular trips that would likely occur on the EPZ road network under a variety of different evacuation scenarios. Ceder, ff. Tr. 5169, at 4. The clearest description of the modeling process was offered by Dr. Ceder:

> Stated simply, IDYNEV is a computer model into which is put instructions describing each key link of roadway network and each key intersection to be used in the evacuation. The model is then given inputs for the number of vehicles entering the simulated roadway network at various "entry nodes," i.e. points at which vehicular evacuation trips originate. Next, the IDYNEV model assigns the input vehicles to certain links (based on some behavioral assumptions) and simulates their movement across the network (based on some assumptions about speed, delay and congestion level). Following this simulation, the model calculates how long it would take to have all the vehicles travel to points 2 miles, 5 miles, and 10 miles from Seabrook Station (or to the EPZ boundary, which in some points is almost 14 miles from the nuclear plant). These time calculations are called evacuation time estimates or "ETEs." As is described in Volume 6, KLD Associates used the IDYNEV model to produce Seabrook's evacuation time estimates for ten (10) different scenarios, depending on the season/day/time/weather combinations (e.g., Scenario 1 is for an evacuation occurring on a summer weekend at mid-day with good weather). ETEs for these scenarios are produced for the "entire" EPZ and for various sub-parts of the EPZ, called "Regions." Id. at 4-5

6.1.46. Figure 1-3 on p. 1-13 of Volume 6 is a graphic display of the IDYNEV model's "link-node" representation for the Seabrook Station EPZ road network.

6.1.47. The number of vehicle trips modeled during each IDYNEV computer run is one of the critical variables. See Volume 6 at 2-1. In conducting its ETE study KLD Associates estimated what the total number of vehicle trips would be. This process was referred to as roadway "demand" estimation. Volumber 6, 2-1 and passim.

6.1.48. Section 2 of Volume 6 specifically describes the demand estimation process KLD used for estimating the total number of vehicular trips that would be generated in the evacuation process by the following groups:

--permanent residents: evacuation trips taken after leaving their homes (at 2-5 et seq.);

--beach area population: evacuation trips taken from where their cars were parked (at 2-8 et seq.);

--seasonal housing residents (off the beach area): evacuation trips taken upon leaving their seasonal units (at 2-14);

--those in overnight accommodations (off the beach area): evacuation trips taken from the hotel or motel (at 2-14);

--those in campgrounds (off the beach area): evacuation trips taken upon leaving the camp grounds (at 2-20);

--those at Seabrook Greyhound Park: evacuation trips taken by those in attendance upon leaving the park (at 2-20);

--those parked at retail establishments along Route 1: evacuation trips from those points (at 2-20, 2-24);

--those employed at or visiting Seabrook Station: evacuation trips from that point (at 2-24);

--"through" vehicles: those trips taken by vehicles traveling through the EPZ at the time of the accident (at 2-27).

6.1.49. Section 5 of Volume 6 describes the demand estimation process utilized for the employee population. There it is noted that

> "[f]or purposes of estimating evacuation traffic demand, we focus on those employees who work within the EPZ and who live outside the EPZ. (Those who live within the EPZ have already been counted as part of the permanent population.)

Id., at 5-1.

6.1.50. Intervenors contend that the KLD effort to estimate the total road demand that would occur within the EPZ after notification of an accident at Seabrook Station is seriously deficient because it ignores altogether the thousands of return trips home made by commuters who live within the EPZ. Dr. Adler, who examined the KLD computer runs, testified that these "return home from work" trips were not explicitly modeled in any of the evacuation scenarios even though they would add a significant number of trips to the road network during an evacuation. Adler, ff. Tr. 7181, at 30. This testimony was uncontradicted.

6.1.51. In his testimony, Dr. Adler noted that the 1986 employment data contained in Volume 6 indicates that there could be 54,488 such commuter trips home by residents of the

EPZ, assuming that all commuters would want to return home in an emergency. Id.

6.1.52. In his rebuttal testimony, Dr. Adler presents a credible analysis of how many trips would likely be generated by commuters who would want to return to their homes in the EPZ during an emergency at Seabrook Station. Adler, ff. Tr. 9524, at 4-5. He calculated that there would likely be from 35,200--41,500 such trips home. Id. at 5. This testimony, too, was uncontradicted.

6.1.53. For the summer weekday scenarios (Scenarios 3 and 4), KLD modeled a total of 101,995 trips. Volume 6 at M-10. For the offseason mid-week mid-day scenarios (Scenarios 5, 6, and 7), KLD modeled a total of 82,571 trips. Id. at M-15.

6.1.54. If, for the summer weekday scenarios, KLD had modeled 35,200-41,500 commuter trips home by EPZ residents in addition to the 102,000 trips that were modeled, there would have been a 35-41% increase in the total number of trips modeled. And if they had modeled these commuter trips home as well for the off-season mid-week mid-day scenarios, there would have been a 43-50% increase in the number of trips modeled.

6.1.55. The KLD analysis in Volume 6 does make certain assumptions that bear indirectly on the impact these returning commuters will have on the ETEs, but Dr. Adler testified that these assumptions are themselves unrealistic and, moreover, they do not begin to account for the full impact these "return home from work" trips will have on evacuation times. See generally Adler, ff. Tr. 7181, at 28-31; Adler, ff. Tr. 9524, at 4-8. One assumption built into the model was that there would be a 10% directional "split" for traffic moving over two-way roads (i.e., of the traffic on the roads, 90% would be moving outbound and 10% moving inbound). Adler, ff. Tr. 9524, at 7. See Volume 6 at 3-8. When traffic flows in opposite directions on undivided roads, there is a "frictional" interaction which has the effect of reducing the capacity of the road. Id. To find out what the capacity reduction factor is for a 90-10 "split," KLD referenced the Highway Capacity Manual ("HCM") and found it to be 0.75. Volume 6 at 3-8.

6.1.56. Presumably a high proportion of the inbound vehicles on the two-way roads will be returning commuters; so by reducing the capacity of the outbound lanes by an amount which is appropriate for a 90-10 split, inbound commuters whose trips flow opposite to the evacuating traffic do have some impact in the model in generating longer ETEs.

6.1.57. But this impact alone is far from the full impact returning commuters will have on ETEs, because it ignores altogether the fact that commuter trips fall into two other categories: 1) trips that flow with the evacuating traffic, and 2) trips that flow across the evacuating traffic at intersections. Adler, ff. Tr. 9524, at 7.

6.1.58. Commuter trips that flow with the evacuating traffic will have the effect of reducing the amount of roadway capacity that can be used by evacuating traffic. Id.

6.1.59. This effect is not included or considered at all in the evacuation traffic model. Id. Instead, commuters whose trips home originate toward the center of the EPZ and terminate at home at some point farther out in the EPZ are assumed to magically show up at their homes without having traveled on the roads with the flow of evacuating traffic. Id.

6.1.60. Commuter trips that flow across the flow of evacuating traffic at crucial intersections in the EPZ will have the effect of reducing the effective "green time" available to evacuating traffic at these intersections because the evacuating traffic will be forced to "give up time" to cross flows of commuter traffic. Id.

6.1.61. The effects of cross flows of commuter traffic have not been included at all in the evacuation traffic model. Id. The cross flows were not modeled, nor were their effects on intersection capacities considered. Adler, ff. Tr. 7109, at 30.

6.1.62. Thus, even if the 90-10 directional split assumption were reasonable, it would not justify ignoring the impact on ETEs that would be caused by commuter trips that flow with and across evacuating traffic.

6.1.63. To make matters worse, however, the 90-10 directional split assumption was made without any empirical foundation and does not appear to be realistic, because it reflects a serious undercount of return trips. Id.

6.1.64. The other assumption made by KLD which relates to returning commuters concerns their "commute home times." In making its ETE calculations KLD assumed that after public notification of an emergency at Seabrook Station, returning commuters will have "commute home times" which are normal for the late afternoon peak hour conditions. App. Dir. No. 7, ff. Tr. 5622, at 78-79. See Vol. 6, 4-10 (time to travel home data comes from the telephone survey which asked commuters how long it takes to travel home from work or college, see Vol. 6 at F-3).

6.1.65. But the traffic conditions which exist during a commuter's normal trip home will not resemble the much more congested conditions that will occur after notification of an emergency at Seabrook Station. Adler, ff. Tr. 7109, at 29-30; Adler, ff. Tr. 9524, at 6. In Volume 6 KLD uses data from its telephone survey to estimate that 95% of the returning commuters will leave work within 30 minutes of being notified of an emergency at Seabrook Station. Vol. 6, 4-10. KLD also estimates that these commuters receive notification at different times occurring over a 40 minute period after the declaration of an emergency. Vol. 6, 4-8. KLD then combines these two distributions and concludes that 95% of the commuters will leave work within 1 hour of the declaration of the emergency. Vol. 6, Table 4-2, at 4-16 (Distribution A). Data from the Social Data Analysts survey shows, however, that under normal conditions only one-third of the EPZ's resident workers leave work in the afternoon peak one-hour period (4:00 to 5:00 p.m.). Adler, ff. Tr. 7109, at 29, 29a; ff. Tr. 9524, at 6. The remainder of the EPZ's resident workers leave work during other times of day, generally between 3 and 6 p.m. Id., ff. Tr. 7109, at 29, 29a. This data was generated from the answers given in response to questions which asked what time of day commuters left their places of employment to return home for the evening. Attachment 5, pp. 70-71, to Zeigler, Johnson, Cole testimony, ff. Tr. 7851. Thus, during the first hour after the declaration of an emergency, when 95% of all commuters will be heading home, there could be nearly 3 times as many commuters on the roads as during a normal "peak" (4-5 p.m.) rush hour, if all commuters drive home. If one considers only the number of commuters who would likely return home, there would still be more than twice the number of commuters on the road as during the normal peak hour conditions. Adler, ff. Tr. 9524, at 6. It is simply not reasonable to assume that under these circumstances returning commuters will be able to drive home as quickly as they could under normal conditions. Adler, ff. Tr. 9524, at 6.

6.1.66. By assuming that commuters return home earlier than could realistically be expected, the KLD analyses use trip generation times for evacuating households that are unrealistically short. This has the effect of lowering ETEs for all scenarios. Adler, ff. Tr. 9524, at 6.

6.1.67. To gauge the sensitivity of the KLD ETEs when commuter traffic is added to IDYNEV's traffic demand, Dr. Adler added only 200 commuters to his "combined run" and the result was an increase in ETEs of 10 minutes. Adler, ff. Tr. 7109, at 31. Since this represents only a small percentage of either the 54,000 potential or the 35,000-41,500 likely commuter trips home, the effect on ETEs if KLD had explicity modeled commuter trips home appears to be substantial. Id. In Dr. Adler's opinion, the failure by KLD to include the full effects of returning commuters in their analysis has seriously compromised the reliability of their ETEs. Adler, ff. Tr. 9524, at 8. Based on the evidence he reviewed, he stated that he cannot exclude the possibility that commuter traffic flows, if fully included in the KLD baseline analysis, would extend ETEs by several hours. Id.

6.1.68. Dr. Adler testified that the effects of returning commuters on ETEs could be more precisely calculated with some additional data collection and analysis, Adler, ff. Tr. 7109, at 76, and then by modeling these commuter trips in a more explicit way than KLD did in its Volume 6 analyses. Tr. 9535 (Adler). He described how this could be done by making three changes in the IDYNEV model. First, the 90-10 directional split should be changed to something in the range of 70-30 or 60-40 to account for the vehicles potentially flowing in the opposite direction. Tr. 9536 - 9537 (Adler). Second, for those intersections which have traffic flowing across the evacuation flow, that cross-flow traffic will cause a reduction in the ability of that intersection to service the evacuation direction flow; and that ought to be taken into account. Tr. 9537 (Adler). Third, to account for the fact that some of the commuting traffic is actually traveling in the direction of the evacuation flow, the evacuation flow itself should be factored off by some amount. Id.

6.1.69. While some data on where commuter trips go would be needed to make the appropriate changes to the IDYNEV model, Dr. Adler testified that he has a tabulation of those data which could be used. Tr. 9538 (Adler). This data was obtained from the survey taken by Dr. Cole's firm for the Mass. A.G.'s office. Id.[1/] Dr. Adler testified that by using that

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1/ At Tr. 9538 there is a transcript error on line 10. The word "didn't" should read "did," as is confirmed by the context of the sentence.

data one could do a better job of modeling commuter trips than by ignoring them entirely, which is essentially what KLD did. Id.

6.1.70. There is nothing in the Applicants' testimony which indicates that in the ETE update work conducted by KLD subsequent to the publication of Volume 6 the trips generated by returning commuters have been modeled more explicity than they were in the analyses reflected in Volume 6.

6.1.71. In proposed findings 6.1.152 - 6.1.161, the Applicants seek to respond to Dr. Adler's testimony about returning commuters.

6.1.72. Applicants first argue that the IDYNEV model compensates for any delays commuters would experience driving home, and it does this by using a pessimistic assumption about the time commuters would spend at home packing and preparing to leave home on their evacuation trips. Applicants' PF 6.1.153, citing Tr. 5676 (Lieberman).

6.1.73. Intervenors' primary concern, however, is not that delays in driving home have not been properly addressed. The assumptions KLD made about preparation times at home may or may not compensate for the realistic delays commuters will experience driving home. If they did not, then KLD did not utilize a "trip generation distribution" for IDYNEV which is realistic. See Vol. 6, ch.4. While, intervenors do dispute that KLD's trip generation times are realistic, Adler, ff. Tr. 524, at 6A, their chief concern lies elsewhere in the failure of IDYNEV to model the returning commuters' trips at all. It is the delays these trips cause to other evacuees that is the primary focus of Dr. Adler.

6.1.74. Intervenors' Proposed Findings next assert that Dr. Adler has misread Volume 6, which he cites for the proposition that 95% of all commuters would leave work with 30 minutes of notification. Applicants insist that 95% would leave within 1 hour, not 30 minutes. Applicants' PF 6.1.156. This, too, is not a significant point in Dr. Adler's critique of the treatment given in the model to returning commuters. Either way--30 minutes or 60 minutes--the surge of commuter traffic that will occur in the first hour after a declaration of an emergency will be either 2 or 3 times as great as that experienced under "normal" peak rush hour conditions. See PF 6.1.xx, supra. Dr. Adler's chief concern is that such a volume of returning commuter traffic will impede outbound evacuation flow, at least for the first few hours of an evacuation, and is simply too large a consideration to ignore.

6.1.75. In any event, Dr. Adler has not materially misread Volume 6. In his testimony, ff. Tr. 7181, at 29, he refers to Volume 6, p.4-9, which contains a table showing the distribution of the times it would take workers to prepare for and leave work after receiving notification of an emergency. It shows that the percentage of commuters who will have left work 30 minutes after such notification is 93%.

6.1.76. Applicants also seek to undercut Dr. Adler's concerns about commuter traffic by noting in their proposed findings (6.1.157) that commuter traffic entering the EPZ along interstate highways will be traveling "counterflow" to the evacuation traffic for the most part. Dr. Adler's concern, however, is not with what will happen on the interstates but with the effect returning commuter trips will have at intersections and on roads leading to and from the interstates within the EPZ. These effects will be generated both by commuters who did not use interstates and by commuters who do enter the EPZ on interstates but who must proceed off the interstates to get home and then travel on local roads and highways across, against, and along with evacuation traffic.

6.1.77. Applicants also argue in their proposed findings (6.1.157) that the portion of commuter traffic which moves along with the evacuees will not affect the ETEs because the commuters will at some point leave the traffic stream to go home, and the gaps they leave will be filled by the evacuating vehicles. While this might be true where only a few commuter vehicles are in a traffic queue with a large number of other vehicles, Dr. Adler's test run adding only 200 commuters trips to the model demonstrates that it is not true when a hundred or more commuters is present on a given link over the period of time that commuter trips are expected to occur. This test run, which is described on pp.7-8 of Attachment 8 to Dr. Adler's direct testimony, ff. Tr. 7181, examined the effect of only 200 commuters traveling on Route 51 with the evacuation flow onto I-95 on-ramp (see Vol. 6, p.I-39) under the summer weekend conditions. The ETEs for the northern part of the EPZ went up

10 minutes, while the Hampton Beach ETE went up 15 minutes. Thus, it apears that when the evacuating traffic stream passes through a constraining element, which could be an intersection, an on-ramp, or a narrow "bottleneck" link, the presence of even a few hundred commuter vehicles flowing along with evacuation traffic will reduce the ability of that constraining element to service the evacuating vehicles, see Tr. 9537 (Adler), and will increase the ETEs along that evacuation pathway. Because there are likely to be tens of thousands of returning commuters on weekdays, see Adler, ff. Tr. 9524, at 4-5, the potential effects on ETEs for some Regions are substantial; ETEs could be extended by several hours. Id., at 8.

6.1.78. In PF 6.1.159 the Applicants contend that the test run Dr. Adler conducted, using IDYNEV and adding 200 commuter vehicles to the Route 51 traffic stream, was spurious "because the model already assumes all commuters who return will evacuate and accounts for them." This non sequitur does not respond, however, to Dr. Adler's criticism that KLD has programmed the IDYNEV model to magically take commuters home without putting their return trips home onto the road network. Tr. 7259. Dr. Adler convincingly explained that in fact there are likely to be many EPZ residents who work at the many places of employment along Route 1 in the Hampton/Seabrook area who, in order to return home to EPZ towns to the north (e.g., Exeter, Newfields, Stratham, Greenland, or Portsmouth), would have to go through this critical intersection at I-95/Route 51. Tr. 7259-60 (Adler). While the KLD study assumes that all these commuters will return home and then, using IDYNEV, accounts for their evacuation trips from their homes, it ignores their return trips home altogether. In doing so, it jumps these vehicles over the I-95/Route 51 intersection, an important constraining element in the evacuation of those persons in the beach areas and in other areas close to the nuclear plant, and it puts them in places from which evacuation out of the EPZ is not constrained. Tr. 7259 (Adler). The upshot is that the ETEs reported by KLD for the beach area evacuees and others are spuriously low.

6.1.79. For some reason the Applicants think it is important that Dr. Adler could point to no other ETE study where the effects of commuters who live and work within the EPZ was modeled. Applicants' PF 6.1.160. Dr. Adler admitted that he had reviewed only two other evacuation plans, and these he reviewed only cursorily. Tr. 7077 (Adler). There is no evidence that Dr. Adler was familiar with all previous ETE studies. Furthermore, even if no other ETE study has modeled the effects of returning commuters, that would not mean that it should be ignored here too if, as a result, the ETEs are not reasonably accurate.

6.1.80. The Board finds that the NHRERP's ETE study underestimates the impact of returning commuters on ETEs, an impact which the evidence shows is potentially significant.

6.1.81. Because of the inadequate consideration given to returning commuters in the ETE study and the evidence showing that ETEs could be significantly longer if commuters were adequately considered, the Board must find that the Applicants have not met their burden of showing that the ETEs are realistic. The ETE analysis contained in Volume 6 is not adequate and will have to be re-done in a manner that realistically addresses the impact retruning cor.muters will have on the ETEs.

2. Beach Area Vehicles

6.1.82. There is no dispute that during the summer season, vacationers and other transients enter the EPZ beach areas in large numbers. These non-residents may dwell within the EPZ for the entire summer season, for a month, for a week or two, for a day or two, or may enter and leave within the same day. Volume 6, at 2-1, 2-2. The beach areas also contain some permanent residents. Id. at 2-8.

6.1.83. There is also no dispute that the population in the beach areas can vary widely from day to day and even over the course of a single day. See Vol. 6 at 2-10, 2-13 and 10-12; see generally Applicants' Ex. 32. One of the key factors behind these fluctuations is the weather. See Tr. 5748 (Lieberman).

6.1.84. There is also no dispute that the Volume 6 ETEs are sensitive to this variation in the size of the population in the beach areas. Volume 6, 10-12.

6.1.85. Dr. Adler testified that the ETEs are in fact "very sensitive" to variations in the beach population and that the reason for this is that it is precisely the evacuation routes that the beach area evacuees will have to use which are the most congested and which serve as a bottleneck to the entire region. Tr. 7036 (Adler).

6.1.86. The dispute over the size of the EPZ's beach area population between the Applicants and Intervenors centers on: (1) how large the total beach area population gets; (2) what information about the beach population should be used in an ETE study; and (3) whether the Volume 6 ETE study, even with Applicants' update work, provides decision-makers with an adequate factual basis for making reasonably accurate judgments in an emergency about the ETEs for the extant beach area population at any point in time in the summer, given the widely variable nature of the size of this population. These issues are raised in contentions TOH III(1), (3) and (A); SAPL 31(20); and SAPL 34.

6.1.87. NUREG-0654, Rev. 1, App. 4, which provides guidance on what should be contained in an evacuation time assessment study, states that "[e]stimates of transient population shall be developed using local data such as peak tourist volumes." NUREG-0654, Rev. 1, at 4-3 (emphasis added).

6.1.88. In conducting the ETE study that resulted in the publication of the final report contained in Volume 6, KLD sought to determine the "peak" size of the beach area population. This conclusion is compelled by the language used in Volume 6 itself. See, e.g., Volume 6 at 2-8 ("To estimate the number of people and vehicles during peak conditions, . . . [emphasis original].") See also the language used to describe "parking capacity," about which KLD notes that "[i]n a practical sense beach traffic is generally limited by parking capacity." Id. (emphasis supplied). That "parking capacity" was thought in Volume 6 to be the key to determining the "peak" population is further confirmed by the following statements from Volume 6 at 2-10:

> It must be emphasized that these parking capacities limit the number of people who occupy the beach areas at any point in time [emphasis in original]. *** The evacuation plan must consider the peak traffic which could occupy the beach areas at any point in time [emphasis supplied].

If this is so, i.e., that in producing ETEs for Seabrook Station one "must consider" the peak traffic which could occupy the beach areas at any point in time then this goal is not met by focusing only on the less-than-peak, but perhaps more typical size of the vehicle population on a busy beach day. Further confirmation that the authors of Volume 6 were focusing on "peak" beach population in their examination of parking capacity is found on page 2-12 (estimate of parking capacity, traffic volumes, and sandy beach person capacity "all provide consistent estimates of peak vehicle and person population" [emphasis added]) and in the definitions given for the summer Scenarios. See Volume 6, Table 10-1 at 10-2. Scenario 1 describes those conditions existing during a summer week-end at mid-day when the beach area population is "at capacity." Id. When one compares this definition with the definitions of Scenario 3 (for which the beach area population is "at 75 percent of capacity"), id., it is evident that Scenario 1 stands for a beach population which is at 100% of capacity, i.e., it is at its peak. This is stated explicitly in the discussion of the "varying beach population" on p. 10-16 of Volume 6, where Scenario 1 is described as having a beach area population of "100 percent of capacity" and Scenario 1A and B are defined as 80 percent and 60 percent of capacity respectively. Furthermore, that section, on p. 10-16, describes sensitivity runs done using the IDYNEV model to quantify the elasticity of the ETEs to the beach area population and, not surprisingly, all the sensitivity runs described are for reduced beach area vehicle capacities, again indicating that Scenario 1 ("at capacity") stands for a beach area population which is "peak." Whether or not a "peak" beach area population should be used in an ETE study, as opposed to something like a "reasonably crowded" beach population, the language of Volume 6 makes clear that its authors were seeking the upper limit, the peak, and not the size of the population (or vehicles) on a representative good beach day. The words the authors used are simply inconsistent with any other conclusion.

6.1.89. The methodology used by KLD to estimate beach area parking capacity is described on pages E-4 and E-5 of Volume 6. That methodology can be summarized as follows. First, KLD examined 9 sets of color slides containing aerial views of the EPZ coastal area, Volume 6 at E-4, all apparently taken in August 1985. Id. at 1-2. Next, KLD selected the set of slides which appeared to be taken on the most crowded weekend day. Id. at 2-10, E-5. The weather on that day, August 11, 1985, was described as clear, with a high temperature of approximately 90 degrees, "ideal conditions for attracting day trippers to the beaches." Id. at E-5. From these slides, KLD then counted all the parked vehicles that were sighted on the film. Id. at E-4. In order to estimate parking capacity, KLD then counted all remaining open spaces in marked parking lots and some of the spaces where cars could conceivably park along curbs, in open fields and lots, and in driveways and the yards of houses and cottages in the beach areas. Id. at E-5. KLD did not assume that every conceivable piece of open ground was a parking space; in his deposition Mr. Lieberman explained that he used a series of protocols that sought to limit the spaces counted to those which reasonably could and do appear to be used on the busiest days. See Tr. 7035; see also Tr. 6102 (Lieberman). The total of the vehicles and vehicle spaces counted was 25,470, and this was KLD's estimate of parking capacity for the entire EPZ beach area. Volume 6 at E-5. KLD described this estimate as "a reasonable upper bound" to the number of possible parked vehicles in the beach area. Id.

6.1.90. The Intervenors presented the testimony of Dr. William Befort, Dr. Colin High, and Dr. Thomas Adler, which described the work they did to evaluate the KLD estimates of parking capacity in the beach areas.

6.1.91. Dr. Befort is an assistant professor at the University of New Hampshire where he teaches courses in aerial photography, terrain analysis, digital image processing and other courses in the Forest Resources Department. Befort, ff. Tr. 6849, at 2. He has 12 years of academic and professional experience in taking and interpreting aerial photographs, and he has served as a remote sensing instructor and airphoto research associate for the U.S. Forest Service. Id.

6.1.92. Dr. High is an associate professor of Engineering and Environmental Studies at Dartmouth College. High, ff. Tr. 6849, at 1. He has been an instructor in aerial photo interpretation, remote sensing, and statistical methods at the university level, and he has 22 years of experience in the use of aerial photographs in land use studies, site evaluation, and environmental science. Id. at 1-2. He has received grants and contracts from NASA, the U.S. Department of Energy, the U.S. Forest Service, and the U.S. Department of Agriculture involving the use or interpretation of aerial photographs and other remote-sensed images. Id. at 2.

6.1.93. Dr. Adler's qualifications have been previously noted. Based on his experience with traffic analysis and parking lot planning, he provided Dr. High and his staff with advice on the interpretation of parking spaces. Adler, ff. Tr. 6849, at 10. He provided advice on the parking access and traffic requirements of parking lots and curb spaces to insure that the only spaces counted were those which could practically be used and would not obstruct traffic. Id.

6.1.94. We find that Drs. Befort, High, and Adler were extremely well qualified to undertake the evaluation of the KLD estimates of parking capacity described in their testimony.

6.1.95. Drs. Befort, High, and Adler conducted their evaluation in the following manner. First, they examined the set of color slides relied on by KLD and confirmed that KLD's count of parked vehicles sighted on the August 11, 1985 slides was essentially accurate. Befort, ff. Tr. 6849, at 11. They also obtained and examined two new sets of aerial photographs, one take between 3:30 and 4:45 p.m. on July 5, 1987, and the other taken on July 19, 1987, between 1:40 and 2:40 p.m. Id. at 12. From the set taken on July 5, Dr. Befort counted the observable vehicles and Dr. High, aided by Dr. Adler, sought to estimate the parking capacity by counting empty parking spaces using essentially the same criteria used by KLD for its Volume 6 work. Id. at 12, 14. In his deposition, Mr. Lieberman described the criteria in greater detail than he did in Volume 6. Tr. 6903 (High); Tr. 7382 (Urbanik). Dr. High followed essentially the same method described by Mr. Lieberman in Volume 6 and in his deposition. Tr. 6904, 6905, 7035.

6.1.96. Drs. Befort, High and Adler were much more qualified to conduct the counts of parking spaces than Mr. Lieberman was. Mr. Lieberman admitted that he did not consider himself to be an expert in the area of aerial photo interpretation. Tr. 5642 (Lieberman). In fact, he admitted he had never taken a formal academic course in aerial photo interpretation. Id.

6.1.97. In response to a question as to whether their count of parking spaces in the beach area was an "absolute upper limit on the parking capacity of the area," Drs. High and Adler replied:

> No. It represents, in our judgment, a reasonable estimate of the available parking capacity in the area. Not all of that capacity may be in use at one time as vehicles move around the area. However, all of it could be used. The absolute upper limit is clearly greater because our parking capacity estimate restricts blocking and double-parking in driveways and yards, and does not allow for double parking on side

> streets, parking on traveled lanes, or lots and beaches. Clearly any or all of these could be used under very heavy use of beach areas. If all of these additional areas were used, the number of vehicles that could be parked would be much higher than our estimate.

High, Adler, ff. Tr. 6849, at 18.

6.1.98. In order to test how much larger an absolute upper limit on parking in the beach areas might be, Drs. High and Adler selected 10 photographs at random from the set of 108 photos taken on July 5,1987, and they counted all possible parking spaces in those photos in addition to those which had previously been counted. High, Adler, ff. Tr. 6849, at 18. In making this count they counted potential spaces previously excluded, such as vacant lots, spaces in driveways that would block others, and areas on front lawns of houses that might be used under unusual conditions. However, they did not count parking spaces that would obstruct traffic. Id. For this sample of 10 photos, this count resulted in more than double the number of unoccupied parking spaces originally counted. Id.

6.1.99. At the hearing, the members of the Board had an opportunity to review some of the aerial photos taken by Dr. Befort and a number of the work sheets created by Dr. High and his staff in the process of counting parking spaces from those photos. These work sheets were made when each slide was projected onto a sheet of white paper. Check marks were then made on the paper as a permanent record of each parking space counted. See High, Adler, ff. Tr. 6849, at 19. Two projectors were used side-by-side to ensure that there was no double counting of vehicles in overlapping photographs. Id. Some of the counting was done by two technical assistants working under

Dr. High, but both have science degrees, have experience in traffic and parking analysis, and were trained by Dr. High and Dr. Adler in the protocols being used to identify parking spaces on the photos. In blind cross-checking of their parking space counts, Dr. High testified that the counts done by the assistants differed from Dr. High's own counts by 3% or less without systematic bias. Id. at 19-20.

6.1.100. Drs. Befort, High and Adler testified that they were conservative in their interpretation of ambiguous parking spaces. High, Befort, Adler, ff. Tr. 6849, at 22. At one point, Dr. High described what they counted as the "available and obviously used parking spaces." Tr. 7027 (High). Having carefully examined the work sheets on which sample slides were projected at the hearing, see Tr. 6944-6962, the Board is in agreement with these characterizations of the work done by Dr. High.

6.1.101. We noted that parking spaces were not counted on green lawns and that the tic marks placed appeared to follow the strict protocols regarding what to count as a parking space. We had no difficulty seeing what was happening; the indication of having counted a parking space came across to us rather clearly. Tr. 6960. (Smith).

6.1.102. We find that the results of the efforts of Drs. Befort, High, and Adler to apply the KLD methodology in Volume 6 to estimate a reasonable upper bound of the parking capacity in the EPZ beach areas in 1987 are credible and supported by substantial evidence that their work was done carefully and methodically. Their results do not reflect that they counted the "absolute upper limit" on the parking capacity of the area. They appear to have done what KLD sought to do originally in conducting its ETE study, i.e., they have used aerial photography of the entire beach area to estimate a reasonable upper bound of the parking capacity in the beach areas. We specifically reject the Applicants' PF 6.1.92 that seeks to have us characterize Dr. High's estimate of beach area vehicle capacity as having been "divined by Dr. High."

6.1.103. When one compares the vehicle capacity estimates contained in Volume 6 with the results obtained by Drs. Befort High, and Adler, the numbers vary substantially. In Volume 6, KLD estimated the capacity to be 25,470. Volume 6, at 2-11, E-5. For its Volume 6 ETE runs, KLD loaded 25,808 vehicles into the IDYNEV model at "origin centroids" in the beach areas. High, Befort, Adler, ff. Tr. 6849, at 5, 17.[2/] Drs. High, Befort and Adler, however, applying essentially the same methodology, counted 38,825 parking spaces, a 52% increase over KLD's vehicle capacity estimate (25,470) and a 50% increase over the number of vehicles used in KLD's Scenario 1 ETE runs using IDYNEV. Id. at 5.

6.1.104. In separate testimony, Dr. Adler used the IDYNEV model to test the impact on KLD's Volume 6 ETEs of this higher beach area vehicle capacity. For this IDYNEV run he held all of KLD's inputs constant except that he substituted his new data for the KLD beach vehicle inputs. Adler, ff. Tr. 7181, at 21. The result for a Scenario 1/Region 1 (summer

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2/ This discrepancy is not explained, but we assume it occurred as a result of the "round-offs" associated with the need to allocate these trips over time and among the many beach centroids. See Volume 6, at M-20.

weekend/full EPZ) evacuation was that the ETE increased 51%, from 6:16 to 9:25. Id.

6.1.105. No witness at the hearings defended the beach area vehicle capacity estimates contained in Volume 6 as being currently realistic or accurate.

6.1.106. Drs. High, Befort and Adler testified that there were several possible reasons why their estimate of parking capacity in the beach areas was significantly larger than the KLD estimates. High, Befort, Adler, ff. Tr. 6849, at 21. While it is likely that an increase in the number of parking spaces did occur to some extent since 1985, this appears to have been a minor factor. Id. at 21-22.

6.1.107. The Board finds that there is inadequate evidence in the record on which to conclude that the vehicle capacity estimates contained in Volume 6 were accurate when made. There is overwhelming evidence that they are certainly inaccurate today.

6.1.108. At the hearings, the Applicants chose not to defend the current accuruacy of the NHRERP's beach vehicle capacity estimates (or the NHRERP's ETEs) but instead presented new estimates of the number of vehicles which the Applicants believe were likely to have been parked in the beach areas at about 2:00 p.m. on July 18, 1987, a day the Applicants describe as a "representative peak day." See Applicants PF 6.1.81; Tr. 6075 (Lieberman). According to Mr. Lieberman, that day "represented a day of peak traffic in the sense that it lies within the range of peak traffic day [sic], and is therefore representative of what should be used in an ETE calculation."

Tr. 6075 (Lieberman). Based on the Applicants' interpretation of the aerial photos they had taken that day, they assert that 29,239 vehicles were parked in the beach areas at 2 p.m. Lieberman, et al., ff. Tr. 5622, at 38.

6.1.109. The Applicants, in their testimony, noted that this information was being submitted "for the purpose of obtaining a broader data base and an updating of estimates." Lieberman, et al., ff. Tr. 5622, at 27. Applicants panel of witnesses, however, contained no one from the State of New Hampshire, and there is nothing in the record to indicat that the State intends to amend the NHRERP to incorporate this data. In fact, Richard Strome, the Director of the New Hampshire Emergency Management Agency, stated that other than "housekeeping" amendments to the NHRERP, there were no contemplated amendments to the plan that were not mentioned in the prefiled testimony of panels on which be participated. Tr. 4547-4548 (Strome). Moreover, on December 1, 1987, counsel for the State of New Hampshire acknowledged and stipulated that the State of New Hampshire had not yet decided to accept or reject any data bearing on evacuation time estimates recommended by the Applicants or the Intervenors. Tr. 6824-6825. According to Mr. Huntington, the State of New Hampshire will "consider any reasonable empirical data that's put before the state. We've never said anything to the contrary, and we'll stipulate to that now." Tr. 6824. When questioned by the Board whether this meant that no source of information is categorically excluded and that the State of New Hampshire will accept as useful information from any source "including evidence put on by the Massachusetts AG and Intervenors," Mr. Huntington responded: "That's absolutely correct." Tr. 6825.

6.1.110. Along with their higher estimates of the number of peak beach area vehicles, the Applicants presented additional ETE calculations. Lieberman, et al., ff. Tr. 5622, at 42-43. While these new ETE calculations are the result of a number of changes to IDYNEV's inputs, see id. at 41, the Applicants admitted that their increased estimate of vehicles in the beach areas (up 15% from 25,470 to 29,293) was probably the most pronounced factor in causing their new ETEs to be higher than those in Volume 6. Tr. 5735 (Lieberman). For a Scenario 1/Region 1 evacuation (summer weekend with good weather at mid-day/full EPZ), the Applicants now believe the ETE is 7:05, not 6:15 as noted in Volume 6. Compare Lieberman et al. ff. Tr. 5622 at 43 with Volume 6 at 10-9. The new ETE would have been higher yet, but the Applicants new ETE calculations were done using increased ramp capacities, which has the effect of decreasing the ETEs. Tr. 5735 (Lieberman).

6.1.111. The upshot is that both the Applicants and the Intervenors have submitted testimony which demonstrates that the Volume 6 ETEs are currently not realistic and are too low by a significant margin because the peak beach vehicle inputs used in calculating the Volume 6 ETEs are significantly too low. Meanwhile, the State of New Hampshire has chosen not to defend the Volume 6 ETEs, but instead has indicated that it is examining all reasonable data, including the ETE evidence presented by the Intervenors.

6.1.112. Neither FEMA nor the NRC staff sought to defend the Volume 6 beach vehicle capacity estimates. FEMA presented no ETE testimony or witnesses. The NRC staff presented the testimony of Dr. Thomas Urbanik in which he commented that, in using IDYNEV to compute summertime ETEs for Seabrook Station, he would recommend using 1,500 more vehicles than the approximately 29,000 the Applicants have recommended to account for the vehicles that are moving in traffic in the beach areas on peak days. Tr. 7374 (Urbanik).

6.1.113. Given this record, the Board must find that the IDYNEV inputs for beach vehicles used in calculating the Volume 6 ETEs are unrealistically low. These inputs have generated ETEs which themselves are hereby found to be unrealistically low for the current time period.

6.1.114. Much of the cross and re-direct examination conducted by the parties at the hearing was designed to either support or undermine the new beach vehicle estimates made by the Applicants, the Intervenors, or Dr. Urbanik. In a narrow legal sense, this Board need only decide whether the NHRERP's ETEs as contained in Volumbe 6 are realistic appraisals of the minimum period in which, in light of existing local conditions, an evacuation could reasonably be accomplished. Cincinnati Gas & Electric Company (Wm. H. Zimmer Nuclear Power Station Unit No. 1), ALAB-727, 17 NRC 760, 770-771 (1983). Having decided that the Volume 6 ETEs are not such realistic appraisals, it is not necessary for this Board to go further and comment on what should be done to achieve realistic appraisals, and we certainly are in no position to rule definitively on what the realistic ETEs in fact are. But because the State of New

Hampshire is so clearly looking for guidance on how best to proceed with its ETEs, and because the parties have created such a robust record regarding this particular issue, the Board hereby offers some further guidance on this matter.

6.1.115. We begin with an assessment of whether the evidence indicates that the State of New Hampshire has sufficient reliable and complete data now available from the Applicants, the Intervenors, or Dr. Urbanik to simply change the IDYNEV input values for beach area vehicles and then produce an adequate set of ETEs for use by protective action decision-makers. For the reasons set forth below, we find that the necessary data base does not yet exist to do this.

6.1.116. Apart from the data already contained in Volume 6, here is what the existing data base consists of. First, the Applicants, for their part, flew one aerial photo mission over the EPZ beach areas taking photos between 12:00 noon and 1:20 p.m. on Saturday, July 18, 1987. Lieberman, et al., ff. Tr. 5622, at 27, 31. The Intervenors took beach area photographs on two aerial missions, one on Sunday, July 5, 1987, between 3:30 and 4:45 p.m., and the second on Sunday, July 19, 1987, between 1:40 and 2:40. High, Befort, Adler, ff. Tr. 6849, at 12.

6.1.117. Applicants contend that the weather on Saturday, July 18, 1987, was sunny, warm and in the mid-80s. Lieberman, et al., ff. Tr. 5622, at 27. One witness, however, noted that at 11:30 a.m. that day it was cloudy and overcast off the coast in Hampton near Interstate 95. Tr. 8627 (Weinhold). On Sunday, July 5, 1987, the temperature was 80 degrees and there were scattered clouds; similarly on Sunday, July 19, 1987, the temperature was 80 with scattered clouds, but it was slightly hazy and more humid than on July 5th. High, Befort, Adler, ff. Tr. 6849, at 12.

6.1.118. The Intervenors note that their July 5th aerial photos were taken after the peak beach hours that day because parts of the coastal strip were closed to general aviation earlier in the afternoon due to a flying exhibition at Pease Air Force Base. Id. It was also noted that this flying exhibition drew a crowd of approximately 200,000 and that as a result there were likely fewer people on the beaches that day than would have been there otherwise. Id. at 21.

6.1.119. There was no dispute among the parties that the beach area population generally peaks on hot summer days at about 2:00 p.m. See Volume 6 at 2-12, 2-13; Lieberman, et al., ff. Tr. 5622, at 30-31. There is a net influx of vehicles into the beach areas prior to this point and a net outflow thereafter, at least until early evening when another net inflow occurs. Volume 6 at 2-13. About 45-50% of the tourists to the area are day-trippers. Volume 6 at 2-12, E-4.

6.1.120. Thus, the Intervenors' photos from July 19, 1987, were taken when beach population was at the peak hour that day; the Applicants' July 18, 1987, photos were taken shortly before the beach population peaked; and the Intervenors' July 5, 1987, photos were taken 1 1/2 to 2 3/4 hours after the beach population peaked.

6.1.121. Dr. Befort, who took and analyzed both the July 5th and July 19th photos, noted that even though there were more parked vehicles visible on his July 19th peak hour photos than on his July 5th late afternoon photos, there is evidence that on July 5th earlier in the day at the peak hour the number of parked vehicles may have been "much higher" than during the peak hour on July 19. Befort, ff. Tr. 6849, at 13. He noted that in the July 19th photos there is no indication of roadside parking along Route 51 leading into Hampton Beach, but in the July 5th late afternoon photos there are numerous cars still parked along that same stretch of highway, suggesting that earlier in the day on the 5th there had been a continuous line of parked cars along the road. Id. at 13-14. Dr. Adler, who was in Hampton Beach during the peak hours on July 5, actually observed a continuous line of cars parked there early that afternoon. Id. at 14. Thus, it appears that at about 2 p.m. July 5, 1987, was actually busier than July 19, 1987.

6.1.122. In modeling an evacuation from the Seabrook Station beach areas using IDYNEV, the key inputs are the number of vehicles on each portion of the beach, i.e., the number of vehicles to be loaded into the model at each "origin centroid." See generally Volume 6, Figure 1-3 at 1-13, and Appendix M. The total number of vehicles in the beach areas is not itself a number which is loaded into the model.

6.1.123. Thus, for purposes of analyzing the data obtained from these aerial photos, it is important to look at and compare the number of vehicles seen on each portion of the beach on each of these days. The evidence in the record contains such a breakout of the beach vehicle data for (1) KLD's August 11, 1985, photos, see Volume 6 at E-5; (2) Dr. Befort's July 5, 1987, photos, see Befort, High, Adler, ff. Tr. 6849, Figure 1 at 17; and (3) the Avis photos, Lieberman, *et al.*, ff. Tr. 5622, at 38. The table below summarizes these beach vehicle counts for each beach community. For each date, the top number was the number of vehicles observed and counted. The lower number -- in parentheses -- is an estimate of "capacity" or of "peak."

Beach Community	Number of Vehicles — Observed and Counted (Capacity or Peak Estimates)*		
	Aug. 11 1985	July 5 1987	July 18 1987
Plum Island	1440 (2830)	2730 (3594)	2799 (3095)
Salisbury Beach	5800 (8060)	7211 (10,567)	5548 (6119)
Seabrook Beach	2280 (2650)	2237 (3922)	2785 (3040)
Hampton Beach	6710[a] (9070)[a]	9827[a] (15,358)[a]	12,210 (13,257)
North Hampton	500[b] (600)[b]	678[b] (1140)[b]	286 (308)
Rye	1490 (2260)	1626 (4244)	3222 (3474)
TOTALS	18,220/	24,309/	26,850/

a. Excludes Plaice Cove, which is included in North Hampton totals.

b. Includes Plaice Cove

*For Aug. 11, 1985, and July 5, 1987, the numbers noted inside parentheses ( ) are estimates of a reasonable upper bound of the parking capacity of the area indicated. For July 18, 1987, the number in parentheses ( ) is the number of parked vehicles estimated by Applicants to be present at 2:00 p.m.

6.1.124. This breakout reveals that the photos for July 18, 1987, contained substantially fewer parked vehicles in Salisbury Beach than were seen parked in the July 5, 1987, photos taken between 3:30-4:45. (The July 18, 1987 photos contained fewer parked vehicles on Salisbury Beach than even the August 11, 1985, photos.) Even with the Applicants' adjustment in their July 18th counts to project forward in time to 2:00 p.m., the number of vehicles they estimate to be the "representative peak" for Salisbury Beach (6119) is over 1000 vehicles less than were observed parked (7211) well after the peak (2:00 p.m.) hour in the July 5th photos. At least for Salisbury Beach, July 18, 1987, was not the peak day last summer.

6.1.125. Given this beach-by-beach data, it is clear that Applicants' estimates of parked vehicles at 2 p.m. on July 18, 1987, cannot, by themselves, represent an approximation of the "peak" number, or capacity, of vehicles that would be in each of the beach communities under Scenario I conditions.

6.1.126. The evidence in support of a finding that July 18, 1987, was a "representative peak day" for the Hampton and Seabrook beach areas is also less than convincing. In Applicants' direct testimony they note only that the weather conditions that day "were ideal for beach-goers: sunny, warm and in the mid-80s." Lieberman, et al., ff. Tr. 5622, at 27. From this the Applicants, in an unexplained leap of logic, immediately conclude that "[t]his weather attracted an attendence at the beach which was comparable to that on the peak day in the summer of 1983, July 16th." Id. During cross examination, Mr. Lieberman sought initially to justify this conclusion by noting that (1) the July 16, 1987, counts of parked vehicles "corresponded in magnitude, although not in dispersion, to the upper bound estimate which we made on the basis of the '85 films" and (2) that there were press reports at the time "to the effect that the heat wave which took place in mid-July [1987] resulted in peak volumes at the beach." Tr. 6074 (Lieberman). It is pure sophistry, however, to argue that by showing a correspondence of the gross number of parked vehicles seen in the photos taken on July 18, 1987, and the parking capacity estimates made from photos taken in August 1985, you have proof that July 18 was a peak day. If the August '85 capacity estimates are themselves well below actual capacity, as Intervenors' testimony has shown, then one cannot argue convincingly that days which draw a corresponding number of vehicles are "peak" days. As for the press reports, Mr. Lieberman identified these to be a Boston Globe article and some tourist-oriented publications which are issued in the coastal areas. Tr. 6075 (Lieberman). Mr. Lieberman described these articles as reporting unnamed local officials who were proclaiming "that this was a banner year with some recordbreaking crowds at the beaches." Id. There is no indication that these assessments by local officials were anything but subjective. Applicants wisely chose not to offer these press reports into evidence. Even if they had been received, they would be highly unreliable hearsay and we would give them little probative weight. Local officials in tourist areas, and tourist publications promoting these areas, are not known for their objective assessments of weather and tourist crowds. Apart from this, however, Mr. Lieberman's description of these press reports indicates that the reports themselves are general in nature and do not pinpoint July 18, 1987, as the peak day last summer.

6.1.127. Later during his cross examination, Mr. Lieberman attempted yet another argument to justify his conclusion that July 18, 1987, the day on which Avis Airmap took aerial photos for him last summer, was a representative peak day. This argument is based on two sets of traffic count data for vehicles entering the beach area on Routes 51 and 286. The first set of data was obtained by HMM Associates on July 16, 1983, and is but a small part of a large traffic count study conducted by HMM in the beach areas in the summer of 1983. See Volume 6, Appendix E, item 9 at E-7; Applicants' Ex. 32. The second set was obtained by the Applicants themselves on July 18, 1987. Both sets of data are for the time period when the Avis photos were taken on July 18, 1987, i.e., 11:30 a.m. to 12:30 p.m. These data are reported in the Applicants ETE testimony, where they are used for another purpose (to justify the projections of Applicants' vehicle counts on July 18, 1987, forward to 2:00 p.m.). Lieberman, et al., ff. Tr. 5622, at 33. These data are set forth below:

Entering Vehicles	Applicants' Counts July 18, 1987 11:30 - 12:30	HMM Counts July 16, 1983 11:30 - 12:30
Route 286	975	856
Route 51	869	998
TOTAL	1844	1854

Mr. Lieberman's argument starts from his premise that 1983 was the "previous banner season," Tr. 6084 (Lieberman), and that July 16 was the "peak day" that summer. Tr. 6083, 6084 (Lieberman). He then notes that for this 1-hour period the total entering vehicles on these two beach-access roads on July 18, 1987, was within 10 vehicles of the number recorded on July 16, 1983. On this basis, Mr. Lieberman concluded that "the traffic on July 18th, 1987, is representative of peak traffic. By representative, I mean in the general range of peak demand on the beaches." Tr. 6084 (Lieberman).

6.1.128. The Intervenors dispute every aspect of this argument. First they attack the premise that 1983 was the previous banner season prior to 1987. Next, they challenge Mr. Lieberman's conclusion that July 16 was the day in 1983 when the highest number of vehicles were present in the beach areas. Finally, they challenge the notion that a similarity in the influx rates from 11:30 a.m. to 12:30 p.m. on two summer days in different years indicates that the total number of vehicles present in the beach areas at 2:00 p.m. on both those days was comparable. Each of these points is discussed in turn below.

6.1.129. With respect to Mr. Lieberman's conclusion that 1983 was the previous banner season prior to 1987, the evidence is slim. Mr. Lieberman bases his conclusion on only his conversations in 1985 with local officials in which they offered their subjective judgments that 1983 was the peak year within memory. Tr. 6084. On cross-examination Mr. Lieberman also admitted that by calling 1983 the previous banner season, he did not know whether there might have been days during other years when more vehicles were present than were present on July 16, 1983. Tr. 6096. All he could say was that in his view, July 16, 1983, was the peak for the two years 1982 and 1983. Id.

6.1.130. The Board finds that there is no reasonable assurance that 1983 was the previous "banner" season, but it also finds this to be an inmaterial issue. More importantly, regardless whether one season or another was generally warmer and drew more people to the beaches in total over the course of the season, there is wholly inadequate evidence from which to conclude that the peak day in the past five or six years occurred in 1983. It may well be that a series of individual days in other years form a class of representative peak days which experienced significantly greater beach attendance than occurred on July 16, 1983.

6.1.131. Intervenors also dispute that July 16, 1983, was the day in 1983 when, at any single point in time, the number of vehicles in the beach areas reached its highest level. Mr. Lieberman cites the 1983 HMM traffic count study as his source for the conclusion that July 16, 1983, was the day that year in which the peak traffic volume occurred. Volume 6 at 2-10, E-7.

6.1.132. Dr. Adler testified, however, that this HMM study does not contain reliable data which can be used to support this conclusion; instead it indicates only that the "total daily traffic" (i.e. the sum of inbound plus outbound traffic) counted at six automatic counter stations peaked on

July 16, 1983. Adler, ff. Tr. 9524, at 10. See also Volume 6 at E-7. However, as Dr. Adler cogently explained, this is only part of the story. Id. at 10-11. As noted previously, there is general agreement that only approximately one-half of the total beach area transients on busy days are day-trippers; the other half are comprised of seasonal, monthly, weekly, and overnight vacationers. See also Volume 6 at 2-12 and Appendix E, item 6, at E-4, E-5. Thus, there are two traffic cycles occurring in the beach areas: one is a daily cycle of day-trippers into and out of the beach areas; the other is a longer cycle which reflects the total accumulation of overnight vacationers. Tr. 9552 (Adler).

6.1.133. Other witnesses have confirmed the existence of a large population of vacationers who rent motel rooms and cottages during the summer. See, e.g., Hollingworth, et al., ff. Tr. 8608 at 3.

6.1.134. Dr. Adler testified that traffic recorders (counters) measure only the amount of traffic flowing in and out of the beach areas at a particular point in time on a particular day. Tr. 7000 (Adler). But, he said, there are many people who come into the beach areas who stay for longer than a single day. Id. Thus, to use automatic traffic recorders ("ATRs") only on a Saturday to measure the beach population is to exclude all those vehicles that have accumulated in the beach areas over the previous days and weeks. Tr. 7000 (Adler). It is for this reason that he believes that simply counting traffic at exterior locations on a particular day does not give a very good indication of the total accumulation of people and vehicles in the beach areas. Id. We are persuaded by this reasoning and agree with it.

6.1.135. We also agree with Dr. Adler's opinion that the periods of peak daily traffic likely correspond to the days when the day-tripper population peaks. Adler, ff. Tr. 9524, at 10; Tr. 9554. It is reasonable to assume that a day with the kind of ideal beach weather that draws massive numbers of day-trippers is also the kind of day when those vacationers who are already there go swimming and sunning rather than driving around.

6.1.136. Logically, the Board recognizes that there may well be weekly and seasonal trends in the size of the vacationing population that are not reflected by an examination of the total daily traffic levels. For example, there could be a massive number of day trippers -- and a high "total daily traffic" level -- on a hot day early in the summer before the vacation population had grown much at all. Similarly, there could be low "total daily traffic" on a day during the prime vacation season when thousands of vacationers were present but, because the weather was awful, the day-tripping population was off and the vacation population stayed in the motels and cottages. By definition, the total number of vehicles in the beach area peaks on the day when the sum of 1) the vehicles arriving that day (mostly day-trippers with some arriving vacationers) and 2) the vehicles already there (mostly vacationers and a few residents) reaches the highest level of the season.

6.1.137. Dr. Adler examined the HMM traffic count data, collected over the summers of 1982 and 1983, to see what it indicated about the accumulated number of vacationers' vehicles in the beach area over the course of those summers. In Dr. Adler's view this HMM data, in theory, could be used to determine the actual accumulation of such vehicles in the beach areas over the course of a full season. Adler, ff. Tr. 9524, at 10. This could be done by examining the HMM data from those HMM counter stations which defined a "cordon" around the beach areas. Id. at 11. The seasonal accumulation of vacationers' vehicles can then be graphed by plotting, for each day, the net number of vehicles remaining in the area overnight, i.e., the sum, accumulated across each day of the season, of the number of vehicles entering minus the number leaving the area. Id. at 10-11. These accumulated vehicles do not reflect day-tripper vehicles because day-trippers are in and out within a 24 hour period.

6.1.138. When Dr. Adler graphed the 1983 HMM seasonal vehicle accumulation data for the cordon formed by the Hampton, Seabrook, and Salisbury beach areas, the trend revealed was a decrease rather than an increase in net vehicle accumulation over the course of the summer. Id. at 11 and Figure 1. In Dr. Adler's opinion, this trend is not plausible and cannot be true if 1983 had seasonable warm and sunny weather. Id. at 11; Tr. 9556, 9696. The 1983 trend also did not parallel the 1982 data, which showed an upward trend with reasonable daily accumulations. See Tr. 9587 (Adler).

6.1.139. In Dr. Adler's opinion, the most plausible reason for the negative net vehicle accumulation revealed by the graph of HMM's 1983 data was that one of HMM's pneumatic tube-type recorders was malfunctioning over the 1983 season. Adler, ff. Tr. 9524, at 11; Tr. 9587, 9606. Such pneumatic tube-type recorders have a propensity to miscount vehicles if the tube is misaligned or a vehicle passes very slowly over the tube. Adler, ff. Tr. 9524, at 11 n. 3. It does not take a very high percentage daily error to result in an accumulated error over the season of 80,000 to 100,000 vehicles. Tr. 9556 (Adler). Thus, in Dr. Adler's veiw, the 1983 HMM data obscures actual trends and therefore cannot be used to make seasonal projections of net vehicle accumulation. Id.; Adler, ff. Tr. 9524, at 11; Tr. 9556, 9591.

6.1.140. Given the absence of reliable seasonal trend data for 1983 which indicates when the population of overnight-staying vacationers peaked, Dr. Adler states that there is no assurance whatsoever upon which to conclude, as Applicants have done, that the 1983 HMM data reveal July 16th to be the "peak" day that year for total vehicles in the beach areas. See Tr. 9610, 9613 (Adler).

6.1.141. Dr. Adler also used the HMM traffic count data to examine and compare for 1982 and 1983 daily (as opposed to seasonal) vehicle accumulation and daily total traffic in some of the beach areas. Adler, ff. Tr. 9524, at 11, and Figures 2 and 3. Dr. Adler testified that the measurement errors which prevent meaningful analysis of the seasonal trends are not as severely compounded when only the daily vehicle accumulations are plotted. Id.; Tr. 9586. So while Dr. Adler recognized that the daily data are somewhat inaccurate, perhaps by one or two percent, he believed that the data were reliable enough for making daily comparisons. Tr. 9556. For 1982, the daily HMM data he relied upon came from four data stations which defined a cordon around the entire Seabrook and Salisbury beach areas and the significant portion of Hampton Beach. Id., Figure 2; Tr 9626 (Adler). For 1983 the daily HMM data he relied upon came from three data stations which defined a cordon around approximately one half of the Salisbury and Seabrook beach areas. Id., Figure 3; Tr. 9586. Using these cordons, Dr. Adler was then able to graph the HMM data and show, day by day, the fluctuation in 1) the total traffic level (the sum of inbound plus outbound at each counter station) and 2) the daily vehicle accumulation (the total daily inflow minus the total daily outflow for the counters which formed the cordon). Adler, ff. Tr. 9524, at 11. See id., Figure 2 and 3 (hereinafter "Adler Figure 2" and "Adler Figure 3").

6.1.142. These graphs in Adler Figure 2 and Adler Figure 3 show that the days with the highest traffic levels do not generally correspond to the days with the highest daily accumulation. Adler, ff. Tr. 9524, at 11. In the graphs, the former occur earlier the season than the latter. Id. In fact, the days with the highest daily vehicle accumulation tended to be in late July or August. Id. at Figure 2 and 3.

6.1.143. Based on this limited HMM data showing days of heavy vehicle accumulation in late July and August, Dr. Adler suggested that it was at least a plausible hypothesis that the seasonal peak vehicle accumulation was more likely to be in late July or August than in mid-July. Adler, ff. Tr. 9524, at 11; Tr. 9594, 9596.

6.1.144. This hypothesis seems to be reasonable to Dr. Adler and worth exploring further because it is consistent with other information which suggests that late July or August might be very reasonable times for vehicles to peak in the area. Tr. 9598 (Adler). For example, the day-tripper population is known to be very large in Salisbury each year in late July when the pro beach volleyball tournament attracts crowds of upwards of 100,000. Id. In addition, many vacationers in the seacoast area take their vacations in late July and August, when the ocean water temperature in northern New England is always highest. Id.

6.1.145. In cross examining Dr. Adler regarding this use of the 1983 HMM data, Applicants sought to undermine Dr. Adler's conclusions, and his credibility, by suggesting that Dr. Adler intentionally biased his analyses by using a smaller "cordon" for his 1983 graph (Figure 3) than he did for his 1982 graph (Figure 2). Tr. 9585-9601, 9607-9610. Dr. Adler repeatedly explained that he used the smaller cordon for 1983 because he believed the data for the larger cordon were not reliable due to a malfunction in one of the recorder stations. Tr. 9587, 9610. On many, but not all, days in 1983 he found that the larger cordon registered a negative accumulation, and it showed negative net accumulations over the summer. Tr. 9589. Dr. Adler believed that such a negative accumulation was not plausible. Tr. 9606. On cross examination Applicants had

Dr. Adler examine the 1983 HMM data for the larger cordon and identify a few of the days in the summer of 1983 when that cordon recorded positive vehicle accumulations. Tr. 9588, 9589, 9607-9609. Applicants then challenged Dr. Adler to admit that if he had graphed the 1983 HMM data for the same larger cordon that he had used in 1982, the result would have run counter to and totally negated or refuted his hypotehesis that peak accumulation could occur in late July or August. Tr. 9589, 9591, 9595, 9586. While Dr. Adler agreed that the HMM data set was qualitatively inadequate to make definitive judgments about when peak days occur, Tr. 9596, Dr. Adler denied that, if graphed for the 1983 summer season, the HMM data set for the larger cordon necessarily "runs counter" or totally negates or refutes his hypothes that the peak occurs in late July or August. Tr. 9589, 9591, 9594.

6.1.146. Applicants' Ex. 32, the HMM data which Dr. Adler relied upon, has now been carefully examined by the Board. We sought to plot the 1983 data for the larger cordon (count locations 1, 3, 5, 6) just as Dr. Adler had done for 1982. In doing so we do not suggest that we disagree with Dr. Adler's opinion that this data set is unrealiable due to the malfunction of a recorder. We have examined this data only to see whether -- as was suggested by the Applicants -- the entire data set, and not just the data from the particular days questioned by the Applicants, negates Dr. Adler' hypothesis.

6.1.147. The graphi[illegible] result of this [illegible]alysis [illegible] Applicants' Ex. 32 are set [illegible] Appendix A hereto. [illegible] data in the graph are tak[illegible] [illegible]m Table 3.1 (p. 3-[illegible]) of the HMM report submitted as Applicants' Ex. 32. The upper line represents total daily traffic (both directions) recorded at the four cordon locations listed at the bottom of Table 3.1. (These are known as count locations 1, 3, 5, and 6 and define the same larger cordon Dr. Adler graphed for the 1982 HMM data in Adler Figure 2.) The corresponding data are shown in the rows labeled "Day Total" in that table. The lower line represents the daily vehicle accumulation, and again the data come from Table 3.1; each point on the graph represents the value in the Table 3.1 row labelled "Day In" minus the corresponding value in the "Day Out" row for each day.

6.1.148. While Dr. Adler is correct that there are a large number of days when there was a large negative daily vehicle accumulation, there are also a number of days when significant positive net daily accumulation occurred. The three days during the 1983 season with the highest net accumulations were Friday July 1, Thursday July 28, and Thursday August 25. August 25th had the highest net accumulation -- about 7,000 vehicles on that one day. See also Tr. 9606 (Adler). We also note that, as with Dr. Adler's graphs (Figures 2 and 3), the days with the highest daily traffic levels do not generally correspond to the days with the highest daily accumulations.

6.1.149. Based on our examination of this data set, we cannot find that it negates or refutes Dr. Adler's hypothesis that the day of peak accumulation is more likely to occur in late July or in August.

6.1.150. We dismiss the suggestion that Dr. Adler intentionally biased his results by declining to rely on this data set for his testimony. To the contrary, because Dr. Adler even though he could have done so, chose not to present us with a graph like the one we set forth in Appendix A, a graph that appears to support his hypothesis nearly as well as his Figure 3, we find our esteem for his credibility to be enhances. He believed the 1983 data to be less than reliable; so he elected not to present these data to us even though they support his hypothesis and would have avoided generating the questions that arose by his use of the data from the smaller cordon.

6.1.151. We also agree with Dr. Adler and find that the 1983 HMM data provide an inadequate data base from which to conclude, as the Applicants have done, that July 16, 1983, was the day when the number of vehicles in the beach areas was at its season high. The HMM data for 1983 indicate only that July 16 was the "peak" day that year for total daily traffic. See Appendix A. The HMM data do not confirm, however, that more vehicles were present that day in the beach areas than at any other point that summer. The 1983 data do not reveal July 16 to have experienced anywhere near the highest "daily vehicle accumulation" for the season, nor do the data confirm that a large build up, or accumulation, of vacationers' vehicles occurred in the days immediately preceeding July 16, 1983. The Board recognizes that it is possible for the peak day of the season to occur on a day when, sometime after the peak hour, a massive outflow (negative accumulation) of vacationers occurs.

Thus, the "daily vehicle accumulation" registered for that day could well be a large negative number. But we would expect such days to be preceeded by days which experienced a sizeable build-up of vacationers' vehicles that would be reflected in the HMM data. For example, in Dr. Adler's Figure 2, attached to his prefiled tesitmony, ff. Tr. 9524, the day in 1982 with the highest "total daily traffic," Sunday July 4, had a "daily vehicle accumulation" that was close to zero. Numerous other days experienced a much large "daily vehicle accumulation." But the two days prior to July 4th both experienced a significant accumulation of vehicles. Thus, we can surmise that on Sunday, July 4, 1982, there was a very large number of vacationers and day-trippers present in the beach areas at mid-day. However, when we examine the days immediately prior to July 16, 1983, see Attachment A, we find no such vehicle accumulation pattern. There appears to have been a very modest vehicle accumulation on the day before July 16 and sizeable negative accumulation over the five days before that.

6.1.152. However one examines them, the HMM data do not support the Applicants' claim that July 16, 1983, was the day in 1983 when more cars were present in the beach areas than at any other point during the summer.

6.1.153. While the net influx of vehicles on Routes 51 and 286 between 11:30 a.m. and 12:30 p.m. may have been similar on July 18, 1987, and July 16, 1983, see Tr. 6083-6084, this similarity is not probative of whether July 18, 1987, is a representative peak day. First, as noted above, the HMM data do not support the argument that July 16, 1983, was such a day. Second, [illegible] July 16, 1983, was such a peak day, the Board [illegible] persuaded that a one hour similarity in net vehicle influx on two day which are 4 years apart means necessarily that both days had a similar net influx for other hours or that the total vehicle accumulation for both days was the same.

6.1.154. For the reasons described above, the Board finds that the 1982-83 HMM traffic data do not support Applicants' position that their July 18, 1987, aerial photos of the EPZ beach areas were taken on a representative peak day, i.e., a day in which the total number of vehicles belonging to day trippers, vacationers, and residents in the area is approximately as high as it gets.

6.1.155. Thus it appears that none of the Applicants' arguments that July 18, 1987, was a "representative peak day" are persuasive. The best that can be said of Applicants' beach vehicle count testimony is that we are left with substantial uncertainty regarding whether July 18th was such a day.

6.1.156. Ther is another independent reason to have serious doubt about the Applicants' beach vehicle count testimony. In cross examining the panel which presented the Applicants new beach vehicle estimates, the Intervenors established that the Applicants started their beach vehicle update work in the summer of 1987 fully intending to use the same methodology for counting beach vehicle capacity used in making the Volume 6 estimates. Well after the photos were taken on July 18, 1987, the Applicants were pressing Avis Airmap to count the non-delineated parking spaces needed to make these estimates of "capacity." Late in the summer, however, when Applicants finally realized that Avis Airmap was not going to count these non-delineated spaces and that the Applicants were not going to have a new "capacity" estimate to insert into their testimony, the Applicants belatedly decided to call July 18, 1987, a representative peak day. See generally Tr. 5861-6140. At best this was a desperate attempt to rationalize the use of what they had -- an estimate of parked vehicles only -- as a measure of the Scenario 1 beach vehicle population. At worst, it was a deliberate effort, in reaction to the "high" vehicle count they received back from Avis, to shift methodologies (from (1) vehicles parked plus spaces, in Volume 6, to (2) vehicles parked) in order to minimize the increases in ETEs this new data would otherwise have generated if spaces were added to the vehicles counted. In either case, our suspicions that July 18, 1987, may not have been a representative peak day are heightened by the sequence of these events.

6.1.157. The Intervenors presented other testimony which tended to refute the Applicants' position that July 18, 1987, was a representative peak day in Hampton Beach. One traffic volume indicator which Mimi Fallon has noticed during her many years of observing traffic in the beach areas is the number of cars parked along the sides of certain roads such as Route 51 as it leaves Hampton Beach. Tr. 8666. This condition was described by William Lally and Victor DeMarco, two of Hampton's police officers, ff. Tr. 3659, at 7, and was observed by Dr. Adler when he vistied the Hampton Beach area on Sunday, July 5, 1987. Tr. 6889. Mrs. Fallon's videotape contained footage which showed traffic parked along Route 51 in the marsh area to the west of Hampton Beach. See SAPL Ex. 7. See also Tr. 8618-89619. Mrs. Fallon testified that she finds such parking conditions along Route 51 on the busier summer days. Tr. 8666 (Fallon). When she viewed the Applicants' July 18th photo of this area and saw no cars parked along that road, she was absolutely certain that the photo had not been taken on a peak beach day. Tr. 8667. The traffic she observed on July 5 and 19, 1988, was "considerably heavier," she testified. Fallon, ff. Tr. 8608, at 3.

6.1.158. State Representative Beverly Hollingworth of Hampton, who is lifelong resident of the New Hampshire seacoast area and has been a motel owner there since 1956, testified that the vacationing population (those renting cottages and motel rooms) dips near mid-day on Saturdays during the summer. Hollingworth, ff. Tr. 8608, at 3; see Tr. 8640-8642. This occurs, she stated, because check-out time for renters of motel rooms and cottages in the area is generally on Saturdays at 11 a.m., and no check-ins or parking are allowed before Saturday at 1 p.m. Id. Therefore, she testified, Applicants' July 18, 1987, aerial photos of the beach areas were taken on the wrong day of the weekend. Id. These photos were taken on a Saturday between 12:00 noon and 1:20 p.m., Applicants' Dir. No. 7, ff. Tr. 5622, at 31, which coincides with the check-out/check-in period described by Rep. Hollingworth. She believes that photos taken on a summer Sunday at mid-day would show a greater occupancy of motel/cottage parking spaces. Id. She inspected the Applicants' Saturday July 18th aerial photo which showed her motel, and it showed several open spaces in her parking lot. Id. Yet, according to Representative Hollingworth, this parking lot is always virtually filled during the busy summer weeks except for this span of time on Saturdays between check-out and check-in of renters. Id.

6.1.159. The Intervenors also presented testimony that, weather being equal, Sundays are generally busier days than Saturdays. Fallon, ff. Tr. 8608, at 3; see Tr. 8640 (Hollingworth). Rep. Hollingworth, who has lived in the area for close to 50 years, also has personally observed that traffic is much heavier on Sundays, Tr. 8675, and Mrs. Fallon testified that in examining 61 years of receipts of an operating drugstore, the Sunday receipts were always the largest of the week. Fallon, ff. Tr. 8608, at 3.

6.1.160. Mimi Fallon, who has resided at Hampton Beach for the past 32 summers, Fallon, ff. Tr. 8608, at 1, also testified that people who live and work in the beach areas drive as little as possible on Sundays in the summer in order to avoid the traffic jams caused by the day-trippers. Tr. 8622 (Fallon).

6.1.161. One witness also noted that on Saturday, July 18, at 11:30 a.m. it was cloudy and overcast in Hampton out near Interstate 95. Tr. 8627 (Weinhold)

6.1.162. To the extent that it can be argued that because there was a similar number of observed parked vehicles in each of the three sets of aerial photos the parties had taken in July 1987 this proves the existence of a class of representative peak days, we reject this argument. See

Applicants' PF 6.1.86. First, the photos were taken on only two weekends during the summer. There is no evidence regarding the 10 or 11 other weekends. Second, each set of photos was taken at a different time of day. We cannot assume that if all three sets had been taken at 2:00 p.m. they would have revealed a similar number of observed parked vehicles. Third, as we have already noted, the number of vehicles observed on Salisbury Beach was not similar on July 5 and July 18. The evidence noted previously of parking along Route 51 on July 5 but not on July 18 also suggests that at the peak hour (2:00 p.m.) there was a dissimilar number of vehicles present in Hampton Beach on these two days. In sum, these three sets of aerial photos taken in the summer of 1987 constitute an inadequate data base from which to conclude that each or any of them were among a class of representative peak days.

6.1.163. If anything, what the three sets of aerial photos reveal is that the <u>distribution</u> of vehicles in the beach areas is not uniform. A peak day for Hampton may not be a peak day for Salisbury, and the time of day when the number of vehicles in the beach areas peaks may not be 2 p.m. in all places. The flow of vehicles into and out of each of the beach areas appears to be a much more complex system than the Volume 6 ETE study assumed.

6.1.164. Dr. Adler testified that in the absence of an adequate data base from which to determine when the number of parked vehicles reaches its peak in the beach areas, the only prudent approach is to use parking "capacity" as an indicator of maximum vehicle accumulation. Adler, ff. Tr. 9524, at 12. He notes that this was the approach used in Volume 6. Id.

6.1.165. Mr. Lieberman generally agrees with this view, admitting that when one lacks evidence that one's aerial photos were taken on a peak day, "and if you have no other data source for which to make an estimate, which was the case for us in August of 1985, then you are obligated, it seems to me, to do the kind of thing that we did, and as documented in [Volume 6] Appendix E." Tr. 6104 (Lieberman).

6.1. 166. Dr. Urbanik also agrees with this general approach. In his direct testimony he admitted that the methodology utilized by KLD in Volume 6 to estimate transient populations was reasonable. Urbanik, ff. Tr. 7372, at 15; Tr. 7378,7379.

6.1.167. The only estimate in the record of a reasonable upper bound for parking capacity in the beach areas for the 1987 season is that offered by Drs. High, Befort and Adler -- 38,825. See High, et al., ff. Tr. 6849, at 5, 17.

6.1.168. Dr. Urbanik believes, however, that a capacity estimate of nearly 39,000 vehicles is unreasonble and substantially exceeds the highest number of vehicles that would ever likely be present in the beach area at one time. See generally Tr. 7385-7388, 7397-7399. Dr. Urbanik expressed two reasons for this view. First, he believes the roads leading into the beach areas have capacity constraints which actually prevent an influx rate sufficient to accumulate 39,000 vehicles on busy days. Tr. 7397-7399. Second, he believes that in actual practice it is difficult to achieve a parking occupancy rate close to 100% of capacity. Tr. 7385-7388.

6.1.169. In his rebuttal testimony, Dr. Adler responded to Dr. Urbanik's claim that 39,000 vehicles could not enter and park in the beach areas. Adler, ff. Tr. 9524, at 12-13. He explained that to accumulate 39,000 vehicles in the beach areas it is necessary for the roads to handle in one day only the inbound day-trippers plus (especially on Sundays) some small fraction of the overnight visitors. Id. Many vacationers (and some permanent residents) would already be there on peak days. Thus, only as many as 20,000 vehicles or so would need to arrive in the morning and early afternoon to reach an accumulation of 39,000 vehicles, and Dr. Adler is confident that the roadway capacity is sufficient to handle an influx this large over this time span. Id. We find this response to be credible and convincing.

6.1.170. Mr. Lieberman also disagrees with Dr. Urbanik's theory that the inbound roads constrain the entry of vehicles into the beach areas on busy days. He said that it would be "dead wrong" to assume that the inbound roads approach saturation in the hour or two before the 2:00 peak on busy days. Tr. 6091. He notes that on the July 18th Avis photos, which were taken between noon and 1:00 p.m., the inbound roads are seen to be lightly traveled. Tr. 6091-6092. Of course, this may be just another indication that July 18, 1987, was not in a class of representative peak days.

6.1.171. Representative Hollingworth also disagreed with Dr. Urbanik's opinion that the parking lots in the beach areas are never totally filled. Hollingworth, ff. Tr. 8608, at 5. She testified that the lots are almost always filled on weekends. Id.

6.1.172. The Board is not persuaded that 39,000 is an impossible number of vehicles to have in the beach areas at any one time.

6.1.173. To further evaluate the reasonableness of 39,000 as the number of vehicles to load into the IDYNEV model at the beach centroids for Scenario 1 purposes, the Board has assessed how may vehicles in total may have actually been in the EPZ beach areas at 2:00 p.m. on July 18, 1987. Although we have noted above that there is evidence to suggest that July 5, 1987, was a busier day, the Applicants have provided a reasonable estimate of how may vehicles were parked in the beach areas out-of-doors at 2:00 p.m. that day, and for purposes of our analysis here, this number provides a reasonable starting point. Applicants' estimate of parked vehicles observed on July 18, 1987, was approximately 29,300. To this we add the 1500 vehicles which the Avis photos reveal were on the beach area roads. They, too, will be part of the evacuation stream off the beaches, and Dr. Urbanik and Dr. Adler both testified they should be included. Tr. 7374 (Urbanik); Adler, ff. Tr. 9524, at 9. In addition, the Intervenors presented convincing unrebutted testimony based on field observations that there are in excess of 2200 parking spaces in the EPZ beach areas which are not observable in vertical aerial photos because they are in under-building parking areas, garages, and carports. Hollingworth, ff. Tr.

8608, at 5 (1664 such spaces in New Hampshire); Moughan ff. Tr. 9494 at 2 (548 such spaces in Massachusetts). It is not unreasonable to assume that on reasonably busy beach days 90%, or about 2000, of these vehicle spaces would be occupied. See Adler, ff. Tr. 9524, at 14. Together the 29,300 parked vehicles seen, the 1500 vehicles seen on the roads, and 2000 more which likely were parked in spaces hidden from view, total 32,800 vehicles which were likely present in the beach areas on July 18, 1987, a day which we have noted appears to be less than a peak day for both Salisbury Beach and Hampton Beach.

6.1.174. Taking this analysis a step further, the Board has sought to estimate how many more vehicles have actually been known to be present in Hampton Beach and Salisbury Beach on busy days. As we noted earlier, using his July 5th aerial photos taken in the late afternoon, Dr. Befort actually observed and counted about 1000 more parked cars in Salisbury Beach than the Applicants have estimated were parked there at 2:00 p.m. on July 18th. Compare Befort, et al., ff. Tr. 6849, at 17, with Lieberman, et al., ff. Tr. 5622, at 38. Dr. Befort notes that by the time he photographed the coast on July 5th, i.e., between 3:30 and 4:45 p.m., the parking areas were already starting to empty, and the Salisbury parking lot, which is the largest parking lot in the entire strip, was only half full. Befort, ff. Tr. 6849, at 13. Given that Dr. Befort counted over 7,000 parked vehicles in Salisbury Beach between 3:30 p.m. and 4:45 p.m. on July 5, 1987, we think it is reasonable to estimate roughly that an additional 500-1000 or more vehicles would have been parked in the entire Salisbury

Beach area at 2:00 p.m. on July 5 than were seen parked there between 3:30 and 4:45 p.m. that day. Cf. Volume 6, Table 2-3 at 2-13 (net outflow from Seabrook and Hampton Beach areas exceeded 1650 vehicles between 2-4 p.m. on July 16, 1983).

6.1.175. Regarding Hampton Beach, witnesses have noted that Applicants' July 18th photos do not reveal a line of parked vehicles extending out of Hampton Beach on Route 51 toward the mainland as would happen on the busier summer days. See e.g., Tr. 8660-8667 (Fallon). Applicants, however, have projected the number of parked vehicles seen in the Avis photos forward in time to 2:00 p.m. and estimated that there would be about 1050 additional vehicles parked in Hampton Beach than were observed parked in the Avis photos. See Lieberman, et al., ff. Tr. 5622, at 36. And our starting point for this exercise was the Applicants' 2:00 p.m. estimate, which included these additional vehicles. So, presumably, some of these later-arriving vehicles could have parked out along Route 51. But the Avis photos of Hampton Beach also reveal that there were large lots, such as the one at Hampton Beach State Park, see SAPL 37, Tr. 8619, which were not filled when the photos were taken between 12:00 noon and 1:00 p.m. So we doubt that all the later-arrivals on July 18th would have parked along Route 51. Those spaces are quite some distance from the beach, and we suspect that people do not park there in large numbers until the lots and spaces closer to the beach are nearly filled. Thus, on days when many cars are parked well out on Route 51 to the west of Hampton Beach, there could reasonably be another 500-1000 vehicles or more in total in the Hampton

Beach area than Applicants have estimated were present on July 18th. Thus, if we take our estimate of 32,800 total vehicles present in the beach areas on July 18, 1987, and adjust that figure upward by a reasonable amount to account for vehicles that are known to park in the Salisbury and Hampton beach areas on busier days we must add:

	1000	Additional vehicles Dr. Befort observed parked in Salisbury on July 5th (after 3:30).
	+ 500 - 1000	Additional vehicles likely to have been parked in Salisbury on July 5th at 2:00 p.m.
	+ 500 - 1000	Additional vehicles likely to be parked in the Hampton Beach area on days when many cars park along Rt. 51.
TOTAL	2000 - 3000	

This means that on busy days, there could well be from 34,800 - 35,800 or more vehicles in total in the beach areas.

6.1.176. In this context, the Intervenors' estimate of 38,825 vehicles appears to us to be a reasonable "upper bound" to the parking capacity in the beach areas, and we have no objection if the state of New Hampshire opts to use this number as the "peak" number of vehicles anticipated for the 1988 summer beach season when it re-does its ETE study. We do not view the Applicants' estimate of 29,293 vehicles or Dr. Urbanik's estimate of about 31,500 vehicles to be reasonable estimates of the "upper bound" of the parking capacity in the beach areas. (Nor can those estimates reasonably be described as "representative" of a peak day.)

6.1.177. This does not mean that all the state of New Hampshire needs to do is to plug 38,825 vehicles into the IDYNEV model and then run the numbers just as was done in Volume 6. Dr. Adler testified that without additional information emergency decision-makers will not know accurately enough on a given day how many vehicles are in the beach areas to be able to project ETEs to within 10 or 15 percent of accuracy. Tr. 7052 (Adler). He stated that the question of which ETE numbers to use on a particular day "is in fact a very complex question." Tr. 6999. While decision-makers may have some indirect evidence whether the beach population is large or small, id., the NHRERP does not provide them with a mechanism to make a more precise estimate on a particular day of how many people (vehicles) are there. Tr. 7000 (Adler).

6.1.178. It is not only the highest number of people/vehicles that is in the beach areas during the summer that is of concern. Emergency decision-makers need to have a reasonably realistic estimate of how many people/vehicles are there at different times. What, for example, is the size of the beach population during the evening hours? A variety of events, such as concerts, fireworks, and shows at the Club Casino, bring large numbers of visitors into Hampton Beach in the evenings. Hollingworth, ff. Tr. 8608, at 3. Rep. Hollingworth testified that in the summer of 1987 there were about 88 shows at the Club Casino in Hampton. Tr. 8642. Attendance at these events is often large enough to fill the public parking lots in Hampton Beach. Hollingworth, ff. Tr. 8608, at 3; Tr. 8642. There are also people who come to

Hampton Beach in the evenings to shop and eat in the restaurants. Tr. 8643 (Hollingworth). And there are so many young people out cruising and sitting around in parked cars at night that it has been a problem the Chamber of Commerce has attempted to address. Id. In sum, there is a great deal of traffic in Hampton Beach on many evenings in the summer. Id. The young drivers even gather in large numbers in the beach area on some pre-season evenings. Tr. 8645 (Hollingworth). How are decision-makers to know -- after dark -- how many people are in the beach areas, given the high variability of this number? The NHRERP provides no mechanism to estimate it.

6.1.179. Our review of the record concerning the number of vehicles in the beach areas convinces us that Dr. Adler is correct and that the inflow and outflow of vehicles in the beach areas is a highly variable and complex phenonenon about which the state of New Hampshire and the Applicants know too little. This ignorance is transmitted through the NHRERP to emergency decision-makers and is epitomized by the fact that while the plans offer certain estimates, albeit unreasonable ones, of the size of the total beach area vehicle population when it reaches its peak, New Hampshire's emergency decision-makers will have no idea -- apart from guestimation -- how many vehicles are in the beach areas at any given point in time in the summer. Thus, they will have no idea what the realistic ETEs are for the moment at hand when an emergency occurs. For example, Anthony Callendrello, the Manager for Emergency Planning at New Hampshire Yankee was asked what an emergency decision-maker would do if a Seabrook Station emergency occurred mid-week in the summer in good weather at a time other than mid-day. Tr. 5708-5709. This poses a problem because the Volume 6 ETE tables provide only one summertime, good weather, midweek ETE, and that is for the peak vehicle population which can be expected at mid-day (which itself is arbitrarily assumed to be 75% of the weekend "capacity"). Volume 6, Table 10-1 and Tables 10-4 to 10-8. Mr. Callendrello responded: "I certainly can't predict what the state responders would do." Tr. 5709. But he stated he would use the ETE for the summer mid-week mid-day scenario. Tr. 5709-5710. Both of his remarks are extremely disconcerting. First, he is right -- one cannot predict what state responders will do at times of the day other than those provided in the ETE tables. The NHRERP provides absolutely no guidance regarding a) how to assess whether the extant beach population approximates the size of the population assumed in the closest Scenario or b) how the ETE in the table would be adjusted to account for a smaller or larger population even if decision-makers knew how much smaller or larger the beach area population was. Thus, there is no reasonable assurance whatsoever what the New Hampshire protective action decision-makers will do -- i.e., what ETE they will use -- at times of the day for which the ETE tables offer no guidance. Mr. Callendrello's other comment, that he would use the mid-day ETE provided in the tables for an emergency occurring other than mid-day, is troubling not only because it ignores the fact that the day-tripper population would likely be less than it would be at mid-day, but also because it ignores the actual size of the beach population altogether and relies on a pre-determined 75% of peak estimate. This suggests that even if an emergency were to happen just at mid-day, Mr. Callendrello would not seek to adjust his ETE for the population at hand. Yet we know from our review of the HMM data and the testimony that the beach area population can vary dramatically from one day to the next.

6.1 180. When he was asked which ETEs he would use for decision-making purposes in an emergency which began in early evening, Dr. Adler gave this response:

> There is no information provided in the relevant chapter of Volume 6 (chapter 10) or in the revised submissions which would help a decision-maker to select an accurate ETE for this situation. The beach area vehicle population varies widely throughout the summer season, among "peak" days and, importantly, even over the course of a single day. These variations are not described in Volume 6 in ways that could be used by decision-makers to reliably determine the relevant vehicle population and the corresponding ETE. It is likely that the beach area vehicle population varies over the course of the summer from a low of 5,000 vehicles (very rough estimate) to a high of approximately 40,000 vehicles. For a summer weekend evacuation, the corresponding range in ETE's is from less than 6 hrs. to 9 hrs. 25 min., assuming all other parameters in the KLD analysis are left unchanged. Clearly, it is critically important for a decision-maker to have reasonably reliable information on beach vehicle population in order to reliably determine the ETE. Adler, ff. Tr. 9524, at 15.

6.1.181. When Dr. Adler was asked what additional information should be provided in the NHRERP to allow decision-makers to reliably determine the ETE on a given day at a given time of day, he gave this answer, id., at 15-17:

Two new sets of information would be required. The first would give data and general guidance for determining the likely beach-area vehicle population at a given point in time and the second would be a set of ETE's calculated for the full range of likely beach area vehicle populations. Some information on the influx and outflux of beach area vehicles over the hours of a "peak" day is included in Volume 6, but these data are not sufficient nor in a form that is useful for this purpose. There are many ways that better information on vehicle population at a particular point in time could be obtained for evacuation planning. The most accurate information could be obtained from a real-time link with automatic traffic recorders located on each of the area's access roads. These could be located as in the HMM studies conducted in 1982 and 1983, but should have inductive loop detectors for greater accuracy and the data should be transferred either continuously or at regular intervals (e.g. by telemetry) to a centrally-located microcomputer for storage and analysis. The result would be an accurate estimate of beach-area vehicle accumulation at any point in time.

There are other, less sophisticated, methods which could provide much better information on beach area vehicle population than can be obtained from Volume 6 or from the applicants' revised submissions. For example, a table could be prepared that shows the percent variation in beach vehicles that occurs over the hours of, for example, a typical "good weather" summer day, a "mediocre weather" day and a typical "poor weather" day. In addition, estimates of maximum vehicle population could be prepared for selected typical days such as good/mediocre/poor weather weekday/weekend days in June/July/ August. To illustrate, the time-of-day table might indicate that, at a particular early evening hour, the vehicle population is typically at 60% of maximum and that the maximum beach population would be 25,000 vehicles. These two data would be used to determine that the evacuating beach area population would be 15,000 vehicles (=.60 x 25,000).

As I mentioned earlier, there are many other methods intermediate between these two that could provide progessively better information on actual vehicle populations present at a particular point in time. Contemporaneous information on variables which serve as "indicators" of traffic influx could be maintained and these indicators could be statistically correlated to actual observed vehicle populations in past summers. For example, information on the numbers of vehicles admitted into each of the beach area state park parking lots could be maintained, and these could be entered into a statistically-estimated equation to calculate likely total beach area vehicle accumulation. Such a method could involve only a relatively modest effort including, initially, analysis of a dozen or so aerial overflights (35mm oblique-angle photography, counting only visible vehicles would be sufficient since we have already estimated the area's parking capacity) and developing a protocol for obtaining the state park vehicle admissions data at the onset of an emergency.

Of course, it would also be necesary to re-structure the ETE tables presented in Volume 6 so that the ETE's were shown for different beach area vehicle populations for the summer scenarios. Currently, the tables do provide for an evacuation of the entire EPZ (Region 1) a Scenario 1A and 1B ETE for 80% and 60% occupancy of beach area parking capacity. But, for Regions 2 to 9, only one ETE is provided for a summer weekend and one for a summer weekday, and each is for 100% of vehicle capacity. This is hardly enough information to be called a "best effort" approach.

6.1.182. With respect to the method which used a real-time link with automatic traffic recorders, Dr. Adler pointed out that this is a kind of technology that has advanced very substantially even in the last three or four years, and it is now at a point where it is "very inexpensive" and relatively much more reliable than the kind of technology that was used by HMM. Tr. 9615 (Adler). He estimated it would cost in total in the neighborhood of $20,000 to put into place. Id. That would include the cost of the counters themselves (which are little computers), the computer links, and the devices that would allow communications over telephone lines directly between the counters and the central computer. Id.

6.1.183. Dr. Adler testified that such a system, if properly maintained and periodically calibrated using aerial photos from a single aerial overflight, would provide a real-time, accurate estimate of vehicle accumulation in the key beach areas. Tr. 9616. The aerial photos would be obtained once a summer or so just to calibrate the system against ground truth and to ensure against having small counter errors accumulate over several years. Id.

6.1.184. Dr. Befort testified that the cost of flying on one day and obtaining a full set of adequate aerial photos would be under $500, including pilot, photographer, and all consumables. Tr. 7080-7081. The photo interpretation needed would be just a counting of cars and not spaces as well. Tr. 7084 (Adler). An experienced person could complete this count in a day; the photo interpretation costs would be minimal. Tr. 7084 (Befort).

6.1.185. We note that the Applicants paid Mr. Lieberman between a quarter and a half million dollars to do the ETE study that resulted in Volume 6, Tr. 5650-5652, and a quarter of a million more to do the update work in 1987 reported in his testimony. Tr. 5652. In light of the size of the sums being spent by the Applicants to obtain realistic ETEs, and the importance the Board recognizes realistic ETEs have in selecting protective actions, we find that the costs of installing such a system and keeping it calibrated are modest and reasonable.

6.1.186. While Dr. Urbanik noted that such a real-time system was not required by NUREG -0654, Tr. 7742, he agreed that it would provide useful information and that the technology was available today. Tr. 7738-7739 (Urbanik).

6.1.187. With respect to Dr. Adler's "other methods" of providing better information on beach area vehicle populations, it appears that they would be somewhat less expensive, but the quality of the information they would provide drops off from that provided by the real-time system. For example, he describes a method which uses contemporaneous information on variables which serve as "indicators" of traffic influx and then statistically correlates this information to actual observed vehicle populations in past summers. Adler, ff. Tr. 9524, at 16-17. These observed populations would come from a dozen or so aerial overflights using Dr. Beforts' methodology, id. at 17, and the cost here too would be less than $500 per flight plus a minimal cost for photointepretation. See Tr. 7080-7081, 7084.

6.1.188. The Board has found that the ETE study in Volume 6 contains estimates of peak beach vehicle counts which are unrealistically low, and as a result the Board cannot approve this ETE study. In addition, the Board now finds that by providing no method to estimate the size of the beach population for the moment at hand during an emergency, the ETE study has an inadequate factual base to permit decision-makers to make reasonable real-time pojections of vehicle counts and ETEs for the extant conditions during an emergency. This issue is raised in Town of Hampton Revised Contention III to Revision 2, which alleges that the Volume 6 ETE study "fails to provide reasonable assurance that adequate protective measures can and will be taken," because, inter alia, (Basis 1) the study has an "inadequate factual base to provide reasonable projections for traffic counts and movements during an evacuation within the EPZ, and particularly the beach areas," and (Basis A) "KLD lacks adequate data to compute the permanent and transient population of the Town of Hampton since KLD ...counts beach populations using a limited number of photographs ...although KLD concedes the beach populations vary widely depending on weather, time of day, and day to day." It is also raised in SAPL 31, which alleges that the Volume 6 ETE study "fails to account properly for the number of vehicles that would be evacuating the EPZ" and "does not rely upon an extensive enough empirical base" because (Basis 20) "[t]he KLD Report lacks a sufficient empirical base for computing the transient population of the EPZ."

6.1.189. Just as NUREG-0654, Appendex 4, offers only guidance and does not require that an ETE study be done in any particular way, we do not wish to compel the state of New Hamphsire to re-do its ETE study in any particular way. But we will require that any re-done ETE study meet the test of realism, i.e., that it provide an adequate data base and methodology for decision-makers to reference an ETE which is reasonably realistic for the size of the beach population present at the time of an emergency, whenever it occurs. Thus, we reject the notion that all the state of New Hampshire needs to do is plug into the IDYNEV model a reasonably accurate number of "peak" or "capacity" beach area vehicles, or the number present on a "typical" beach day (whatever that means), and run the numbers just as before.

3. Delayed Staffing of Traffic Control Posts

6.1.190. SAPL 31/Basis 4 asserts that the ETEs presented in Volume 6 are not realistic because they were calculated using the unrealistic assumption that traffic management and control measures are in effect at the time the evacuation is ordered. This issue is also raised by TOH III/Basis C(2).

6.1.191. The evacuation time analysis summary in Volume 6 states that the analysis assumed "that the recommended traffic control tactics are in effect (see Appendix I)." Volume 6 at 10-70. Clarifing this statement, Dr. Adler notes that the IDYNEV results presented in Volume 6 assume that all of the traffic control posts are fully operational from the beginning of the beach closing (which is assumed in the ETE study to occur 25 minutes before the order to evacuate). Adler, ff. Tr. 7181, at 44.

6.1.192. Volume 6, Appendix I, contains a complete set of traffic control post diagrams. Volume 6 at 8-11 indicates that there are 70 separate traffic control posts in New Hampshire.

6.1.193. According to Volume 6, traffic control posts ("TCPs") are designed to perform a number of functions: (1) facilitate evacuating traffic movements which serve to expedite travel out of the EPZ along the planned evacuation routes; (2) discourage traffic movements which permit evacuating vehicles to travel in a direction which takes them significantly closer to the power station; and (3) resolve potential conflicts between traffic streams at intersections, by assigning right-of-way so as to promote safe operations, and to keep traffic moving. Volume 6 at 7-1, 8-4.

6.1.194. Volume 6, Appendix L, contains a complete set of access control post diagrams which detail the control tactics and the personnel and equipment needed at each access control post. Volume 6 at 9-1. Table 9-4 in Volume 6 (at 9-12) contains a list of the 19 access control posts ("ACPs") in New Hampshire and a summary of the personnel and equipment needed at each.

6.1.195. According to Volume 6, the purpose of access control is to restrict entry to the EPZ and to expedite the traffic movement of evacuating vehicles. Entry is to be permitted only for: (1) commuters returning to the EPZ to gather household members for the purpose of evacuation; (2) transit vehicles (buses, vans, ambulances) dispatched to the EPZ to participate in an evacuation; and (3) all vehicles transporting emergency response personnel. Volume 6 at 9-1. All other travelers seeking entry to the EPZ are to be denied access. Id.

6.1.196. At almost all ACPs and TCPs traffic movements are facilitated and/or discouraged through the strategic placement of traffic cones and barricades as well as by the actions of the "traffic guides" who staff each post. See Volume 6, Appendices I and L.

6.1.197. Those who staff TCPs and ACPs also play another important function in the overall traffic managment plan. They act as the means of surveillance for road blockages and accidents that occur during an evacuation. Volume 6 at 12-1. The Volume 6 ETE study assumed that this surveillance would take three forms: (1) aerial patrols using the Civil Air Patrol's fixed wing aircraft; (2) ground patrols by the State Police along key evacuation routes (see Figure 12-1 in Volume 6; and (3) fixed-point surveillance by all traffic guides at ACPs and TCPs. Volume 6 at 12-1. Volume 6 notes: "These concurrent surveillance procedures are designed to provide coverage of the entire EPZ as well as the area around its periphery. With the coverage, any blockage caused by a disabled vehicle should be quickly identified within a matter of minutes." Volume 6 at 12-1.

6.1.198. We note, however, that the Civil Air Patrol procedures in Volume 4B of the NHRERP contain only a series of "stand-by" functions which the Civil Air Patrol could perform upon request. Volume 4B, Civil Air Patrol procedures, at 3. While one of these functions is "aerial observation of evacuation," the CAP will also be performing air transportation, air monitoring of the plume, communications support and general ground support to NHEMA. Id. Thus, surveillance by air for road blockages is not a routine function that the Civil Air Patrol can be relied on to provide throughout an evacuation. At night and during bad weather, of course, the aerial patrols will be of little assistance in spotting road blockages.

6.1199. We also note that the Volume 6 suggestion that the State Police drive surveillance patrol routes has not been implemented. The Summary of Personnel Resource Assessment indicates the functions to which the State Police have been assigned and driving surveillance patrol routes is not among them. See Applicants' Ex. 1, Table 3.1-1.

6.1.200. This means that, by default, ongoing and continuous surveillance for road blockages is left to traffic guides to perform.

6.1.201. Applicants' Ex. 1, the Summary of Personnel Resource Assessment, indicates that many EPZ towns do not have sufficient local manpower to staff all the traffic control posts ("TCPs") in the town. See, e.g., Applicants' Ex. 1, Table 2.2-4 ff. 2-11 (even if they participate in an emergency response, Hampton police can provide only 2 officers for traffic control; State Police will provide up to 28 officers for TCPs in Hampton). In such towns, the State Police have been assigned to staff those traffic control posts not capable of being staffed by local responders.

6.1.202. Altogether, the EPZ towns are expected to provide 72 traffic guides and the State Police will provide 48 more to staff the traffic control points inside the EPZ. See Applicants' Ex. 1 (summing the "Traf Cntr" totals in the tables for each town). This means that 40% of all traffic guides at TCPs in the EPZ towns are expected to be State Police Officers. If we examine that portion of the EPZ in New Hampshire outside the City of Portsmouth, which is a large city and is providing all 25 officers needed to staff TCPs there (see Applicants' Ex. 1, Table 2.3-9), we find that the State Police are providing over 50% of all the traffic guides needed to staff TCPs in all the remaining New Hampshire EPZ towns.

6.1.203. Applicants' Ex. 1, the Summary of the Personnel Resources Assessment for the NHRERP, contains a summary of the personnel resources required from New Hampshire state agencies and organizations. Applicants' Ex. 1, Table 3.1-1. (Table 3.1-1 was bound into the record ff. Tr. 4685 as Applicants' Ex. 1-A.) This summary indicates the need for 26 State Police troopers to be placed at Access Control Posts in addition to the 48, noted above, who are to staff Traffic Control Posts. A "remark" in Table 3.1-1 indicates that the total number of State Police troopers needed for both TCPs and ACPs is 74. These numbers reflect implementation of all aspects of the NHRERP with the exception of State assistance to municipalities unable to respond to an emergency. Applicants' Ex. 1 at 3-2. The Summary indicates that 11 additional members of the State Police will be needed to provide assistance to those municipalities anticipated to require full state assistance. Id., Table 3.1-3 and 3.1-4 at 3-6 and 3-7. Six (6) of these will be required for security duties and five (5) will be assigned to local TCPs. Id., Table 3.1-3 at 3-6. Altogether, therefore, it is anticipated that 79 State Police troopers (74 plus 5) may need to be assigned to ACPs and TCPs if there is local non-participation. The Board finds that the State Police are clearly playing a major role in staffing local TCPs, even with full participation of all EPZ towns.

6.1.204. Captain Sheldon Sullivan of the New Hampshire State Police testified that Troop A of the New Hampshire State Police is responsible for covering two counties, one of which is Rockingham County, where Seabrook Station is located. Tr. 4676. But Troop A has only 36 sworn personnel and on any given shift, including a summer weekend, would have only six or seven men on duty. Tr. 4677 (Sullivan). Another six or seven would be on call. Tr. 4677-4678. Captain Sullivan stated that the first troopers to undertake traffic control responsibilities in an emergency at Seabrook Station would come from Troop A. Tr. 4703. For the State Police to provide all 79 of the troopers required to staff all the TCPs and ACPs assigned to it in an EPZ-wide evacuation, other troops from other parts of the state would be mobilized and directed to report to ACPs and TCPs not staffed by Troop A. See Tr. 4679-4680.

6.1.205. Captain Sullivan estimated how long it would take the State Police to get to their assigned ACPs/TCPs in an emergency at Seabrook Station. After the State Police are told to move into the area (Tr. 4725), he estimated that only four could respond and reach TCPs and ACPs in 15 minutes and only three additional troopers could reach TCPs/ACPs within the next 45 minutes. Tr. 4714. Thus, only 7 troopers could arrive at TCPs/ACPs within the first hour after being notified to move into the EPZ. Captain Sullivan assumes that these initial responding troopers would all be from Troop A. Id. In the next hour, Captain Sullivan estimates that only 6 more troopers would arrive at TCP's. Tr. 7415. Thus, within the first two hours after being told to move into the area, only 13 troopers would have arrived at TCPs. After that, additional troopers would continue to arrive so that within 5 hours after notification, about 100 troopers would be on duty. Id.

6.1.206. These time estimates from Captain Sullivan are based from the time the troopers are told to move into the EPZ, even if they had been alerted first. Tr. 4775.

6.1.207. We note that these time estimates indicate only when the State Police will arrive at TCPs/ACPs. This does not necessarily mean that the TCPs/ACPs can be set up a.d established at that point. Traffic and access control equipment (presumably traffic cones and barricades) are to be delivered by personnel from Department of Transportation. See Applicants' Ex. 1-A, ff. Tr. 4685; Applicants' Ex. 1, Table

3.1-3 at 3-7. Dr. Adler noted that these DOT personnel must first report to duty, load the truck with cones and barricades, then drive to the first TCP, unload the designated cones and barricades, then drive to the next TCP and so on. Adler, ff. Tr. 7181, at 46.

6.1.208. The Board also recognizes that in a rapidly escalating accident, there will necessarily be some delay between the declaration of a Site Area Emergency with an order to evacuate and the time when state troopers are actually given word to move to specific ACPs/TCPs in the EPZ. Notification must first be given to the State Police and then the on-duty supervisors at Troop A and the other troops must then be informed (see Tr. 4705) and instructed as to which TCPs/ACPs to staff and in what order. This depends on which ERPAs have been ordered to evacuate. See Tr. 4712-4713. Then the dispatchers must be informed to contact the on- and off-duty troopers, one at a time, to instruct each where to go.

6.1.209. The planning basis accident used in calculating the ETEs in Volume 6 is a fast breaking accident. See Volume 6 at 4-1; Tr. 5666 (Lieberman). It was assumed that the accident escalates almost immediately to Site Area Emergency, that further escalation to a General Emergency occurs 15 minutes later and that the order to evacuate is transmitted to the public 10 minutes after the General Emergency is declared. Volume 6 at 4-1. A further assumption used in the summertime ETE calculations was that the public will be notified to clear the beaches at the Alert level, (which is concurrent with a declaration of a Site Area Emergency). Volume 6 at 4-1, Tr. 5665-5666. See Volume 6 at 10-3, Note 1. At this point, 25 minutes before the order to evacuate is transmitted, it is assumed that vehicles begin leaving the beach areas, Volume 6 at 10-13, and that a sufficient number of people will choose to leave the beach areas that the highways leading from the beach areas quickly become saturated with traffic. Tr. 5671, 5673 (Lieberman).

6.1.210. According to Captain Sullivan, individual State Police troopers would not be nctified to ready themselves for possibly deployment at the Unusual Event stage. Tr. 4723. He said that the State Police would start to muster their people at the Alert stage. Id. Thus, in a fast breaking accident of the type assumed in calculating the Volume 6 ETEs, we have no alternative but to find that the State Police will not be able to have all or even most of the 74 (or, in the event of local non-participation, 79) troopers who are required to staff ACPs and TCPs report to those posts and set them up prior to the declaration of the beach closing or the order to evacuate.

6.1.211. We find that for the planning basis accident on which the ETE study was based, the study did rely on an erroneous assumption, i.e., that all traffic management and control measures would be in effect at the time evacuation is ordered.

6.1.212. The Board is extremely concerned about the delayed arrival of this many State Police, especially in the summer when the beaches are crowded. As noted above, State Police troopers constitute over 50% of the staff needed to man all the TCPs outside of Portsmouth, even with full participation from all New Hampshire towns. Assuming that all of the first-arrivals went to TCPs (and none went to ACPs), only 13 of the 48 troopers needed for TCPs will be able to arrive at a designated TCP within two hours of notification to them. This means that during the first crucial hours of a fast breaking accident for which an EPZ-wide evacuation has been called, numerous traffic control posts will not be implemented fully as described in the plans. At least four of the Intervenors' witnesses testified that even if all the TCPs were staffed as planned, they were seriously concerned that the NNRERP had not provided sufficient traffic control manpower to ensure that an orderly vehicular evacuation could and would occur. Adler, ff. Tr. 7181, at 15-18; Olivera, ff. Tr. 9483, at 5-8; DeMarco and Lally, ff. Tr. 3659, at 10. We think that without prompt staffing of TCPs by the New Hampshire State Police, these concerns become magnified and cannot be dismissed.

6.1.213. Dr. Adler paints a truly frightening portrait of an evacuation trip from Hampton Beach State Park on a busy summer day. Adler, ff. Tr. 7181, at 15-18. He describes how, even with all traffic control in place, substantial traffic queues will develop which, for cars that get out of the jammed parking lots and join the queue, will move along at a rate of only 1 to 1 1/2 car lengths per minute, much slower than most people can walk. Id. at 15-17. He also stated that according to the Scenario I IDVNEV runs which are reported in Volume 6, over 3,000 vehciles (over 7,000 people) will still be stuck along Route 1A in Hampton's Beach area 4 hours after the beach closing (3:35 after the order to evacuate). Id. at 16. Of course, we now realize that the number of vehicles assumed in Volume 6 to be in Hampton's Beach area 6 is significantly too low. Using Dr. Adler's own new estimates of beach vehicle capacity, he estimated that approximately that same number (7,000 people) would be stuck along Route 1A in Hampton's Beach area after 8 hours and over 18,000 people would still be in the queue along Route 1A after 4 hours. Id. In Dr. Adler's opinion, with which we agree, the length of these delays and the extent of traffic congestion experienced would represent travel conditions well outside the realm of any of the evacuees' prior experience. Data from the AEL Associates survey, reported in the testimony of Dr. Luloff (see Luloff, ff. Tr. 8203, at 14-15 and Attachment 4 at 7-8), indicate that substantial numbers of evacuees will simply abandon their cars if little forward progress is made over an extended period of time. Adler, ff. Tr. 7181, at 16. As a result Dr. Adler concludes that:

> there are inherent behavioral uncertainties in how evacuees collectively and individually will repsond to these conditions. I am unable to

> state that full evacuation is likely or even possible without substantial intervention beyond what is described in Volume 6, under the conditions that would exist.
>
> * * *
>
> I am uncertain that a vehicular evacuation will work. I just do not know whether people will stay with their cars that long, traveling much slower than most of them can walk. Id. at 16-17 (emphasis supplied).

6.1.214. Dr. Adler goes on the explain that, in his opinion, these concerns mean, inter alia, that New Hampshire's emergency response planners need to provide additional traffic guides.

> The problem, of course, is that not everyone can walk out. There are many beach-goers with infants and small children, as well as many who are elderly, infirm, handicapped or simply not fit enough to walk a few miles. Will those who abandon their cars leave their cars in positions which block those who remain with their cars? I simply do not know. But it is such a real possibility, particularly for a place like the Hampton Beach State Park lot, from which the nuclear plant is clearly in view, that prudent planners need to plan additional layers of assistance to address this circumstance. I am particularly concerned about the State Park lot for the following reason: because many of the cars in that lot area at the end of the evacuation queue for the entire south beach area in Hampton, those cars will sit there in the lot, not moving at all, for hours before the rest of Hampton's beach area clears out enough to allow the cars in that lot to begin emptying onto Rt. 1A. During the hours befor the lot begins to empty, many cars may well be abandoned and this has the real potential of creating "gridlock" inside the lot unless there is substantial additional planned intervention. The NHRERP Traffic Management Plan calls for only a single traffic guide to be statione' at the point where the

> Hampton Beach State Park lot empties onto Route 1A and that guide's job is described as follows: "[e]ncourage all traffic to move north along Route 1A." (See Vol. 6, p. I-1). <u>More than a single emergency worker certainly needs to be stationed at the Hampton Beach State Park to deal with the potential for "gridlock"</u> there, and emergency strategies need to be devised to address this egress problem, as well as to address the needs of hundreds, if not thousands, of beach-goers who may abandon their cars and attempt to walk out. Id. at 17-18 (emphasis supplied).

6.1.215. Edwin Olivera, the Chief of Police in Salisbury, Massachusetts, had similar concerns about the lack of a sufficient number of traffic guides to keep traffic in the beach areas flowing in an orderly fashion. Under the planning basis accident conditions assumed in the Volume 6 ETE study, Chief Olivera testified that if only the planned number of traffic guides were stationed along the two beach area egress roads in his town (Route 1A heading west out of Salisbury Beach and Route 286 heading west from the state line), he could not believe that evacuating drivers would refrain from using the (incoming) opposite lanes. Olivera, ff Tr. 9483, at 6-8. The NHRERP's traffic managment plan in Volume 6 calls for no traffic guides to be placed along Route 1A to the west of the State Beach Road for two miles, until it reaches Salisbury Center. <u>See</u> Volume 6, Appendix I. Similarly, that traffic management plan calls for no guides to be stationed along Route 286 to the west of its intersection with Route 1A for about 2 miles, until it reaches its intersection with Washington Street. <u>Id</u>. Without having series of troops or police officers stationed at regular intervals along the mid-line of these roads, Chief Olivera believes that evacuating traffic will quickly begin using both lanes of these two lane highways. Id. In his opinion, under Scenario I conditions, there would be few vehicles coming into the beach areas on these roads and those inbound lanes "would just be too tempting for snarled traffic to resist using, especially without any police or traffic guides stationed along the center line." Id. at 6-7 (emphasis in original). He points out that along Route 286, evacuating drivers are actually in view of the nuclear plant for a good portion of that 2 mile stretch. This prompts Chief Olivera to state the following opinion:

> No reasonable person who is familiar with the beach traffic would believe that vehicles evacuating out Route 286 would stay in just the westbound lane during an emergency at the nuclear plant unless, again, a series of troops or police officers were stationed at regular intervals along the midline to prevent it. Id. at 8 (emphasis supplied).

Chief Olivera has been a Salisbury police officer for 25 years and the police station is located right in the Salisbury beach area. He is extremely familiar with the traffic conditions in the Salisbury beach area and we find his testimony to be credible and convincing.

6.1.216. Although Chief Olivera was not sked to comment about the similar situation that exists in Hampton along Rt. 51 heading west out of Hampton Beach, where for 1 1/2 miles before it intersects with Route 1 there are no traffic guides planned (see, Volume 6, Figure 1-3 and Appendix I), we find that for the same reasons he gave regarding Rts. 1A and 286, two-way traffic flow is not likely to be maintained without additional placement of traffic guides along the center line.

6.1.217. Dr. Urbanik states that he did not believe that in an evacuation drivers would "pull out in front of on-coming cars to establish one-way [out-bound] flow" on the beach area egress roads. Tr. 7657. But Chief Olivera noted that under Scenario I conditions -- between 1 and 2 p.m. on a busy summer weekend -- "there would be few vehicles coming into the beach area on Route 1A" and on Rt. 286 "[i]t's the same situation." Olivera ff. Tr. 9483, at 6 and 7. Dr. Urbanik acknowledged that if two-directional flow on these roads was not maintained, it would be "certainly undesireable," assuming that "you had some desire to maintain two-way flow." Tr, 7658. The Board recognizes that there is a clear desire in the NHRERP to maintain two-way flow on these roads so that buses, incoming emergency vehicles, tow trucks, and those returning to pick up family members can enter the area.

6.1.218. Sergeant Victor DeMarco and Detective William Lally of the Hampton Police Department also expressed serious concerns regarding the ability of the NHRERP, even with full staffing, to control an evacuation. In commenting on the TCPs in Hampton, which instruct traffic guides to "facilitate" evacuees to adhere to prescribed routes, they state as follows:

> In our opinion, these measures will still not enable state and local officials to "discourage" significant numbers of evacuees from deviating from the prescribed evacuation routes, who will seek alternative, familiar routes, leading home [sic]. Nor will they prove successful in controlling traffic and preventing congestion.

DeMarco and Lally, ff. Tr. 3659, at 10. See also id. at 15. Sergeant DeMarco and Detective Lally also described their additional concerns about the inability of either the Hampton police or the State Police to staff all the Hampton TCPs promptly. Id. at 11-13. As a result, they are convinced that there will be inadequate personnel to promptly implement the NHRERP's traffic control measures. Id. at 12. As a consequence, they foresee not only a substantial increase in evacuation times, but "the likelihood of substantially increased traffic congestion, delays, accidents, blocked roads and similar problems would be enhanced." Id. at 13-14. Problems of bumper-to-bumper congestion, delays, accidents, breakdowns (as cars overheat) and drivers disregarding established traffic patterns in an attempt to avoid congestion occur frequently in Hampton on hot summer days. Id. at 6 passim. Having reviewed the NHRERP's traffic control, and in view of the inadequacy of the personnel to promptly staff TCPs, the Hampton Police Association voted unanimously on July 1, 1987, that the NHRERP is "totally unrealistic, unworkable and unsupportable." Id. at 19. According to Sergeant DeMarco and Detective Lally, this statement fairly summarizes the postion of all Hampton Plice union members regarding the NHRERP. Id. We find this testimony, too, to be credible and convincing.

6.1.219. Given these very serious concerns about how effective the NHRERP's trffic management plan will be even with full and prompt staffing of all traffic control posts, the Board is extremely troubled by what may happen as a result of the late-staffing of many traffic control posts, especially in Hampton Beach. As noted previously, even if Hampton is fully participating, the Summary of Personnel Resources Assessment (Applicants' Ex. 1) indicates that Hampton is providing only two (2) traffic guides, while the State Police are providing 28 more, to staff 12 TCPs in Hampton. The NHRERP indicates that 13 traffic guides are needed for six (6) TCPs in Hampton Beach alone. Volume 6, Appendix I at I-1 to I-6. It thus appears that these traftic control posts will take at least two hours after a beach closing to establish, even if all the first 13 arriving state troopers went to Hampton Beach. But a draft manning sequence for the State Police, Mass AG Ex. 3, indicates that some of the early-arriving state troopers may, if this sequence in adopted, have assignments elsewhere. Given these circumstances, the Board finds that there is substantial uncertainty whether an orderly vehicular evacuation can and will occur in Hampton's beach area.

6.1.220. In responding to the late-staffing of TCPs and ACPs by the State Police, the Applicants ignore all these concerns about the viability of a beach area evacuation.

Instead, they argue that the only concern with late-staffing is how fast one particular capacity-enhancing TCP, the one at Rt. 51/I-95, will be staffed. And they offer a couple of so-called "sensitivity" runs using the IDYNEV model which they contend show that if the capacity-enhancing function of this one TCP is not implemented for 1 or 2 hours after a beach closing, the effect on ETEs will be negligable. See generally, Lieberman, et al., ff. Tr. 5622, at 44-48, 65-70.

6.1.221. Given the broad range of serious concerns we have about the impact of late-staffing of the TCPs on the viability of the evacuation plan, we must find that the Applicants' "sensitivity" runs have much too narrow a focus to resolve our concerns about late-staffing of the TCPs by the State Police.

6.1.222. Even without these broader concerns, however and assuming that an orderly evacuation of the beach areas could and would ensue despite late-staffing of the TCPs in Hampton Beach and elsewhere, we are not persuaded by the Applicants (1) that the only other impact of late-staffing to be concerned about is how fast the capacity-enhancing function of the TCP at Rt. 51/I-95 gets established, or (2) that the impact of the delay in implementing this capacity-enhancing TCP will be negligible. We discuss our rejection of these propositions below.

6.1.223. Applicants contend that the functions performed by staffed and operating TCPs/ACPs can be ranked in order of decreasing importance as follows:

1. Enhance roadway capacity;
2. Guide evacuees along reocommended routes;
3. Expedite traffic movements;
4. Provide assurance to the public; and
5. Surveillance for road blockages.

Id. at 67.

6.1.224. Applicants acknowledge that the first function -- enhancing roadway capacity -- can have a pronounced influence on ETEs. Id. at 68. In Applicants' Direct No. 7 they note that their most recent analysis reveals that three (3) TCP locations within the New Hampshire portion of the EPZ have been designed primarily to enhance capacity: A-HB-03 (in Hampton Beach at the intersection of Route 51 with Brown Avenue), A-HB-04 (converting Highland Avenue in Hampton Beach to a one-way westbound street), and D-HA-02 (converting the Route 51 overpass of I-95 into two lanes of westbound flow). Id. at 68. See Volume 6 at I-3, I-4 and I-39. Applicants acknowledge that these three TCPs will serve to expedite the traffic movement from within the town of Hampton, including Hampton Beach. Lieberman, et al., ff. Tr. 5622, at 68.

6.1.225. Dr. Adler notes that the capacity enhancement function of D-HA-02 is particularly significant because it "effectively doubles" the capacity of this "critical bottleneck to the EPZ's evacuation. Adler, ff. Tr. 9524, at 3. In his direct testimony Dr. Adler describes an IDYNEV run he did that assumed that this TCP and another one at Rt. 110 and I-95 were not fully operational until 1 hr. 45 min. into the general evacuation (or approximatley 2 hours after the beach closing). All other inputs remained constant. The result was a 7% increase in the full-EPZ evacuation time reported in Volume 6. Adler, ff. Tr. 7181 at 45 and Attachment 7 at 2-3.

6.1.226. Mr. Lieberman conducted an IDYNEV "sensitivity" run (Run #1) which assumed late-staffing of D-HA-02 (the Rote 51 overpass of I-95) such that it would service only the normal one lane of westbound flow for the first hour after a beach closing before traffic control was established. Thereafter, the IDYNEV model assumed that the capacity of the intersection had been doubled to two lanes of westbound flow. A second sensitivity run (Run #2) assumed that the State Police did not set up this TCP (and enhance the capacity) for 2 hours after a beach closing. Lieberman, et al., Tr. ff. 5622 at 45-46. The results of these runs were that for Run #1 the ETE for a full-EPZ evacuation dropped by 20 minutes from his "Planning Basis" ETE and for Run #2 it was 25 minutes longer, i.e., it produced and ETE which exceeded his "Planing Basis" ETE by only 5 minutes. Id. at 46-47.

6.1.227. Based on these so-called "sensitivity" runs, the Applicants have proposed that the Board find that "Applicants have adequately analyzed delays in manning TCPs and the decision makers will have adequate information to respond appropriately in the event of such an occurrence." Applicants' PF 6.1. 139.

6.1.228. On their face these "sensitivity" runs do not support such a finding. First, there is absolutely no reason to assume that the TCP at Rt. 51/I-95 will be staffed either 1 or 2 hours after a beach closing announcement. While this post is to receive the 5th, 6th and 7th responding trooper according to the draft manning sequence, the manning sequence describes only "evacuation" posts, not "beach closing" posts as well. So a beach closing announcement of the type assumed in the Planning Basis for the ETE study could well divert the earliest responding State Police to other posts. Also, pursuant to the manning sequence, only three troopers are assigned to the Rt. 51/I-95 post at first; this is two troopers short of the number needed to fully staff the post. See Volume 6 at I-39.

6.1.229. Moreover, Mr. Lieberman denied that he was relying upon the draft manning sequence when he conducted his IDYNEV "sensitivity" runs to determine the effects on the ETEs of the late staffing of the ACPs/TCPs. Tr. 6160 (Lieberman). If this sequence is disregarded, there is no assurance that this post at Rt. 51/I-95 will be among the first posts staffed by the State Police, and it could be 3-4 hours or more before it gets staffed.

6.1.230. Dr. Adler has an even more compelling reason to reject the Applicants' argument that these "sensitivity" runs have "adequately analyzed" the delays in the arrival of the State Police. He notes that the counter-intuitive results of these IDYNEV runs were obtained only because, in conducting these "sensitivity" runs, Mr. Lieberman did not hold all other variables constant and, instead, changed a number of variables unrelated to staffing at the Rt. 51/I-95 overpass. According to Dr. Adler, these other changes result in the IDYNEV model sending fewer vehicles through this crucial bottleneck. Adler, ff. Tr. 9524 at 3.

6.1.231. According to Mr. Lieberman, one of the other changes introduced into the IDYNEV model for these "sensitivity" runs was that during the first two hours evacuees from Hampton Beach were not "discouraged" from travelling south over the Hampton Harbor Bridge into Seabrook. Lieberman, et al. ff. Tr. 5622, at 45. Mr. Lieberman reasons that since the Avis Photos reveal the Hampton Beach traffic to constitute the critical path, "any movement south over the bridge could expedite the evacuation." Id. at 47. This routing has one important drawback, however, which Mr. Lieberman notes parenthetically as follows:

> Of course, those traveling south from Hampton Beach move soemwhat closer to Seabrook Station, which may be undesireable if a release has taken place.

Id.

6.1.232. Dr. Adler points out that this routing assumes that neither a TCP in Seabrook (A-SE-05, which is just on the south side of the bridge) nor one on Route 1-A in Hampton (A-HB-01, which is just to the north of the bridge) will be staffed. Adler, ff. Tr. 9524 at 3; Tr. 9528. See Volume 6 at I-1, I-12. Dr. Adler adds that this routing also assumes that a significant number of drivers are willing to travel closer to the plant in order to evacuate. Adler, ff. Tr. 9524 at 3.

6.1.233. In fact, for these "sensitivity" runs Mr. Lieberman modeled IDYNEV to assume that up to 900 vehicles will travel south by the time TCP A-HB-01 is manned, and thereafter it assumes that all traffic in Hampton Beach moves north. Lieberman, et al., ff. Tr. 5622, at 47.

6.1.234. The Board is extremely troubled by the Applicants' blatant hypocracy in its treatment of this routing of vehicles south over the Hampton Harbor Bridge. On the one hand, in response to Dr. Adler's concern that even with traffic control in place, a large number of Hampton Beach evacuees would disregard traffic control and evacuate directly to the south along Rt. 1A (Adler, ff. Tr. 7181, at 47; see Applicants' PF 6.1.123), the Applicants propose a finding that "the routing proposed by Dr. Adler would take the people closer to Seabrook Station which violates the criteria based in part on perceived human preference to move away from the accident, Tr. 5679-81. See also, Tr. 7491-92." Applicants' PF 6.1.124. On the other hand, when it is in the Applicants' interest to argue that 900 drivers would take this very same route (in order to obscure the obvious deleterious effects on ETEs that will result from late-staffing of the Rt. 51/I-95 TCP), the Applicants blithly assume that this "perceived human preference "to move away from the plant will not deter these 900 drivers. App. Dir. No. 7, ff. Tr. 5622, at 47.

6.1.235. The Board finds this "sensitivity" analysis to be unconvincing because of this hypocricy alone.

6.1.236. There are other substantive reasons however why the Board rejects the Applicants' "sensitivity" analysis. First, whether the TCPs on either side of the Hampton Harbor Bridge should be staffed as soon as possible after a beach closing is a critical safety decison which the State of New Hampshire must make. The Town of Seabrook and its personnel are clearly cooperating in the planning process and are being relied upon to staff TCPs in Seabrook immediately upon implementation of a beach closing. See Volume 4, Appendix F at F-5, F-7 to F-8 and F-10. They should be able to staff the TCP in Seabrook just to the south of the bridge (A-SE-05) without significant delay. (None of the Priority 1 ACPs/TCPs to be staffed by the New Hampshire State Police, according to the draft manning sequence, are in Seabrook. See Mass AG's Ex. 3.) The question is whether the State of New Hampshire wants to "discourage" travel from Hampton south over the bridge during an emergency in order to prevent those in Hampton Beach from moving closer to the nuclear plant. It is certainly rational, if not preferable, for the state to choose to "discourage" such travel closer to the plant. The way the plans before us now read, the State of New Hampshire appears to have chosen to "discourage" such travel. This conclusion is based on an examination of the traffic management plan in Volume 6 and Volume 4, Appendix F. Nowhere in the plans before us do we see any indication other than that travel over the bridge southbound is to be discouraged during an evacuation.

6.1.237. While safety is certainly a primary consideration which would justify early efforts by the State of New Hampshire to "discourage" southbound travel over the Hampton Harbor Bridge, it is not the only reason. Applicants consider such movements to be potentially desireable only because their Avis data indicates that the "critical path" for its Planning Basis ETEs is that taken by the Hampton Beach evacuees. Applicants' Dir. No. 7, ff. Tr. 5622, at 47. But we have rejected that data as being representative of a peak day, and the data generated by Drs. Befort, High, and Adler indicate a much larger number of vehicles may be present to the south, particularly in the Salisbury Beach area, on peak days. Compare High, et al., ff. Tr. 6849, at 17, with App. Dir. No. 7, ff. Tr. 5622, at 38. On days when the "critical path" is Route 286 or Rt. 1A west out of Salisbury, it would lengthen the ETE for the full-EPZ, and therefore would not be prudent, to send additional vehicles from Hampton Beach down across the bridge into these areas. (Here, too, is a reason for the State of New Hampshire to have a real-time system for estimating how many vehicles are in each of the beach areas throughout the summer.)

6.1.238. The Board finds that the "sensitivity" runs conducted by the Applicants, which assumed that up to 900 Hampton Beach drivers would travel south over the Hampton Harbor Bridge during the first two hours after a beach closing, constitute a less-than-clever attempt to obfuscate the issue and do not justify the conclusion that delayed staffing of the Route 51/I-95 TCP by the New Hampshire State Police will have a neglegible effect on the ETEs.

6.1.239. The Board specifically rejects the Applicants' proposed finding that Dr. Adler's concerns about the assumptions underlying the Applicants' two "sensitivity" runs dealing with the I-95/Rt. 51 interchange involve only "details of implementation easily resolved." Applicants' PF 6.1.137. Whether to permit travel southbound over the bridge from Hampton Beach is a critical safety decision the State of New Hampshire must make, not a mere traffic control detail that needs to be adjusted to compensate for the late arrival of the State Police.

6.1.240. Regardless whether the State chooses to establish TCPs early or late at the Hampton Harbor Bridge, the Planning Basis ETEs will be affected. If soon after a beach closing, traffic is "discouraged" from heading south over the bridge from Hampton Beach, then the late staffing of the capacity-enhancing TCP at Rt. 51/I-95 will have effects which tend to increase the ETEs for those in Hampton Beach. If the bridge is left open for southbound vehicles for some time, however, then it appears that this will have effects which tend to reduce the ETEs for those in Hampton Beach. How much effect these two independent considerations will have on the ETEs depends on how soon the Rt. 51/I-95 post can be staffed and how long the bridge remains open.

6.1.241. But it is not just the late staffing of this one TCP at Rt. 51/I-95 which is of concern. The Applicants, as we have noted, indicate that there were two additional TCPs in Hampton Beach which have been designed primarily as capacity enhancing: A-HB-03 and A-HB-04. App. Dir. No. 7, ff. Tr. 5622, at 68. We are very concerned that the failure to staff these critical posts promptly will lead to the specter of an evacuation breakdown, as so vividly described by Dr. Adler. The Board is also very concerned about the effects of delayed staffing of the TCPs/ACPs in general on the other functions served by traffic control. As was noted above, the staff at ACPs/TCPs also serve to guide evacuees along recommended routes, resolve potential conflicts between traffic streams at intersections, discourage entry of unnecessary traffic into the EPZ, and perform surveillance for road blockages.

6.1.242. Dr. Adler was also concerned about the assumptions made in the ETE study about the effectiveness with which the traffic management plan could perform these functions, and the sensitivity runs he describes in his testimony convince us that ETEs will tend to increase if these functions, too, are not performed by the State Police in a timely fashion.

6.1.243. Thus, the late-staffing of TCPs/ACPs by the State Police has an overall effect on the ETEs which depends on the interactive effects of a number of important factors. For example, even the Applicants admit that if traffic control staff are not present to guide evacuees along evacuation routes and restrict travel in directions which are commonly used during normal times, evacuation times could be influenced. See Applicants' Dir. No. 7, ff. Tr. 5622, at 68. Dr. Adler convincingly describes the problems that will arise at intersections if traffic guides do not "optimize" the flow through the intersection, as the ETE study assumed. Adler, ff. Tr. 7181, at 49-51. Dr. Adler is also of the opinion that if ACPs are staffed late, the assumption made in the Volume 6 ETE study about "through traffic" is not realistic. Adler, ff. Tr. 9524, at 3-4. And if traffic guides have not yet arrived, they can hardly perform surveillance for road blockages.

6.1.244. Given the anticipated late-staffing of the TCPs/ACPs by the New Hampshire State Police, there is no reasonable assurance that ETEs for New Hampshire are realistic if they have been, or will be in the future, calculated assuming that all traffic and access control is in place.

6.1.245. In any re-done ETE study submitted to the Board by the State of New Hampshire, the Planning Basis itself should be fashioned in light of the critical existing local conditions. See Cincinnati Gas & Electric Company (Wm. H. Zimmer Nuclear Power Station, Unit No. 1), ALAB-727, 17 NRC

760, 770-771 (1983). One of those critical conditions is the response time for the State Police. (True sensitivity runs should be reserved for unknown variables, not fixed or known quantities such as the delayed response time of the State Police.) Once the State has adopted a staffing sequence for both a beach closing and an evacuation, it can then model the evacuation process such that certain specific TCPs/ACPs become established at realistic points in time which match the manning sequence and the anticipated arrival time of the police. During the early hours, if less than all of the state police TCPs/ACPs are established, the modeling process should assume a less than ideal set of traffic conditions. For example, a reasonable percentage of drivers should be modeled such that they deviate from the planned evacuation routes at places where TCPs/ACPs are not yet established. Intersection capacities should be reduced at intersection where TCPs/ACPs are not yet established. A random accident generator should generate occassional accidents which block evacuation routes at points where traffic guides have yet to arrive and therefor cannot report them promptly. And some "through traffic" should be modeled such that it continues to flow into the EPZ, or the affected regions, at each ACP location until such time as the post can be established.

6.1.246. Moreover, before we can approve any future set of ETEs as being realistic for the conditions at hand, we must be assured that the number of traffic guides is sufficiently large to provide us with reasonable assurance that the beach areas can be evacuated in an orderly fashion. The current plans have an inadequate number of traffic guides who can be in place during the first two or three hours of an evacuation to provide us with this assurance.

4. <u>The IDYNEV Model</u>

6.1.247. The Intervenors presented substantial evidence from Dr. Avishai Ceder which calls into question whether the IDYNEV model is conceptually sound by current professional standards for the purpose of estimating realistic evacuation times. Dr. Ceder was exceptionally well qualified to comment on this topic. He is clearly qualified as an expert witness in the area of traffic flow models and human behavior. He received a Bachelor of Science in Industrial and Management Engineering from Technion--Israel Institute of Technology in 1971, a Master of Science from the University of California at Berkeley in 1972, and a Ph.D from the University of California at Berkeley in 1975. Both his Masters and Ph.D theses were about traffic flow models and driver behavior. Since 1975 he has been teaching and working on research at Technion. During 1981 and 1982 and again during the past two years (1985-1987) he served as a visiting professor at the Massachusetts Institute of Technology. At the Technion he has taught graduate- and undergraduate-level courses in the areas of Transportation Systems Analysis (Introduction to Operations

Research), Traffic Engineering, Quantitative Methods in Management and Engineering Systmes, Public Transportation, and Urban and Interurban Transportation Services. At M.I.T., he has taught graduate-level courses in the areas of Traffic Engineering, Optimization Techniques, Public Transportation, Microcomputer Applications in Transportation and Transportation Systems Analysis. He has written three books entitled: Driver-Vehicle Modeling and Traffic Flow Characteristics; Network Theory and Selected Topics in Dynamic Programming; and Public Transportation. He has authored more than 40 papers in scientific journals, and as many as 30 research reports. He has also participated in more than 25 interntaional conferences. Since 1975, in addition to his academic appointment, he has been a senior engineer at the Transportation Research Institute and Road Safety center at the Technion Research and Development Foundation Ltd. His research interests have focused on developing and applying methods in five major areas: (1) traffic engineering; (2) traffic safety; (3) traffic flow and human factors; (4) public transportation; and (5) transit scheduling. His contributions to the areas of transportation science can be summarized in three main categories: (1) developing new traffic flow models which interpret the traffic flow phenomena through a human factors or driver's perspective and which were used for on-and-off line freeway control in Los Angeles, (2) developing a safety evaluation approach for road improvement projects which was implemented on a main frame computer in Israel and resulted in a reliable evaluation of before-and-after safety studies about road improvement projects; and (3) developing new theory and methods for transit scheduling which create automated transit time tables and vehicle and crew schedules and have been successfully incorporated into a software package currently implemented in four transit agencies worldwide. Ceder, ff. Tr. 5169, at 1-3 and Curriculum Vitae.

6.1.248. Neither Mr. Lieberman nor Dr. Urbanik have anywhere near the credentials as an expert in the field of traffic flow models and human behavior that Dr. Ceder has.

6.1.249. Because the Applicants refused to provide Dr. Adler and Dr. Ceder with a copy of the source code for IDYNEV, he was unable to do a full-scale model audit and review. Adler, ff. Tr. 7181, at 69.

6.1.250. Dr. Adler testified: "In my professional experience, whenever modeling projects have been undertaken which are meant to come under government scrutiny, this primary computer program [the source code] is generally made available to those reviewing the model and its application on a given project." Id.

6.1.251. NUREG-0654, Appendix 4, requires: "If computer models are used, a general description of the algorithm shall be provided along with a source for obtaining further information or documentation." We agree with Dr. Adler that implicit in this statement is that, if requested for review purposes, this documentation must be made available by the "source." Id. at 69-70. NUREG-0654's requirement is meaningless if all it means is that the "source for obtaining further information" must be identified but that no documentation need be provided by the "source."

6.1.252. This refusal by KLD to provide the source code coupled with Dr. Ceder's testimony, unrebutted as it is by any comparably credentialed witness, requires this Board to find that there is substantial uncertainty regarding the ability of the IDYNEV model to produce realistic evacuation times for Seabrook. Dr. Ceder testified that in his opinion, based on the documentation he examined, the IDYNEV model produces overly optimistic ETEs which are likely to be shorter than would actually be experienced. The aggressive cross examination to which he was subject does not dispel our uncertainty about the model. Mr. Lieberman's self-serving statements about what the model does or does not contain in terms of technical parameters also does not relieve our concerns, so long as he refuses to release the source code for independent review.

6.1.253. Dr. Urbanik stated that he had not reviewed the source code. Tr. 7433. He could only speculate that FEMA might have had Battelle Memorial Institute review it. Tr. 7434. Because it is apparent from our decision here that there needs to be further ETE analysis conducted before we can approve the NHRERP, we do not need to resolve the issues regarding the IDYNEV model at this time. If remedial ETE analyses are undertaken using IDYNEV, or any other model, and these analyses are submitted to the Board and the parties for further review, we will insist that the source code be released to any party upon request, subject to an appropriate protective order. Because of Dr. Ceder's testimony, the State of New Hampshire and the Applicants are on notice as to what some of the concerns about IDYNEV are. They should consider making the changes to the model he has suggested in order to make the ETEs produced more realistic. For now, however, we abstain from ruling on these issues.

6.2. Rulings of Law

6.2.1. Because a set of realistic ETEs is such an important element of emergency response plans, the Board cannot find "reasonable assurance" that adequate protective measures can and will be taken if the evidence presented shows either that the ETEs are unrealistic or that there is legitimate uncertainty regarding whether they are realistic.

6.2.1. The ETE study must be found to have been done in a manner which was not arbitrary or capricious. That is, it cannot (1) entirely fail to consider an important aspect of the problem, or (2) rely upon critical assumptions that run counter to the available evidence or are so implausible that they could not be ascribed to a difference in view or the product of expert opinion. Cf. Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto Ins. Co., 463 U.S. 29, 43 (1983).

6.2.3. While NUREG-0654, Appendix 4, does not spell out exactly how an ETE study is to be conducted, it cannot be done in such a manner as to leave decision-makers guessing as to what the ETEs would be for a wide range of common circumstances. Thus, when an ETE study is done for a summer tourist area which has dramatic variations in population from week to week, day to day, and even over the course of a single day as from 5,000 to 40,000 or more day-trippers arrive, it is not adequate to simply calculate what the ETEs would be if the population were at or near peak, or any other fixed population size. In order to provide reasonable assurance that adequate protective measures can and will be taken by protective action decision-makers, those decision-makers need both (1) a method for determining, with some reasonable degree of accuracy, what the size of the population is in that transient area at the moment at hand and (2) a means for quickly determining what the realistic ETEs are when the transient area has that many people in it.

6.2.4. While the Commission's regulations do not spell out the precise manner in which an evacuation is to be conducted if necessary, nonetheless the regulations plainly require the formulation of satisfactory evacuation plans. Merely having realistic ETEs for an uncontrolled or partially uncontrolled evacuation is not enough to satisfy the requirmeents of 10 C.F.R. § 50.47. Long Island Lighting Company (Shoreham Nuclear Power Station, Unit 1), ALAB-818, 22 NRC 651, 676-677 (1985). Discrete aspects of an evacuation plan may be subjected to adversarial evaluation to determine the efficiency with which an evacuation can be accomplished. Id. at 677 n. 103.

6.2.5. While neither the NRC's regulations nor NUREG-0654/FEMA-Rep-1, Rev. 1, prescribe specific minimum time limits for evacuating an EPZ, it does not necessarily follow that the finding required by 10 C.F.R. § 50.47(a) can always be made regardless how long the ETEs are. If, for example, a large transient population close to a reactor cannot be adequately sheltered, and the only protective action planned for this population is to direct it to engage in an evacuation for which ETEs are lengthy due to traffic congestion, then the NRC could find that this sole protective action -- lengthy evacuation -- resulted in the "entrappment" of those whose prompt evacuation was blocked by traffic congestion, and that for those entrapped this sole protective action did not provide "reasonable assurance that adequate protective measures can and will be taken."[3/]

6.2.6. Emergency response plans must contain adequate bases for making choices of recommended protective actions from the plume exposure pathway during emergency conditions. NUREG-0654/FEMA-Rep-1, II.J.10.n. These bases "shall include," inter alia, evacuation time estimates. Id.

3/ This ruling of law is directed primarily, to TOH Revised Contention VIII, which has been designated a "sheltering contention" although it contends that the NHRERP "fails to demonstrate that adequate protective responses can be implemented in the event of a radiological emergency," and further alleges as one of its bases that the NHRERP's reliance on a lengthy evacuation as the "sole means" of avoiding radiological exposure is a "wholly inadequate protective response to an emergency."

6.2.7. For EPZ's (such as the Seabrook Station EPZ) which experience a highly variable but potentially large influx of seasonal, weekly, and/or daily transients and for which ETEs, for at least some sectors of the EPZ, are affected significantly by the variation in the transient population, an emergency response plan does not have adequate bases for the choice of recommended protective actions if that plan provides no means during an emergency to reference or quickly calculate realistic evacuation times that are based on a reasonable estimate of the actual size of the total population, including transients, in the critical sectors at that point in time.

6.2.8. While the regulations do not require that extreme or unreasonable emergency planning measures be taken, see Southern California Edison Co. (San Onofre Nuclear Generating Station, Units 2 and 3), CLI-83-10, 17 NRC 528 (1983) (construction of additional hospitals and recruitment of substantial additional medical personnel), prudent risk reduction measures must be taken. See id. One licensing board has even stated that the "basic test" for judging emergency plans is whether the plans take the necessary "prudent risk reduction measures." Long Island Lighting Company (Shoreham Nuclear Power Station, Unit 1), LBP-85-12, 21 NRC 644, 653 (1985) (emphasis on the original).

6.2.9. In challenging an ETE study, once the Intervenors present credible evidence that critical data or assumptions used in the study were erroneous, or that there is legitimate uncertainty as to whether those data or assumptions were correct, and that as a result the ETEs calculated may be significantly unrealistic, the Intervenors have no further burden to demonstrate what specific data or assumptions should have been used or how those "correct" data or assumptions should be derived. See Tr. 7071 (Dec. 2, 1987).

6.2.10. When ETEs have been shown to be unrealistic or subject to legitimate uncertainty, the Applicants or governmental entities who put forth the ETE study have no defense that further refinements in the ETE study would be unreasonable. Just as the Board cannot approve the onsite emergency plans if certain key safety pumps were shown not to work, similarly the Board cannot approve offsite emergency response plans which contain ETEs that have been proven to be unrealistic or subject to legitimate uncertainty. See Tr. 7071 (Dec. 2, 1987).

6.2.11. Where, however, an ETE study meets the requirements of NUREG-0654 and the accuracy of the ETEs themselves are not challenged, but the Intervenors claim that the ETEs and the ETE study provide protective action decision-makers with insufficient information to allow prudent protective action decisions to be made for a significant range of conditions, the reasonableness defense does apply if it can be shown that the cost in time, money, or effort of gathering additional information is not reasonably justified by the needs for or value of having the additional information. If gathering additional information would be a prudent risk reduction measure, however, it should be done.

6.2.12. This board finds that it is prudent and not unreasonable to require that the NHRERP provide its protective action decision-makers with the capability to reference or quickly calculate realistic evacuation times which, during the period from May 15 to October 1 each year, are based on a reasonable estimate of the actual size of the total population, including transients, at the time protective action decisions are made.

6.2.13. The NHRERP presently does not contain this capability, and this deficiency constitutes a fundamental inadequacy in the plans.

6.2.14. Normally, Licensing Board decisions must be "supported by reliable, probative, and substantial evidence." 10 C.F.R. § 2.760(c). In adjudicating the adequacy of emergency plans, however, Boards must find "reasonable assurance" that adequate protective measures can and will be taken in the event of a radiological emergency. 10 C.F.R. § 50.47(a).

6.2.15. "Absent some special statutory standard of proof, factual issues decided by this or any other Federal agency are determined by a preponderance of the evidence." TVA (Hartsville Nuclear Plant, Units 1A, 1B and 2B), ALAB-463, 7 NRC 341, 360 (whether existence of an endangered species was "jeopardized" by the location of the discharge diffuser in violation of the Endangered Species Act), reconsideration denied, ALAB-467, 7 NRC 459 (1978) (emphasis supplied). But while various NRC cases have upheld the "preponderance" standard, none concerns a 50.47 issue. See, e.g., Commonwealth Edison Company (Zion Station, Units 1 and 2), ALAB-616, 12 NRC 419, 421 (1980) (whether proposed new fuel racks might corrode); Consolidated Edison Company of New York (Indian Point Nuclear Generating Station, Unit No. 3), CLI-75-14, 2 NRC 835 839 fn. 8 (1975) (whether a proposed amendment regarding the cooling system would be justified based on certain environmental concerns).

6.2.16. When an ASLAB did confront an issue which implicated a "reasonable assurance of safety" test, it noted that the "beyond a reasonable doubt" or "clear and convincing" standards of proof "may or may not" be "appropriate" as "an acceptable restatement (or implementation) of the "reasonable assurance of safety" test established by the Commission's regulations at 10 C.F.R. § 50.35(a)(4) and 50.57(a)(3)(i). But it declined to reach that question, finding that "no matter how the standard is articulated, it plainly has been satisfied in this instance ...." Virginia Electric and Power Company (North Anna Power Station, Units 1, 2, 3 and 4), ALAB-256, 1 NRC 10, 16-17 (1975). In dicta, however, this ASLAB noted: "In passing, we note our agreement with the intervenor that, as a general rule at least, the magnitude of the burden of persuasion placed on a litigant should be influenced by the gravity of the matters in controversy." Id. at 17 fn. 18.

6.2.17. Thus, it is an open question whether the language of 50.47(a) imposes a higher standard of proof on the Aplicants than that contained in the preponderance standard.

6.2.18. We find that the "reasonable assurance" standard is a special regulatory standard of proof, higher than the preponderance standard.

6.2.19. Emergency response plans need not be in final form at the time an operating license application is noticed for hearing. This is not to say, however, that any plan, no matter how skeletal, will suffice at this stage. The plans submitted must include a description of their contents "to an extent <u>sufficient to demonstrate</u> that the plans provide reasonable assurance that adequate protective measures can and will be taken in the event of an emergency." <u>Cincinnati Gas & Electric Company</u> (Wm. H. Zimmer Nuclear Power Station, Unit No. 1), ALAB-727, 17 NRC 760, 770 (1983) (emphasis in original), quoting from 10 C.F.R. Part 50, Appendix E, Section III.

6.2.20. Thus, while a plan can be approved without having all its implementing details finalized, no NRC regulation or decision permits a Licensing Board to disregard testimony about myriad small implementing details which <u>are</u> in plans if those details, when scrutinized carefully for their overall effects, could give rise to serious doubts about the adequacy of any essential element of the plan or a concept of operations. In such circumstances, small but relevant implementing details cannot be considered immaterial evidentiary "background noise."

6.2.21. The degree of accuracy of an ETE study for the Seabrook Station EPZ should be in the range of ± 10%. Tr. 7459-7460 (Urbanik).

6.2.22. Upon finding an ETE study to be deficient (or that it is subject to legitimate uncertainty as to whether it is adequate), the Board ought to do what it does with quality assurance deficiencies, i.e., inform the parties now of the substance of its views on the issues, retain jurisdiction over them, and provide for further proceedings before it when the remedial actions taken become ripe for consideration. See Commonwealth Edison Co. (Byron Nuclear Power Station, Units 1 and 2), ALAB-770, 19 NRC 1163, 1169 (1984).

6.3. Conclusion

6.3.1. The Board finds and rules that the Volume 6 ETE study does not contain a sufficiently realistic set of ETEs for use by New Hampshire's protective action decision-makers in 1988. Moreover, the Applicants have not provided adequate additional analyses and data upon which to conclude that the state of ongoing planning makes the deficiencies in Volume 6 easily correctible. The ETE analysis needs to be re-done in the manner suggested by this opinion before we can find reasonable assurance that adequate protective measures can and will be taken to protect the population in the New Hampshire portion of the EPZ. We hereby retain jurisdiction over these matters. If and when we are informed that remedial action has been taken, we will make the results of that effort known to the Intervenors and the public and set a schedule for the filing of new contentions.

7. HUMAN BEHAVIOR IN EMERGENCIES

7.1. Proposed Findings

7.1.1. In making its findings concerning the adequacy of the NHRERP, this Board is called upon to predict, to some extent, the nature of the human behavior that is likely to emerge in the event of a radiological emergency at Seabrook. Specifically, this Board is called upon to predict emergency behavior in the areas of driver behavior and ride-sharing, role abandonment by emergency workers, and the public's response to various protective action recommendations.

7.1.2. To a great extent, the Applicants have sought to meet their burden of proof on these issues by relying on the testimony of their expert Dr. Dennis S. Mileti, a Professor of Sociology at Colorado State University. On the basis of his testimony, the Applicants would have this Board find that: (1) aberrant driver behavior will not appear during a vehicular evacuation from the Seabrook EPZ and, therefore, need not be taken into consideration in the calculation of the ETEs or in planning generally (App. PF 7.1.28); (2) ride-sharing will be widespread and thereby transportation will be available for nearly every transport-dependent evacuee (App. PF 7.1.42); (3) role abandonment by emergency workers will not occur to an extent sufficient to affect the capacity of New Hampshire officials to adequately implement the NHRERP (App. PF 7.1.53 et seq.); and (4) the public response to a Seabrook radiological emergency will be orderly and rational (App. PF 7.1.39, 7.1.41).

7.1.3. The support for these proposed findings are two distinct theories put forward by Dr. Mileti: 1) the theory of the "therapeutic community" that emerges at the time of an emergency; and 2) the theory that public emergency response is primarily shaped by the situational risk perceptions of individuals at the time of an emergency. The Board does not believe that these theories are sufficiently linked by empirical evidence to the population in the Seabrook EPZ. As a result, the Board does not have a sufficient evidentiary basis on the record before it for concluding that issues of human behavior, as outlined above, are resolved.

7.1.4. Dr. Mileti's theory of the "therapeutic community" is a model drawn from the sociological literature. Tr. 6379. There is a dispute that literature concerning the applicability of this theory to emergency response and human behavior during a radiological emergency. Tr. 6383, 6413-6417.

7.1.5. We find Dr. Mileti's argument in support of his position in this debate simply conclusory. Dr. Mileti argues that:

> The position that radiological events are unique argues against the basic premise on which the social sciences rest: that there are knowable reasons and patterns in human behavior that are discoverable through systematic scientific inquiry.

Mileti, et al., ff. Tr. 5622, at 138. True scientific inquiry would not assume that empirical data must conform to a theoretical model developed on the basis of different empirical phenomena.

7.1.6. By acknowledging that the public's pre-emergency fear of radiation is greater than its fear of any natural disaster (Tr. 6425), we find that Dr. Mileti himself has put in question whether a model based primarily on community response to natural disaster should or can be used, without more, to predict human behavior in response to a radiological emergency.

7.1.7. Further, Dr. Mileti has not sufficiently weighed the usefulness of his model of the therapeutic "community" in light of the fact that there is a large transient population in the beach areas of the Seabrook EPZ. He was unable to cite any support for the proposition that a human population made up of significant numbers of transients and non-residents would respond in the same manner as a pre-existing "community." Tr. 6428. It is not clear at all that the preconditions for the emergence of a "therapeutic community" exist if there is no pre-existing "community" with which individuals might identify as described at Mileti, et al., ff. Tr. 5622, at 95. Dr. Mileti offered no support for his assertion that a therapeutic community has emerged or will emerge among a collection of strangers. Tr. 6429.

7.1.8. This is a specific instance of a general failing evident in Dr. Mileti's testimony: it is abstract and theoretical and little or no effort has been made by Dr. Mileti to link his assumptions to the specific characteristics of the population in the Seabrook EPZ.

7.1.9. The other theory proffered by Dr. Mileti concerns the purported capacity of "good" emergency information to overcome all other determinants of emergency response with the happy result that the public behaves in accordance with the emergency plan. Mileti, et al., ff. Tr. 5622, at 150-156.

7.1.10. The Board, again, finds this theory to be highly abstract and non-empirical. Further, the Board finds that more information is needed about the attitudes and fears of the relevant population to support any conclusion that the emergency information to be provided to the public will have the effects ascribed to it by Dr. Mileti.

7.1.11. Dr. Mileti admits that factors other than emergency information may have "profound weight" in shaping the character of the public's emergency response if there is not "adequate" emergency information. Tr. 6343. These factors include location, sex, age, occupation, educational level, and pre-emergency fears, attitudes and intentions.

7.1.12. Dr. Mileti's evaluative criteria for judging the adequacy of the NHRERP's emergency information (i.e., EBS messages) are taken from a research record that does not include radiological emergencies. Mileti, et al., ff. Tr. 5622, at 156-157. As noted, Dr. Mileti acknowledges that in the United States, the public's pre-emergency fear of radiation is higher than its fear of any natural disaster. Tr. 6425.

7.1.13. The assumption that information will overcome other determinants of human emergency behavior is just that -- an assumption. Tr. 6570. In the one significant case of a radiological emergency in the United States, emergency information did not overcome these other determinants, including, significantly, pre-emergency fear of radiation. Tr. 6458.

7.1.14. Dr. Mileti asserted that emergency information provided to the public in the event of an accident at Seabrook would be the key difference between the behavioral response that occurred at Three Mile Island ("TMI") and the response to a Seabrook emergency. Tr. 6462.

7.1.15. However, Dr. Mileti acknowledged that there likely would be similarities between a Seabrook emergency and the event at TMI. Specifically: 1) as at TMI, the news media would be uncontrolled, Tr. 6463; 2) the NRC or somebody else would provide conflicting information, Tr. 6464; and 3) the public would receive conflicting information from a "whole host of other sources," Tr. 6468.

7.1.16. Dr. Mileti's assertion that notwithstanding the conflicting information provided to the public, the EBS messages would still be "adequate emergency information" that would overcome the other acknowledged determinants of emergency response is unsupported by any evidence. In fact, Dr. Mileti acknowledged that the effectiveness of any emergency message is, in part, a function of the credibility of the ascribed source of the message. Tr. 6486. Yet, Dr. Mileti acknowledged that he had no idea how credible the ascribed sources of the EBS messages in the NHRERP are to the Seabrook population. Tr. 6556. Further, Dr. Mileti acknowledged that the public would view the utility as a source for the emergency information (Tr. 6565) and that the utility would have extremely low credibility. Tr. 6566.

7.1.17. Dr. Mileti's judgment that the EBS messages as messages in and of themselves would have the thorough going effects he ascribes to them is based on no empirical research or data. Tr. 6635.

7.1.18 Dr. Mileti appears to have assumed an average level of pre-emergency fear among the Seabrook population in judging the capacity of the EBS messages to control for the other determinants of emergency response. Tr. 6349, 6446-6447. (But cf. Tr. 6339). He acknowledged that pre-emergency fears are a factor in shaping how the receiver of emergency information hears that information. Tr. 6336. Yet, he has no idea what kind of pre-emergency fear actually exists in the Seabrook EPZ and, therefore, has no basis for asserting that:

> public response to a future emergency . . . at Seabrook would largely be a function of the information characteristics of the EBS system.

Meleti, et al., ff. Tr. 5622, at 156.

7.1.19. Dr. Mileti's reasoning on this point is completely circular. He acknowledged that research into pre-emergency perceptions of risk would be beneficial if there was no emergency planning in place. Tr. 6336. He asserted, however, that it was not needed if there was "good emergency planning." Id. But, Dr. Mileti's judgment that there has been "good emergency planning" is based on his assumption that the

EBS messages will overcome pre-emergency fears without any empirical inquiry concerning the scope and extent of those pre-emergency attitudes. In short, to judge whether the EBS messages will be the key determinant of response, it is not enough to review just the messages. It is also necessary to link these messages with the populations who will respond to them. This Dr. Mileti has not done.

7.1.20. The Board does not accept Dr. Mieti's view of the lack of value in any form of social survey designed to scope out the pre-emergency attitudes, fears and intentions of the relevant population when making predictions about future behavior. Mileti, et al., ff. Tr. 5622, at 143-149; Tr. at 6323 et seq.

7.1.21. Dr. Mileti acknowledged that certain behaviors are accurately predicted by pre-behavior research. Tr. 6325-26. Dr. Mileti acknowledged that there are a set of variables, including pre-emergency perceptions of risk, that do influence emergency response. Tr. 6343. Further, he agreed that empirical research concerning such pre-emergency risk perceptions is different from research into intentions per se. Tr. 6329.

7.1.22. On this basis, we find unconvincing Dr. Mileti's assertion that no site-specific pre-emergency research is necessary for adequately predicting the behavioral response to a Seabrook radiological emergency. Tr. 6337. Again, Dr. Mileti's reasoning is circular. He asserts that no pre-emergency reasearch is necessary because:

> we have a good understanding how human populations vary, and how variance in those factors affects response in emergencies.

Tr. 6338.

Yet, the actual level of pre-emergency fear is a factor that affects response (Tr. 6334-36) and does vary from one type of disaster to another (Tr. 6425). Dr. Mileti appears to have simply assumed an average level of pre-emergency fear among the Seabrook EPZ population. Tr. 6342. As a result, we have no confidence in his predictions concerning the impact of emergency information on the character of the behavioral response to a Seabrook emergency. Dr. Mileti appears to have evaluated the quality and effectiveness of the NHRERP's emergency information based on a generic assumption that the Seabrook population has pre-emergency levels of risk perception and fear comparable to those shared by any group of people to any disaster. As Dr. Mileti put it:

> We can presume that the EPZ in the future is filled with totally fearless people and/or totally fearful people, or what's most likely the case, a range of people along that continuum . . ..

Tr. 6342.

Dr. Mileti simply does not know whether pre-emergency perceptions and attitudes in the areas around Seabrook are extreme enough to short-circuit the effectiveness of emergency information. His syllogism that: (1) behavior is a function of emergency information; (2) the emergency information in the NHRERP is adequate; therefore, (3) we can predict that the emergency response will be in accordance with the plan, is based on an unexamined empirical assumption, i.e., that the pre-emergency attitudes of the Seabrook population are average and comparable to other groups' attitudes and fears toward other disasters. The evidence presented by the Intervenors certainly puts that empirical assumption into question. Ziegler, et al., ff. Tr. 7849 at Attachment 5.

7.1.23. The abstract and non-empirical nature of Dr. Mileti's theories of human behavior is clear from his statement that he would not need to know the age of the Seabrook population to assess the adequacy of the emergency information and predict the emergency respones even if it is hypothesized that everyone in the EPZ were over 75 years. Tr. 6355-6358. Dr. Mileti asserted this while at the same time acknowledging that age is a determinate of emergency response and affects how individuals receive information. Tr. 6355.

7.1.24. With regard to role abandonment, Dr. Mileti agreed with the expert witnesses for the Intervenors that large numbers of medical workers left the TMI area during the TMI emergency. Ziegler, et al., ff. Tr. 7849, at 44-47. Tr. 6575. Dr. Mileti did not describe this phenomenon as role abandonment because he stated that TMI medical workers did not have emergency roles to abandon. We find Dr. Mileti's discussion in this regard fractious and forced. First, Dr. Mileti argues that medical workers did not have emergency roles to abandon if emergency plans did not exist at their workplace. Tr. 6578. This is just sophistry. People can and do have emergency roles even without the imprimatur of a formal plan. Second, Dr. Mileti argues that medical workers did not abandon their emergency roles because there was no medical emergency at TMI. Tr. 6580-6583. This view flies in the face of the undisputed first-hand reportage at TMI cited by Dr. Mileti that indicates that real staff shortages existed due to medical worker flight that caused some health facilities to close and hampered ad hoc preparation of emergency medical services at certain other facilities. Tr. 6582-6592. We find totally unconvincing Dr. Mileti's claim that nothing would have suggested to medical workers at TMI that there was a medical emergency (Tr. 6580) when at the same time health facilities in the area were trying to prepare for the possibility of large numbers of contaminated injured. Tr. 6583.

7.1.25. With respect to the topic of driver behavior under conditions that are likely to exist in an evacuation from Seabrook on days when the beaches are crowded, we find that Dr. Mileti has no expertise. We note that when he was asked if there is going to be a "traffic jam" under those conditions, he replied: "I really don't have the expertise to answer that question." Tr. 6316. He also stated: "I can't say that I have expertise on traffic jams or driver behavior in traffic jams." Tr. 6317. When asked specifically if he was familiar, from a driver behavioral perspective, with even one emergency in which there was a traffic jam, he responded: "I haven't interviewed drivers, no." Tr. 6318. When he was asked if he was aware of any evacuation occuring after an emergency in which the traffic was in congested flow, stop-and-go conditions, for as long as 10 hours (as Applicants predict the ETE will be under Scenario 2/Region 1 conditions), he responded: "No, I don't, and the reason is, I'm not an expert on traffic and I've not examined the behavior of traffic." Tr. 9431. He admitted that he had not been consulted by the utility to give them his views as a behavioral scientist on driver behavior. Tr. 6319, 6321. In light of these admissions, we must decline to treat Dr. Mileti as an expert witness on this topic. We therefore disregard all his testimony on the subject of driver behavior in an evacuation from Seabrook. We do note, however, his agreement that it is possible in a Seabrook evacuation that drivers whose immediate escape is blocked by traffic congestion will get out of their cars and pursue their escape routes on foot. Tr. 9420. He also did not rule out the possiblity that evacuating drivers might drive up the right-hand shoulder, cross a double yellow center line and proceed up the left (opposite flow) lane, and abandon their vehicles and leave them in a traffic stream. Tr. 9421-9422. In fact, under some circumstances, he thought that driving on the shoulder "might make good sense." Tr. 9422.

7.1.26. On the subject of driver behavior we adopt here those findings on this subject made previously in Part 6 regarding our serious concerns about the viability or workability of an evacuation of the beach areas when they are crowded, especially in light of the late-staffing of the traffic control posts.

7.2. Rulings of Law

7.2.1. When human behavior issues are raised to challenge off-site emergency response plans, and the state of the record is such that there is substantial uncertainty whether major elements or components of the plan will work in an emergency because of the uncertainty over these behavioral issues, the Board must find that there is no reasonable assurance that adequate protective measures can and will be taken until those behavioral issues are resolved.

7.3. Conclusion

7.3.1. The board does not have sufficient evidentiary basis on the record before it to conclude: (1) that aberrant driver behavior, including increased vehicular accident rates, will not appear during a vehicular evacuation from the New Hampshire portion of the Seabrook EPZ and therefore need not be taken into consideration in calculating ETEs or in planning generally; (2) that ride-sharing will be widespread and will obviate the need to arrange transportation for all transport-dependent evacuees; (3) that role abandonment by emergency workers will not occur to an extent sufficient to affect the capacity of New Hampshire officials to adequately implement the NHRERP; and (4) that the public response to a Seabrook radiological emergency will be orderly and rational. Substantial uncertainty exist with respect to each of these behavioral concerns.

7.3.2. Given this substantial uncertainty on these major behavioral issues, the Board must find that there is no reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency at Seabrook Station.

Respectfully submitted,

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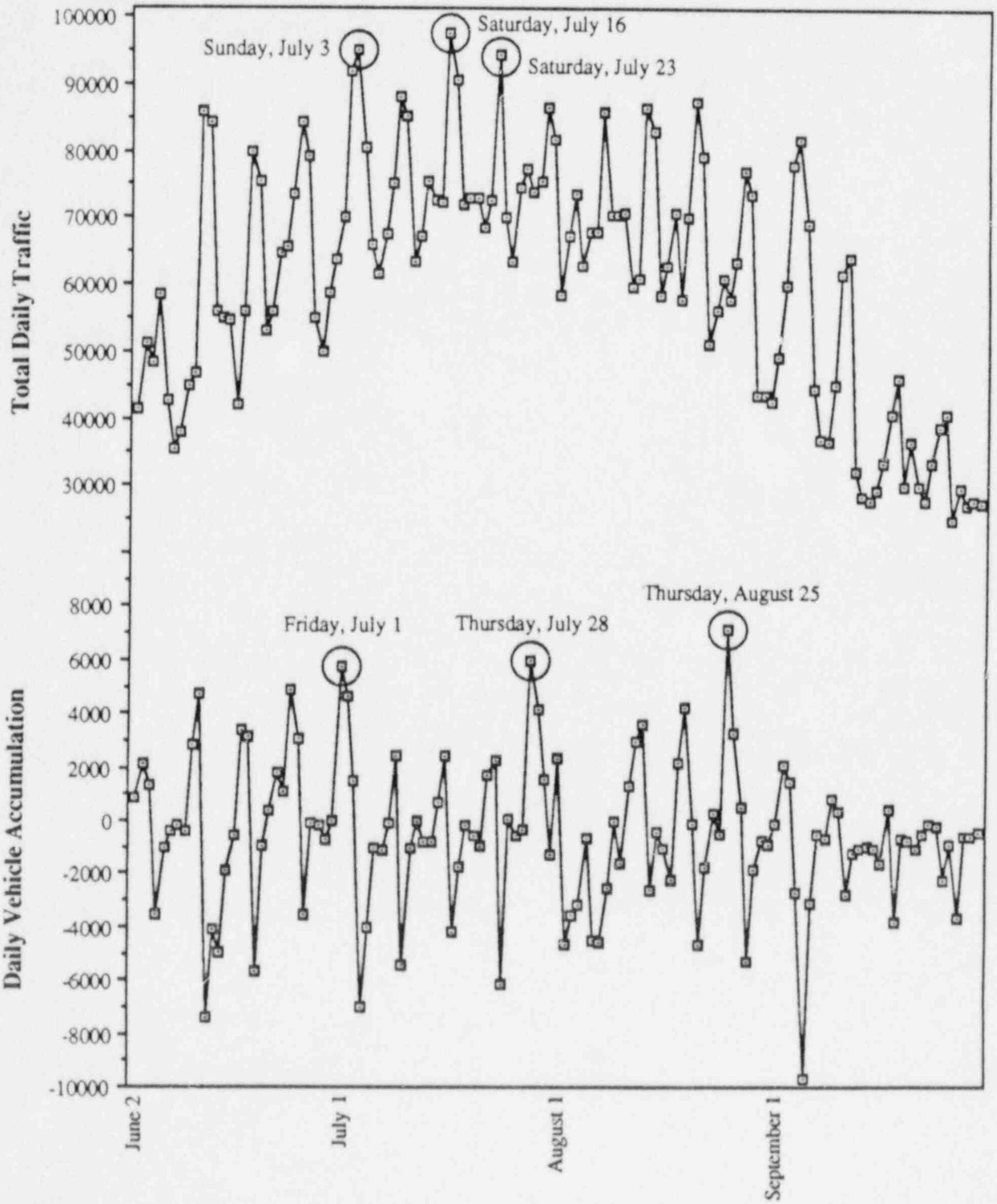
APPENDIX A

Comparison of Roadway Traffic Levels and Daily Vehicle Accumulation

Hampton, Seabrook and Salisbury Beaches

1983



Source: HMM Associates: 1983 Beach Area Traffic Count Program (Count Locations 1,3,5,6)

TABLE 3.1 BEACH AREA ENTRIES AND EXITS*

DATE	DIRECTION	MON	TUE	WED	THUR	FRI	AVERAGE WEEKDAY	SAT	SUN	AVERAGE WEEKEND
5/23-5/29	Day In**	NA	NA	NA	NA	NA	NA	35,537	29,567	32,552
	Day Out***	NA	NA	NA	NA	NA	NA	32,095	32,168	32,132
	Day Total	NA	NA	NA	NA	NA	NA	67,632	61,735	64,684
5/30-6/5	Day In**	21,076	14,676	18,344	21,093	26,602	20,358	24,881	27,467	26,174
	Day Out***	27,475	19,095	20,248	20,258	24,495	22,314	23,578	30,987	27,283
	Day Total	48,551	33,771	38,592	41,351	51,097	42,672	48,459	58,454	53,457
6/6-6/12	Day In**	20,836	17,513	18,923	22,212	24,866	20,870	45,258	38,404	41,831
	Day Out***	21,869	17,934	19,109	22,596	22,025	20,707	40,535	45,786	43,161
	Day Total	42,705	35,447	38,032	44,808	46,891	41,577	85,793	84,190	84,992
6/13-6/19	Day In**	25,937	25,032	26,436	20,686	29,660	25,550	41,448	34,902	38,175
	Day Out***	30,061	30,028	28,292	21,237	26,274	27,178	38,292	40,547	39,420
	Day Total	55,998	55,060	54,728	41,923	55,934	52,729	79,740	75,449	77,595
6/20-6/26	Day In**	26,081	28,199	33,327	33,446	39,163	32,043	43,678	37,801	40,740
	Day Out***	26,987	27,772	31,546	32,380	34,259	33,857	40,592	41,329	40,961
	Day Total	53,068	55,971	64,873	65,826	73,422	65,900	84,270	79,130	81,700
6/27-7/3	Day In**	27,486	24,908	29,039	31,842	37,952	30,245	48,233	48,315	48,274
	Day Out***	27,538	25,029	29,722	31,848	32,204	29,268	43,603	46,781	45,192
	Day Total	55,024	49,937	58,761	63,690	70,156	59,514	91,836	95,096	93,466
7/4-7/10	Day In**	36,758	30,965	30,241	33,194	37,513	33,734	45,262	41,963	43,613
	Day Out***	43,742	34,963	31,276	34,327	37,603	36,382	42,820	45,379	44,100
	Day Total	80,500	65,928	61,517	67,521	75,116	70,116	88,082	87,342	87,712
7/11-7/17	Day In**	31,262	33,696	37,344	35,912	38,558	35,354	50,014	43,201	46,608
	Day Out***	32,281	33,691	38,139	36,671	35,768	35,310	47,594	47,413	47,504
	Day Total	63,543	67,387	75,483	72,583	74,326	70,664	97,608	90,614	94,111
7/18-7/24	Day In**	35,128	36,301	36,204	33,792	37,228	35,731	48,303	31,911	40,107
	Day Out***	36,896	36,480	36,779	34,717	35,216	36,018	46,058	38,063	42,061
	Day Total	72,024	72,781	72,983	68,509	72,444	71,748	94,361	69,974	82,168
7/25-7/31	Day In**	31,828	36,967	38,454	39,953	39,732	37,387	43,962	40,217	42,090
	Day Out***	31,735	37,545	38,747	33,957	35,576	35,512	42,402	41,489	41,946
	Day Total	63,563	74,512	77,201	73,910	75,308	72,899	86,364	81,706	84,035
8/1-8/7	Day In**	30,464	31,360	35,067	29,788	33,571	32,050	44,754	40,643	42,699
	Day Out***	28,112	36,003	38,620	32,943	34,238	33,983	50,159	45,240	47,700
	Day Total	58,576	67,363	73,687	62,731	67,809	66,033	94,913	85,883	90,398
8/8-8/14	Day In**	33,896	35,164	34,624	30,570	31,953	33,241	44,999	42,257	43,628
	Day Out***	36,448	35,167	36,168	29,197	28,992	33,194	41,347	42,838	42,093
	Day Total	70,344	70,331	70,792	59,767	60,945	66,436	86,346	85,095	85,721
8/15-8/21	Day In**	28,945	30,875	34,329	30,024	37,191	32,273	43,724	37,252	40,488
	Day Out***	29,367	31,900	36,522	27,845	32,930	33,587	43,784	41,906	42,845
	Day Total	58,312	62,775	70,851	57,869	70,121	65,860	87,508	79,158	83,333
8/22-8/28	Day In**	25,786	28,210	30,239	32,513	33,317	30,013	38,751	34,195	36,473
	Day Out***	26,505	27,925	30,695	25,327	30,025	28,095	38,168	39,480	38,824
	Day Total	52,291	56,135	60,934	57,840	63,342	58,108	76,919	73,675	75,297
8/29-9/4	Day In**	20,815	21,391	20,854	24,559	31,054	23,735	39,670	39,400	39,535
	Day Out***	22,665	22,114	21,693	24,652	28,945	24,014	38,163	42,155	40,159
	Day Total	43,480	43,505	42,547	49,211	59,999	47,748	77,833	81,555	79,694
9/5-9/11	Day In**	29,752	20,786	18,321	18,020	23,001	21,976	30,969	30,224	30,597
	Day Out***	39,415	32,853	18,788	18,675	22,144	24,575	30,592	33,865	32,229
	Day Total	69,167	44,639	37,109	36,695	45,145	46,551	61,561	64,089	62,825
9/12-9/18	Day In**	15,414	13,771	13,586	14,425	16,760	14,791	19,153	21,124	20,139
	Day Out***	16,879	14,604	14,278	15,034	16,666	15,492	21,611	24,937	23,274
	Day Total	32,293	28,375	27,864	29,459	33,426	30,283	40,764	46,061	43,413
9/19-9/25	Day In**	14,644	18,062	14,555	13,671	16,722	15,531	19,423	19,269	19,346
	Day Out***	15,288	18,774	15,550	14,181	16,821	16,123	19,577	21,460	20,519
	Day Total	29,932	36,836	30,105	27,852	33,543	31,654	39,000	40,729	39,865
9/26-10/2	Day In**	12,127	13,046	13,364	13,669	13,622	13,166	NA	NA	NA
	Day Out***	12,885	13,707	13,903	14,237	14,016	13,750	NA	NA	NA
	Day Total	25,012	26,753	27,267	27,906	27,638	26,915	NA	NA	NA

* Daily (24-Hour) Totals.

** Inbound flows include Route 1A southbound (Hampton), Exeter/Hampton Expressway eastbound (Hampton), NY Route 286 eastbound (Seabrook), and Route 1A eastbound (Salisbury).

*** Outbound flows include Route 1A northbound (Hampton), Exeter/Hampton Expressway westbound (Hampton), NH Route 286 westbound (Seabrook), and Route 1A westbound (Salisbury).

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UNITED STATES OF AMERICA

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NUCLEAR REGULATORY COMMISSION

OFFICE OF SECRETARY
DOCKETING & SERVICE
BRANCH

In the Matter of PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE, ET AL. (Seabrook Station, Units 1 and 2)	)	Docket No.(s) 50-443/444-OL

CERTIFICATE OF SERVICE

I, Allan R. Fierce, hereby certify that on May 19, 1988, I made service of the within Massachusetts Attorney General James M. Shannon's Proposed Findings of Fact and Rulings of Law, by mailing copies thereof, postage prepaid, by first class mail, or as indicated by an asterisk, by Federal Express mail to:

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