KLD TR-174B

EVACUATION PLAN UPDATE

for

Seabrook Station

Seabrook, New Hampshire

Progress Report No. 3

Prepared for

The Commonwealth of Massachusetts
Civil Defense Agency and Office of Emergency Preparedness

by

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1. INTRODUCTION

This is the third of a series of Progress Reports which document the activities performed, and the results obtained, in connection with a study to update the existing evacuation plan for the Seabrook Station.

The practice of publishing progress reports for distribution departs, somewhat, from the conventional practice of completing the study before publishing a Final Report. We have chosen this approach for the following reasons:

1. It is hoped that the early publication of these reports would prove of value to other planning groups.

2. Hopefully, these reports will also stimulate responses from all involved public agencies, citizen planning committees and town officials.

3. The timing of these progress report publications will enable us to review all such responses -- both constructive and critical -- prior to the completion of the study. Any responses which are received in a timely manner and judged to contribute to the accuracy and/or reliability of the final study results, will be incorporated into the evacuation plan development, prior to the publication of the Final Report.

This approach is endorsed by the Massachusetts Civil Defense Agency (MCDA), which is sponsoring this activity.

It is assumed that the reader also has a copy of the prior progress report, since many references are made thereto. Also, the section numbers of this report are a continuation of those of the prior report so that:

- Continuity of text is preserved

- Reference by future Progress Reports to the earlier reports are clear and unambiguous.

13. SCOPE OF THIRD PROGRESS REPORT

This report describes the activity completed since the publication of the second Progress Report. Specifically:

- Performance of sensitivity tests to study the change in Evacuation Time Estimates (ETE) with varying levels of beach area population during the summer season.

While limited in scope, this report addresses a subject of major interest. For that reason, it was published as soon as the results became available.

14. SENSITIVITY TESTS FOCUSING ON BEACH AREA POPULATION

The population of permanent residents and permanent employees within the Seabrook Station Emergency Planning Zone (EPZ) remain reasonably stable over the year. In contrast, the tourist population increases greatly during the two summer months of July and August, relative to the level that prevails over the other ten months of the year.

The beach area population is even more volatile than the seasonal tourist population. Roughly half of the beach traffic on a crowded day is comprised of day-trippers. Thus, the beach area population is "weather-driven" as expressed by a member of a local Chamber of Commerce. If the weather is unappealing, the beach area traffic could be half of what it would otherwise be on a hot, sunny day. Day-of-week is another factor which influences beach population.

The results presented in earlier reports represent "worst-case" beach area population conditions, based on the assumption that all real estate available for parking vehicles is fully utilized for that purpose. Such conditions are rarely, if ever, attained since there is a continuing turnover of parked cars which makes it almost impossible to fully match demand for parking with available supply.

As presented in Appendix E, Item 7, the most crowded parking condition in August, 1985 was tabulated for each beach area and compared with our estimates of parking capacity. On that day, the largest beaches exhibited parking occupancy rates, relative to capacity, of 72, 86 and 74 percent for Salisbury, Seabrook and Hampton Beaches, respectively.

Of course, these occupancy rates may reflect our rather conservative (i.e. high) estimates of capacity, rather than any shortfall in demand. On that day, virtually all the parking lots and curb space were full, with space available only on some unpaved areas and on some front lawns, backyards and driveways.

Thus it is reasonable to expect that actual parking attendance will likely be somewhat less than the estimated capacity, on most days of the season. It is therefore prudent to quantify the "elasticity" of Evacuation Time Estimates (ETE) with respect to beach area population, particularly in view of the high volatility of this population as noted above.

Furthermore, since there is currently limited shelter on the beach areas, relative to their population on crowded days, it is also prudent to explore planning strategies which are designed to provide early responses to emergency conditions at Seabrook Station. For example, the beaches themselves (i.e. the sandy areas) may be closed down and beach area visitors may be advised to evacuate while others with shelter available may be advised to shelter.

In a strict sense, such strategies lie outside the scope of the evacuation planner -- these strategies are developed by emergency planners with backgrounds in health physics and related fields of expertise. Nevertheless, it is within our scope to quantify the ETE consquences of any such strategies which may be considered. For that reason, we have prepared some analyses which explore these issues.

We have also explored the effect on ETE of implementing special traffic management tactics designed expressly to expedite the movement of vehicles from the beach areas. These tactics are assigned a special Scenario 11.

In addition, we have identified a new "region" consisting exclusively of the beach areas throughout the EPZ. The studies conducted on this Region 10 represent the situation where all those on the beach area are advised to evacuate at a time (e.g. at an early stage of an accident situation at the Station), when there is no need to so advise the general public within the EPZ. Such an emergency response strategy would represent a conservative approach to begin moving people off the beach areas before a need to evacuate is clearly demonstrated by the accident condition.

Table 12 identified the ten basic evacuation scenarios to be considered, while the tabulations on page 54 of Progress Report No. 2 defined the nine regions of the Seabrook EPZ. Each region consists of one or more of the Emergency Response Planning Areas (ERPA) defined in Table 14 and shown in Figure 28. For these beach area sensitivity tests, we define an additional region and several new scenarios. These are shown in Table 15, together with a compilation of all test cases presented herein.

Results of Sensitivity Studies

The tabulated results of the sensitivity studies analyzing the elasticity of ETE relative to beach area population, are presented in Tables 16 through 19. Each of these studies will be described in the following text.

Region 9, Scenarios 1, 1A, 1B

Region 9 consists of ERPA A, which approximates a circular area within two miles of Seabrook Station. Scenarios 1, 1A and 1B represent the condition where the vehicle population of the beach areas throughout the EPZ is at 100, 80 and 60 percent of capacity, respectively.

As noted earlier, Scenario 1 represents the extreme condition which may be realized only a few times during the season, e.g. Independence Day weekend and perhaps other weekend days characterized by very hot and humid weather. A more

Table 15. Sensitivity Tests Focusing on the Evacuation of Beach Area Population

New Region 10: All Beach Areas within the EPZ

Scenario	Description
1	Summer weekend day, beach areas at capacity. See Table 12.
1A	Same as Scenario 1, except that the number of vehicles parked at the beach areas is 80 percent of parking capacity.
1B	Same as Scenario 1A, excect that 60 percent of parking capacity is utilized.
11	Same as Scenario 1, except that additional traffic controls are implemented on the access routes to the major beaches of Hampton and Salisbury.
11A	Same as Scenario 11, except that 80 percent of parking capacity is utilized.
11B	Same as Scenario 11, except that 60 percent of parking capacity is utilized.

Test Cases Reported in this Progress Report

Region	Area	Scenario					
		1	1A	1B	11	11A	11B
5	Five-Mile	X	X	X			
9	Two-Mile	X	X	X	X	X	X
10	Beaches	X	X	X			

representative weekend day with good weather is the one discussed in Appendix E, Item 7, which is approximated by Scenario 1A. Finally, a weekday, or a weekend day with more moderate temperatures, would be represented by Scenario 1B.

For all cases where a portion of the EPZ population is advised to evacuate, and the remainder of the population (i.e. those in other regions within the EPZ) is advised to either shelter or to take no action, we assume that 25 percent of those who are advised to shelter or take no action will [spontaneously] evacuate.

Reference to Table 16 indicates that the ETE for the two-mile area is sensitive to the beach area population when standard traffic management is in effect as shown in the table below:

Scenario	Vehicles in Beach Area as Percent of Parking Capacity	Percentage of Vehicles Evacuated from Two-Mile Area			
		50	75	90	100
1	100 percent	1:35	2:40	3:25	4:00
1A	80 percent	1:10	2:00	2:40	3:25
1B	60 percent	0:50	1:25	2:15	3:15

As indicated above, 75 percent of the beach area population can be evacuated beyond a two-mile area around the Station, in 2:40 hours after the order to evacuate when beach area parking capacity is fully utilized, as compared with roughly half that time (1:25) when only 60 percent of the parking area, is used. For a "normal" weekend day, as defined above (Scenario 1A), 75 percent of the population in the beach area is evacuated in 2:00 hours and 90 percent in 2:40.

Beyond the two-mile area, this evacuating traffic will encounter limited congestion, since the [majority of the] population there will not be evacuating. As indicated in Table 16, the ETE for the five-mile and ten-mile areas, and for the entire EPZ, expressed in terms of the percentage of the initial populations within each respective area, are comparable to the ETE for the two-mile area.

For example, suppose there were 30,000 people initially within the two-mile area and 70,000 within the five-mile area. Then according to the results obtained for Scenario 1A, Region 9, it would take 2:00 hours to evacuate 22,500 people (75 percent of 30,000) from within the two-mile area, and 2:05 hours to evacuate 52,500 people (75 percent of 70,000) from within the five-mile area. Note that this group of 52,500 people includes most of the 22,500 people who have evacuated the two-mile area.

Table 16. Sensitivity of ETE to Beach Area Population
Region 9, Scenarios 1, 1A, 1B

Region	Scenario	Area	Percent of Vehicles Evaluated					
			25	50	75	90	95	100
9	1	2	0:40	1:35	2:40	3:75	3:45	4:00
		5	0:35	1:30	2:40	3:35	4:00	4:40
		10	0:30	1:20	2:25	3:30	4:00	5:30
		EPZ	0:35	1:20	2:25	3:20	4:00	5:40
9	1A	2	0:25	1:10	2:00	2:40	3:05	3:25
		5	0:30	1:10	2:05	2:45	3:10	4:10
		10	0:30	1:05	2:00	2:50	3:15	4:20
		EPZ	0:30	1:10	2:05	2:50	3:15	4:35
9	1B	2	0:15	0:50	1:25	2:15	2:35	3:15
		5	0:25	1:00	1:40	2:10	2:35	3:35
		10	0:25	1:00	1:40	2:20	2:40	3:40
		EPZ	0:30	1:00	1:45	2:25	2:50	3:45

Region 9, Scenarios 11, 11A, 11B

Scenario 11 is the same as Scenario 1, except that additional traffic controls are implemented. These include:

- Reversing Ashworth Avenue on Hampton Beach to service northbound traffic toward Route 51.
- Establishing a route feeding northbound traffic on Ashworth Avenue, onto the left lane of Route 51.
- Establishing two outbound lanes on Route 51 extending from Hampton Beach to I-95. Feeding traffic from one lane onto I-95 northbound, and shifting the traffic on the other (left) lane, onto the right lane of Route 51 towards Route 101 in a normal fashion.
- Establishing two lanes outbound on Beach Road (Route 1A in Salisbury) with an additional left-turn bay on the Route 1A approach to the intersection with Route 1 at Salisbury Center. The vehicles discharging from the left-turn bay would be directed south onto Route 1, with the other two lanes of traffic both proceeding west onto Route 110.
- Establishing two lanes of traffic westbound on Route 110 between Route 1 and the interchange with I-95. The traffic from one lane would be directed south onto I-95; the traffic on the other lane will proceed west on one lane to the interchange with I-495 where it will enter the southbound ramp leading onto the Interstate highway.

Table 17 lists the ETE for this study. The tabulation below compares the ETE for the two-mile area of Scenarios 11 with Scenarios 1, for a Region 9 evacuation:

	Two Mile Area Evacuation ETE for Indicated Percent Evacuated					
Scenarios	50 Percent		75 Percent		90 Percent	
	1	11	1	11	1	11
1, 11	1:35	1:10	2:40	2:05	3:25	2:55
1A, 11A	1:10	0:55	2:00	1:45	2:40	2:35
1B, 11B	0:50	0:45	1:25	1:25	2:15	2:15

As indicated above, these special strategies do provide significant benefits (i.e. lower ETE) when the beach areas are crowded (i.e. Scenario 11 relative to Scenario 1), but these benefits attenuate as the beach area population declines (compare the ETE for Scenario 11B with those for Scenario 1B). The reason for this behavior is that the highways become undersaturated

Table 17. Sensitivity of ETE to Beach Area Population
Region 9, Scenarios 11, 11A, 11B

Region	Scenario	Area	Percent of Vehicles Evaluated					
			25	50	75	90	95	100
9	11	2	0:25	1:10	2:05	2:55	3:15	3:45
		5	0:30	1:10	2:10	3:00	3:20	3:50
		10	0:30	1:10	2:00	2:45	3:15	4:10
		EPZ	0:30	1:15	2:10	2:55	3:20	4:15
9	11A	2	0:20	0:55	1:45	2:35	3:00	3:25
		5	0:25	1:00	1:50	2:30	2:55	3:35
		10	0:25	1:00	1:40	2:25	2:50	3:40
		EPZ	0:30	1:05	1:50	2:25	2:55	3:45
9	11B	2	0:15	0:45	1:25	2:15	2:40	3:15
		5	0:20	0:50	1:30	2:10	2:40	3:35
		10	0:25	0:50	1:30	2:10	2:40	3:40
		EPZ	0:25	1:00	1:35	2:20	2:40	3:45

(i.e. uncongested) earlier as demand drops. In an uncongested (or less congested) environment, the time required for trip generation becomes the controlling factor in determining ETE -- not the limitation of highway capacity (see Section 8 for details).

We therefore conclude that there is little to be gained by exercising "heroic" efforts and utilizing valued personnel (which is in limited supply) for this effort, in order to exercise these special control tactics. Specifically, comparison of the ETE results of 11A with 1A, the "normal" weekend situation, indicates a 15-minute improvement, at best.

Region 10, Scenarios 1, 1A, 1B

Table 18 displays the ETE results for these cases. Note that Region 10 comprises all beach areas, in several ERPA. The tabulation below compares these ETE for the two-mile area, with those of Region 9.

Two-Mile Area Evacuation
ETE for Indicated Percent Evacuated

	50 Percent		75 Percent		90 Percent	
Scenario	Reg. 9	Reg. 10	Reg. 9	Reg. 10	Reg. 9	Reg. 10
1	1:35	1:30	2:40	2:20	3:25	2:55
1A	1:10	0:55	2:00	1:40	2:40	2:10
1B	0:50	0:35	1:25	1:05	2:15	1:25

As indicated above, if the beach area population can be evacuated at an earlier time, relative to, say, the population within the two-mile area, then meaningful reductions in ETE can be realized. Specifically, for the "normal" weekend day (Scenario 1A), gains in ETE of up to one-half hour can be realized.

Region 5, Scenarios 1, 1A, 1B

Table 19 displays the ETE results for these cases. The tabulation below compares these ETE, for the evacuation of ERPA A, B, C and D which approximate the five-mile area, with those of Region 9. (We remind the reader, that all the beach areas outside -- as well as inside -- the five-mile area are completely evacuated, while it is assumed that 25 percent of the inland population outside the five-mile area, evacuates contrary to instructions.)

Table 18. Sensitivity of ETE to Beach Area Population
Region 10, Scenarios 1, 1A, 1B

Region	Scenario	Area	Percent of Vehicles Evaluated					
			25	50	75	90	95	100
10	1	2	0:20	1:30	2:20	2:55	3:05	4:15
		5	0:30	1:20	2:30	3:15	3:40	4:40
		10	0:30	1:15	2:30	3:20	3:45	4:45
		EPZ	0:30	1:15	2:20	3:15	3:45	4:50
10	1A	2	0:20	0:55	1:40	2:10	2:20	3:20
		5	0:25	1:05	1:55	2:35	2:55	3:35
		10	0:25	1:05	1:55	2:40	3:05	3:40
		EPZ	0:30	1:05	1:55	2:40	3:05	3:45
10	1B	2	0:10	0:35	1:05	1:25	1:35	3:20
		5	0:20	0:50	1:25	2:00	2:10	3:25
		10	0:25	0:50	1:30	2:05	2:25	3:40
		EPZ	0:25	0:55	1:35	2:15	2:35	3:45

Table 19. Sensitivity of ETE to Beach Area Population
Region 5, Scenarios 1, 1A, 1B

Region	Scenario	Area	Percent of Vehicles Evaluated					
			25	50	75	90	95	100
5	1	2	0:40	2:10	3:15	4:05	4:35	5:15
		5	0:40	1:40	3:00	4:05	4:40	6:20
		10	0:40	1:35	3:00	4:10	4:40	6:40
		EPZ	0:40	1:35	3:00	4:05	4:40	6:45
5	1A	2	0:30	1:35	2:40	3:30	4:05	4:40
		5	0:35	1:30	2:35	3:30	4:05	6:20
		10	0:40	1:25	2:35	3:35	4:05	6:40
		EPZ	0:40	1:25	2:35	2:35	4:05	6:45
5	1B	2	0:20	1:05	2:00	3:10	3:40	3:55
		5	0:30	1:15	2:10	3:05	3:45	6:20
		10	0:35	1:15	2:15	3:10	3:45	6:40
		EPZ	0:35	1:20	2:15	3:05	3:40	6:45

Five-Mile Area Evacuation
ETE for Indicated Percent Evacuated

Scenarios	50 Percent		75 Percent		90 Percent	
	Reg. 9	Reg. 5	Reg. 9	Reg. 5	Reg. 9	Reg. 5
1	1:35	1:40	2:40	3:00	3:25	4:05
1A	1:10	1:30	2:00	2:35	2:40	3:30
1B	0:50	1:15	1:25	2:10	2:15	3:05

As is indicated above, evacuation of the five-mile area will, as expected, lengthen the ETE as compared with an evacuation of the two-mile area. For the "normal" weekend day (Scenario 1A), 75 percent of the population is evacuated from the five-mile area over 2:35 hours, some 35 minutes longer than if only the two-mile area were evacuated. For the "90 percent evacuated" condition, the difference in ETE between evacuating the five-mile region and the two-mile region, widens to 50 minutes.

Summary

We have conducted several sensitivity studies which yield the following conclusions:

1. The ETE for the two-mile and five-mile areas shorten significantly as the beach area population declines. For a "normal" weekend day, 75 percent of the evacuating population will be outside the two-mile area in 2:05 hours when ERPA A is evacuated, and outside the five-mile area in 2:35 hours when ERPA A, B, C and D are evacuated. (Region 9 and 5 studies.)

2. Evacuating the beach area population early, relative to the remaining population within the EPZ, by closing the beaches prior to the General Emergency level, will produce lower ETE for the beach population, relative to delaying the evacuation of beach area population until the general advisory is issued. For a "normal" weekend day, 75 percent of the beach area population will be outside the two-mile area within two hours, and 90 percent within 2:40, after the general order to evacuate is given. (Region 10 studies.)

3. Extensive traffic management tactics to expedite the evacuation of the beach area population are not warranted by the associated marginal reduction in ETE. (Scenario 11 studies.)