SEABROOK STATION
PUBLIC ALERT AND NOTIFICATION SYSTEM

FINAL DESIGN REPORT

Prepared for
PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
Manchester, New Hampshire
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HMM Associates, Inc.
Concord, Massachusetts

PUBLIC ALERT AND NOTIFICATION SYSTEM FOR THE SEABROOK STATION PLUME EXPOSURE EPZ DESIGN REPORT

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1. INTRODUCTION

1.1 Description

Public alerting and notification in the Seabrook EPZ will be accomplished through the activation of sirens, with simultaneous emergency messages broadcast by designated local radio stations. A public education program is underway and will be maintained to advise residents of and visitors to the EPZ that when the sirens are heard, they should tune to the designated radio stations for information about an emergency.

A total of 133 new electronic sirens will be installed in the EPZ to perform the initial alerting function. These will be complemented by seven mechanical sirens recently installed in the City of Newburyport, MA. Sirens in the State of New Hampshire will be activated by radio from the Rockingham County Police Dispatch Center in Brentwood, New Hampshire. Those in Massachusetts will be activated from State Police Troop A Headquarters in Framingham, MA. The 23 cities and towns in the EPZ will also have the capability to activate the sirens within their boundaries, if necessary.

The electronic sirens to be installed will have a public-address capability. Along the public beaches from Newbury, Massachusetts, north through Hampton, New Hampshire, siren locations have been chosen so that the sirens can provide both an alerting tone and a public-address message to notify transient beach users who may not have immediate access to commercial radio receivers.

Supplementing the sirens, a total of 234 tone-activated radio receivers will be provided to institutions within the EPZ that may have to internally coordinate their response to an emergency. These institutions, (schools, hospitals, major employers, etc.) have been identified from the pertinent local emergency plans. An additional quantity of tone-activated receivers will be available for distribution to isolated residences if it is determined that alerting by siren must be

supplemented, and where the provision of siren coverage would be uneconomical. Further, these receivers provide alerting through a signal light and could be provided to residences where an occupant is hearing-impaired.

The tone-activated radio receivers in each state will receive broadcasts from the designated emergency broadcast station in that state.

1.2 Design Basis

The design objective of the public alerting system for the Seabrook EPZ has been to provide coverage to essentially 100% of the populated area of the EPZ. This has been achieved by following the guidance in Appendix 3., Section C. 3. e., of NUREG-0654; entitled "For Organizations Proposing Systems Without Field Surveys." An additional margin of about 5 decibels (dB) has been added within 10 miles of the site.

In order to verify the design guidance that was used, selected measurements were made of ambient background noise, and outdoor sound propagation was computed for a variety of local weather conditions. These studies confirmed that the design guidance followed was appropriate and conservative.

1.3 Summary

In Section 2 of this Design Report, the topography, climatology, demography and ambient noise environment of the EPZ are summarized as they pertain to siren coverage. Section 3 contains a detailed technical description of the alerting system. An analysis of the anticipated performance of the system is given in Section 4. Appendices include measured background noise data, equipment procurement and installation specifications, and computation procedures.

2. DESCRIPTION OF THE SEABROOK STATION PLUME EXPOSURE EPZ

This description is limited to those features of the EPZ that affect the performance of public alerting systems using sirens.

2.1 Topography

Sound propagation over the ground, such as from a siren to a listener, is affected by the terrain. The largest such effect is shielding by hills and the walls of valleys. However, extensive forests can attenuate the sound, and the sound-reflecting properties of the ground are important as well.

Seabrook Station is on a coastal plain about 1 1/2 miles inland from the Atlantic Ocean (see Fig. 2.1). This plain, extending from the shore to about 4 miles inland, is essentially flat, with no hills or valleys to impede sound propagation. The coastline itself is rocky on the north, changing to sandy beaches on the south. Over most of the southern half of the EPZ, the beaches are actually barrier islands separated from the mainland by 1-2 miles of uninhabited tidal estuaries and salt marshes.

Inland of the coastal plain the land gradually rises. To the north, there are scattered, symmetrical hills 200-300 feet in elevation - apparently drumlins or morainic remnants. These tend to be oriented along northwesterly to southeasterly lines. To the south, particularly along the Merrimack River in Amesbury and Merrimac, MA, the terrain is much rougher: a jumble of hills and valleys eroded by drainages into the river. These hills can be a significant impediment to sound propagation. On the other hand, when their tops are accessible, hills offer ideal siren locations because line-of-sight sound coverage can be provided to surrounding valleys.

The Merrimack River flows from west to east through the southern half of the EPZ. In the coastal plain, its banks are shallow, and it is over a mile wide with tidal flats just east of the City of Newburyport. Further upstream, it has formed an irregular valley 50-75 feet deep. Sirens placed outside this valley may not be heard within it and vice versa, so the siren system layout has special provisions for coverage within the valley.

The Piscataqua River, which is also the Maine-New Hampshire State line, forms a portion of the northern boundary of the EPZ. The Piscataqua drains Great Bay, also part of the northern limit of interest.

For the most part, the EPZ is heavily forested with deciduous trees: second-growth oak. The only exceptions are the beaches, urban areas, tidal marshes, and occasional open fields. The trunks of the trees in such forests can scatter and thus attenuate sound to some extent. The effect is the same year-round, for the presence or absence of foliage is of minor importance for siren tones.

2.2 Climatology

Coastal New Hampshire has a typical, 4-season, northern temporate climate, modified somewhat by the proximity of the ocean.

"There are three distinct types of air masses that affect the site area:

a. Cold, dry air originating in subarctic North America,

b. Warm, moist air from the Gulf of Mexico or the subtropical Atlantic, and

c. Cool, damp air moving in from the North Atlantic.

As the prevailing flow aloft over New Hampshire is usually offshore, the first two types of air masses influence the site area more than the third. The climate of the site is thus continental in character, but with an important maritime influence."[1]

The most important meteorological parameter affecting siren-sound coverage is wind direction because the vertical wind-speed gradient refracts sound waves. In general, sound carries downwind to a much greater distance than upwind. Hence, a listener in the midst of a number of sirens is most likely to hear those upwind of his location.

Fall, winter and spring winds at the site prevail from the WNW and NW, with a typical speed of 9-11 mph at 30 feet. In the summer, winds are more likely from the WSW and SW, and gentler: 4.5-7 mph. In the fall and spring, NE winds are not uncommon, and in the summer, gentle (7-9 mph) seabreezes from the SE occur during the daytime.[2]

The water-vapor content of the atmosphere influences the extent to which sound is absorbed in air. Absorbtion is greatest for cool, dry air and least for hot, damp air. The mean monthly relative humidity at Pease AFB, near the site, ranges from 64.7% in February to 74.4% in September.[3] Daily minimum temperatures range from about 12°F in January to 57°F in July; the daily maxima from about 31°F to about 80°F.[4]

The vertical temperature gradient influences sound propagation in much the same way as the wind gradient, but to a lesser extent. The vertical temperature gradient is related to atmospheric stability, as indicated in Table 2.1.

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[1] Seabrook Station Final Safety Analysis Report, Vol. 2, PSNH, Manchester, NH, 1981: Section 2.3.1.1.
[2] Seabrook Station Final Safety Analysis Report, Vol. 2, PSNH, Manchester, NH, 1981: Figs. 2.3-2 through 2.3-5.
[3] Seabrook Station Final Safety Analysis Report, Vol. 2, PSNH, Manchester, NH, 1981: Table 2.3-14.
[4] Seabrook Station Final Safety Analysis Report, Vol. 2, PSNH, Manchester, NH, 1981: Tables 2.3-9, 2.3-10.

TABLE 2.1

PASQUILL STABILITY CLASSES
AND TEMPERATURE GRADIENTS

Stability Class	Temperature Gradient*			Standard Deviation of Wind-Direction Fluctuations
	^{o}F/100 ft	^{o}F/1000 ft	^{o}C/100 m	
A	$\Delta T < -1$	$\Delta T < -10.4$	$\Delta T < -1.9$	25^{o}
B	$-1 \leq \Delta T < -0.9$	$-10.4 \leq \Delta T < -9.3$	$-1.9 \leq \Delta T < -1.7$	20^{o}
C	$-0.9 \leq \Delta T < -0.8$	$-9.3 \leq \Delta T < -8.2$	$-1.7 \leq \Delta T < -1.5$	15^{o}
D	$-0.8 \leq \Delta T < -0.3$	$-8.2 \leq \Delta T < -2.7$	$-1.5 \leq \Delta T < -0.5$	10^{o}
E	$-0.3 \leq \Delta T < 0.8$	$-2.7 \leq \Delta T < 8.2$	$-0.5 \leq \Delta T < 1.5$	5^{o}
F	$0.8 \leq \Delta T < 2.2$	$8.2 \leq \Delta T < 22$	$1.5 \leq \Delta T < 4$	2.5^{o}
G	$2.2 \leq \Delta T$	$22 \leq \Delta T$	$4 \leq \Delta T$	-

*Upper-level temperature minus lower-level temperature, divided by the difference in levels.

From NUREG-CR-2654

In coastal New England, C or D stability generally prevails. However, very unstable air (Class A) is not uncommon on blustery winter days, and very stable air (Class F) often occurs on clear, calm summer nights.

2.3 Demography

Almost the entire Seabrook EPZ is populated: the only exception being the marsh and water areas along the coast and a few hilly areas inaccessible by road in the west. Year-round residential concentrations exist in Hampton Center, about 3 1/2 miles north of the site; in Amesbury, 5 miles SW; in Newburyport, about 6-7 miles SSW; in Exeter, 8 miles NW; and in Portsmouth, 12 miles and more to the NNW. during the summer, the 12 miles of beaches from Newbury (Plum Island) on the south through Hampton on the north are densely populated by seasonal residents and visitors.

Population distribution is important to the design of a public alerting system for the obvious reason that alerting coverage should be concentrated where people are concentrated. Furthermore, the ambient background noise, which can interfere with people's ability to hear siren sounds, tends to increase with population density. This is because most of the background noise comes from motor vehicle traffic, and traffic tends to be heaviest in densely populated areas.

There have been a number of studies of population distribution in the Seabrook EPZ. The most recent summary of these is "A Comparison of 1980 Federal Census and FSAR Population Distribution Data for the Area Within Ten Miles of Seabrook Station," dated September 1983 and prepared for Yankee Atomic Electric Company by HMM Associates, Inc. The figures shown in Table 2.2 are the highest of any of the estimates in that summary document. They include both permanent and seasonal residents.

Listed in Table 2.2 are the maximum resident populations by ring and sector, and the population densities per square mile. The latter were obtained by dividing the populations by the ring/sector areas noted at the top of each column.

The guidance in Appendix 3 of NUREG-0654 indicates that, for sirens, a minimum coverage of 60 dB should be provided in areas having a population density of less than 2000 people per square mile. For densities greater than 2000 people per square mile, the minimum coverage should be 70 dB. As indicated on Table 2.2, only two areas exceed 2000 people/square mile: Seabrook Beach and downtown Hampton. In addition, Amesbury comes close to this threshold.

Because of the large area involved, the population data on Table 2.2 for the ring between 5 and 10 miles are not adequate for computing population densities. Furthermore, the data do not extend beyond 10 miles, and thus do not include downtown Portsmouth. For these reasons, and in consideration of the high summer traffic volumes to the beaches, a much more conservative design approach has been used for the areas in which siren coverage should be 70 dB or more. The areas designated for this higher coverage are illustrated on Figure 2.2.

TABLE 2.2

HIGHEST ESTIMATES OF SEASONAL PLUS PERMANENT RESIDENTS WITHIN 10 MILES OF SEABROOK STATION (1983)

Sector	Distance from Station											
	0-1 mile (A=0.2 mi.^{2})		1-2 miles (A=0.59 mi.^{2})		2-3 miles (A=0.98 mi.^{2})		3-4 miles A=1.37 mi.^{2})		4-5 miles A=1.77 mi.^{2})		5-10 miles (A= 14.7 mi.^{2})	
	Pop	Dens	Pop	Dens	Pop	Dens	Pop	Dens	Pop	Dens	Pop	Dens
N	20	100	85	144	542	553	811	592	424	268	5266	358
NNE	-	-	-	-	1962	[2002]	2278	1663	431	244	8921	607
NE	-	-	131	222	981	1001	1786	1304	1186	670	2332	159
ENE	-	-	974	1651	1481	1511	172	126	-	-	-	-
E	-	-	886	1502	-	-	-	-	-	-	-	-
ESE	-	-	1426	[2415]	-	-	-	-	-	-	-	-
SE	_	_	79	134	885	903	-	-	-	-	-	-
SSE	10	50	103	175	432	441	821	599	1120	633	4980	339
S	161	805	275	466	631	644	694	507	1227	693	8045	547
SSW	282	1410	314	532	493	503	608	444	480	271	10,370	705
SW	80	400	764	1295	520	531	270	197	3386	1913	11,974	815
WSW	-	-	765	1297	736	751	314	229	3435	1941	11,904	810
W	154	770	761	1290	293	299	364	266	751	424	2739	186
WNW	180	900	81	137	275	281	137	100	751	424	3036	207
NW	30	150	247	419	170	173	128	93	127	72	10,975	747
NNW	30	150	293	497	168	171	207	151	335	189	4126	281

Source: "A Comparison of 1980 Federal Census and FSAR Population Distribution Data for the Area Within Ten Miles of Seabrook Station" (September 1983).

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2.4 Ambient Noise

2.4.1 Background

The audibility of a siren sound depends upon the magnitude of other extraneous sounds at the listener's location while the siren is operating. These other sounds, called the ambient background noise, come mostly from motor-vehicle traffic; but numerous other sources are familiar (aircraft, barking dogs, children at play, construction, etc.). As these sources come and go, the ambient background noise fluctuates with time in a way that is unpredictable, except in a statistical sense.

Siren audibility is based upon the minimum background noise that occurs during the time the siren is operating. Louder noises are unimportant, provided their duration is less than the duration of siren operation, because people tend to hear during the quiet periods between interfering noises.

2.4.2 Design Basis

A meaningful characterization of the minimum ambient background noise over several hundred square miles, for all weather conditions, seasons of the year and times of the day, would be very difficult and costly to obtain. Realizing this, FEMA/NRC have provided a siren system design option which avoids background noise measurements.[5] This option says, in effect, that the minimum ambient background noise in urban areas (defined as areas with a population density of 2000 people per square mile or more) will generally be less than 60 dB at some time during siren operation. In other areas, FEMA/NRC indicates that it will generally be less than 50 dB.

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[5] NUREG-0654/FEMA REP-1, "Criteria for the Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," Rev. 1 dated November 1980, Appendix 3. See also Section 3.1 of this report.

The alerting system for the Seabrook Station has been designed using this option. However, we took the opportunity to make seventeen noise measurements in order to verify the design guidance provided by FEMA/NRC. The results of these measurements, and the procedure by which they were made, are described below.

2.4.3 Measurement Locations

On the basis of previous ambient noise studies in the EPZ[6], seventeen of the noisiest locations were selected for measurement.* These measurement locations are listed on Table 2.1 and illustrated on Figure 2.3.

2.4.4 Measurement Equipment

Measurement equipment consisted of a GenRad Type 1933 Sound Level Meter/Octave Band Analyzer, feeding a GenRad 1945 Community Noise Analyzer. These were operated continuously for 1/2 hour at each site to observe the cumulative statistical distribution of the sound levels at that site.

2.4.5 Measurement Bandwidth

The process by which background noise interferes with the audibility of a sound is called "masking." Researchers have studied masking for many years. They have found that a sound is masked predominantly by background noise in the immediate frequency range of the sound. High-pitched sounds are not masked by low-frequency noise, nor vice versa.

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[6] Costello, Lomasney and de Napoli, Inc., "Preliminary Report on the Public Alerting Systems for the Seabrook Station Emergency Planning Zone" (undated).

* The measurements reported here were made in the Fall, when the public beaches were not in use. Hence the beaches and beach access roads were somewhat quieter than in the summer. However, we believe that the noise levels in most other areas of the EPZ were representative.

The background noise that contributes to the masking of a siren sound is contained in a relatively narrow frequency band centered on the frequency of the predominant siren tone. This band, sometimes called the "critical band," is very narrow: typically 1/6 to 1/10 of an octave wide. Filters for measuring the background noise in such a narrow band are not readily available. The sirens to be installed around Seabrook Station will produce tones at 700 Hz. Hence, the measurements reported here were made with an octave-band filter centered at 500 Hz (i.e., a filter spanning the range from 353 Hz to 707 Hz).

Because the octave band contains much more noise energy than the critical band of interest, the measured data were converted to equivalent 1/3 octave band levels by subtracting 5 dB (i.e., 10 log (1/3)). FEMA suggests the use of 1/3 octave bands for ambient noise measurements.[7] Of course, the critical band is even narrower than 1/3 octave, so the data reported herein are somewhat higher than the actual background noise of interest, and hence more conservative.

2.4.6 Results

The data sheets from each of the seventeen measurement locations are given in Appendix A. The data are in the form of "L-levels." The L_{10} is the level that was exceeded 10% of the time during the 1/2-hour sampling period; the L_{50} was exceeded 50% of the time; the L_{90}, 90% of the time; etc. The maximum and minimum momentary levels that were observed are also reported, along with the equivalent level: L_{eq}. The L_{eq} is the level of a hypothetical steady sound that would have had the same energy over the half-hour period as the actual, fluctuating noise. Because sound is measured on a logarithmic scale, the L_{eq} tends to be influenced by brief, intense noises.

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[7] FEMA-43, "Standard Guide for the Evaluation of Alert and Notification Systems for Nuclear Power Plants," September 1983. Section E.6.2.1, pp. E-6.

The data in Appendix A include the -5 dB correction to 1/3-octave-band levels.

The levels observed at each site typically span a range of 30 dB or more. This raises the question as to which level in that range should be used as the masking level. An estimate that is often used is the L_{90} level. This is called the "residual" level, and it generally characterizes the background in the absence of brief transient noise sources like passing vehicles.[8]

For the purposes of this study a more conservative value, the L_{50}, is used. The L_{50}'s are tabulated on Table 2.3. The L_{50}, or median level, could be considered representative of the "average daytime level" used by FEMA in FEMA-REP-1 and FEMA-43. For sirens operating 15 minutes or longer, the L_{50} would establish the highest possible masking level. For sirens operating less than 15 minutes, there would be some chance of masking at higher levels. This chance would increase as the siren duration decreased. Examination of the L_{50} levels on Table 2.3 indicates that only one exceeds the 50 dB "rural" design level provided by FEMA/NRC. This is 53 dB at site #10 in downtown Portsmouth. The site is clearly in an urban area where FEMA/NRC's 60 dB design background level applies.

Three other sites are worth mentioning. At site 3 in Salisbury, 50 dB was observed and at Site 8 in Seabrook 48 dB was observed. Both sites are close to Interstate 95 and receive relatively steady traffic noise from that source. The siren system for these locations is designed for 60 dB (i.e., urban) background noise. Finally, at site 16 in downtown Exeter, 48 dB was observed. Siren coverage in that area is also designed for a 60 dB background. At all other sites, the L_{50} was 45 dB or less.

In conclusion, the background noise measurements confirm that the FEMA/NRC design levels are suitable, and quite conservative.

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[8] US EPA NTID 300.3, "Community Noise," December 1971.

TABLE 2.3

SUMMARY OF AMBIENT BACKGROUND NOISE MEASUREMENTS IN THE SEABROOK EPZ* (CONTINUED)

Municipality	Location	Date	Time	Sound Sources Observed	1/3 Octave Band L50	Site No.
Exeter	Center St., 80 yds. S. of Water St., in downtown area	11/7/83	12:30 PM	Light traffic on Center St., but intermittent noise from cars leaving parking spaces and drive-in windows at bank. Moderate traffic on Water St., ambulance siren heard for several minutes.	48	16
North Hampton	Ocean Blvd. at Willow Ave.	11-1-83	2:15 PM	Very little traffic in area, no unusual noise sources.	40	12
Portsmouth	Cass St., between Islington and State	11-1-83	11:15 AM	Light traffic on Cass St., noise from a street sweeper for several minutes.	45	9
Portsmouth	Banfield Rd., 1/4 mile S. of Peverly Hill Rd.	11-1-83	12:00 Noon	Intermittent traffic on Banfield St., heavy equipment operating continuously at nearby sand and gravel mine.	53	10
Rye	Washington Rd., between Route 1 and Dow Lane	11-1-83	1:15 PM	Very light traffic on Washington Rd., with several large trucks. Two loud jets flew overhead for several minutes.	42	11
Seabrook	Lakeshore Rd., 200 yds. W. of Route 1	10-25-83	9:45 AM	Steady traffic on Route 1, occasional cars passing on Lakeshore Rd. No unusual noise sources.	44	1
Seabrook	Unnamed street on N. side of Route 107, near New Zealand Rd., halfway between I-95 and Seabrook Station gate	11-1-83	9:45 AM	Moderate traffic on Route 107, with occasional noisy fuel trucks. Background noise from I-95 and Route 1.	48	8
Stratham	Stratham Heights Rd., 200 yds. E. of Route 108	11-1-83	3:15 PM	Steady traffic on Route 108, intermittent on Stratham Heights Rd. No unusual noise sources.	43	15

* See Appendix A for detailed data.

TABLE 2.3

SUMMARY OF AMBIENT BACKGROUND NOISE MEASUREMENTS
IN THE SEABROOK EPZ*

Municipality	Location	Date	Time	Sound Sources Observed	1/3 Octave Band L50	Site No.
Amesbury	High St., 75 yds. from Market St. in downtown area	11-7-83	11:00 AM	Light traffic on surrounding streets, cars accelerating up incline on High St.	43	15
Merrimac	Bear Hill Rd., 50 yds. N. of Route 110	10-25-83	1:00 PM	Occasional traffic on Bear Hill Rd., including several tractors. Background noise from Route 110, including dump trucks.	36	4
Newbury	Elm St., on campus of Gov. Dummer Academy, 200 yds. W. of Route 1	10-25-83	4:00 PM	Light traffic on Route 1, occasional passing cars on Elm St. No unusual noise sources.	39	7
Newbury	Newbury Neck Rd., 100 yds. E. of Route 1A, just S. of Parker River	11-7-83	1:45 PM	Very light traffic on both Route 1A and Newbury Neck Rd., chain saw motors in background.	40	17
West Newburyport	Gypsy Lane, 75 yds. N. of Route 113	10-25-83	2:00 PM	Very light traffic on Gypsy Lane, with exception of one bus. Moderate, intermittent traffic on Route 113, with occasional buses.	39	5
Newburyport	Cottage Court, S. of Route 113, just off Route 1	10-25-83	3:00 PM	Steady traffic on Route 1, cars accelerating on upgrade 30 yds. away, students walking home.	45	6
Salisbury	Glenwood Ave., 75 yds. N. of Route 1A	10-25-83	10:45 AM	Moderate traffic on Route 1A, none on Glenwood. Dog barked for approximately 5 min.	39	2
Salisbury	Intersection of Rabbit Rd. and Old Elm St., 1/4 mile NE of I-95 and Route 110 intersection	10-25-83	11:15 AM	Cars on Rabbit Rd., with many accelerating. Background traffic noise from I-95.	50	3
Salisbury	Old County Rd., 50 yds. from Route 1A	11/7/83	9:45 AM	Light, intermittent traffic on both Old County Rd. and Route 1A. No unusual noise sources.	45	14

* See Appendix A for detailed data.

TABLE 2.3

3. DESCRIPTION OF THE ALERTING SYSTEM

3.1 Design Criteria

As indicated above, the Seabrook siren system has been designed in accordance with Section C, 3, e of Appendix 3 of NUREG-0654. This section indicates that for areas with population densities less than 2000 persons/square mile, 60 dB(C) minimum siren coverage shall be provided. It further indicates that siren coverage range can be based upon the assumption of a 10 dB attenuation rate per doubling of distance as the sound level radiates from the siren. This is equivalent to:

$$\text{Range to 60 dB(C) in ft.} = 100 \times 10^{\exp \frac{\text{Siren Output} - 60}{33.22}}$$

where "Siren Output" is the rated siren sound level at 100 feet, in dB(C).

The design guidance of Appendix 3 goes on to indicate that coverage for areas with population densities exceeding 2000 people/square mile should be based upon Figure 1 of FEMA CPG 1-17, "Outdoor Warning Systems Guide," March, 1980. This is equivalent to requiring a minimum 70 dB(C) sound-level in such areas, with an attenuation rate of 8 dB per doubling of distance for sirens rated 110 dB(C) or more.* Siren range for such areas can be computed from:

$$\text{Range to 70 dB(C) in ft.} = 1550 \times 10^{\exp \frac{\text{Siren Output} - 110}{26.57}}$$

where "Siren Output" is again the rated siren sound level at 100 feet, provided it exceeds 110 dB(C).

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* Figure 1 of CPG 1-17 suggests a different relationship for urban high-rise areas where the sirens are mounted below the rooftops. No such areas exist within the Seabrook EPZ.

The coverage range of the public-address capability of the electronic sirens will depend upon the voice message content, and in general will be considerably less than the 60 dB(C) range for tones. This is in part because the attenuation of high-frequency speech sounds in the atmosphere is greater than it is for siren tones. In addition the average sound output of the sirens in their voice mode must be about 7 dB less than it is for tones in order to avoid clipping of the speech peaks. Hence this design is based on the assumption that the voice coverage range will be the same as the 70 dB(C) range for tones.

To allow for the possibility that siren output may be less than specified, all ranges were computed for a siren output 1 dB less than rated. In addition, because 125 dB(C) electronic sirens are actually advertised as having a 124 dB(C) rating, an additional 1 dB(C) was subtracted for this size siren. The resulting design ranges are listed in Table 3.1.

TABLE 3.1

SIREN RANGES UTILIZED FOR DESIGN, BASED UPON SECTION C, 3, e OF APPENDIX 3 OF NUREG-0654

Nominal Siren Rating	Rating Used for Design	Range: 2000 p/mi^2 60 dB(C)	Range: 2000 p/mi^2 70 dB(C)
125 dB(C)	123 dB(C)	7900 feet	4800 feet
115 dB(C)	114 dB(C)	4200 feet	2200 feet
113 dB(C)	112 dB(C)	3600 feet	1800 feet

3.2 Siren Locations

Based upon the siren ranges listed in Table 3.1 and field investigations, sites were selected for 140 sirens in the Seabrook EPZ. These sites are shown on Figure 3.1 and listed in Appendix B. Table 3.2 contains a summary by siren type, community and state.

Criteria for the selection of siren sites were as follows:

- Achievement of adequate sound-level coverage throughout the EPZ.
- Clear line-of-sight throughout coverage area of each siren. (i.e., hilltop sites preferred).
- Concentration of coverage in densely-populated areas.
- Utilization of sites where community has already installed audible warning devices.
- Availability of distribution power: ideally 120/240 V, single-phase secondary power.
- Location accessible by maintenance vehicles in all weather.
- If roadside, the location is across the street from distribution primaries and safe for the installation of a pole and parking of maintenance vehicles.
- Tree clearance.
- On an extended property line.

TABLE 3.2

SUMMARY OF SIREN REQUIREMENTS BY SIREN TYPE, COMMUNITY AND STATE

	Numbers of Sirens			
Community	115dB	125dB	Existing (113 dB)	Total
New Hampshire				
Brentwood		5		5
East Kingston	1	3		4
Exeter	2	8		10
Greenland	1	3		4
Hampton	1	9		10
Hampton Falls	2	3		5
Kensington	2	3		5
Kingston		4		4
New Castle		1		1
Newfields		2		2
Newton		5		5
North Hampton	1	5		6
Portsmouth		8		8
Rye		7		7
Seabrook	1	7		8
South Hampton	1	3		4
Stratham	2	4		6
Totals	14	80	-	94
Massachusetts				
Amesbury	3	7		10
Merrimac	4	2		6
Newbury	1	6		7
Newburyport		1	7	8
Salisbury		9		9
West Newbury	2	4		6
Totals	10	29	7	46
GRAND TOTALS	24	109	7	140

- Out of view of and reasonably removed from residences, if possible.

- Avoidance of noise-sensitive areas where possible.

Each site was visited, often in the company of local and State Civil Defense Officials, and marked and documented. In almost every case, the sirens are to be mounted at least 50 feet in the air on wooden utility poles. They are to be placed along public roads, or on town or municipal property. No sirens are to be placed on private property, and no land-takings will be necessary.

Detailed specifications for the installation of the sirens are given in the siren installation specifications.

3.3 Description of Sirens

Of the 140 sirens in the system, 133 will be new electronic sirens; 109 rated 125 dB(C) nominal, and 24 rated 115 dB(C) nominal. The remaining seven are existing Federal Signal Type 3T22 mechanical sirens recently installed by the City of Newburyport. To accommodate the needs of the overall system, the City has agreed to the relocation of three of these existing mechanical sirens.

The new electronic sirens are directional sirens of the rotating type capable of four different tonal sounds plus a voice message. One of these sounds will be reserved for use in the event of a Civil Defense Emergency, including a sufficiently serious accident at the Seabrook Station. The remaining three tonal sounds will be available for other local purposes as selected by the community.

All of the new electronic sirens will be capable of broadcasting, acoustically, a voice message received over the radio-frequency (RF) siren-control channel. Present plans call for the use of this capability along the public beaches to both alert and notify beach users of a radiological emergency. The

sirens that will be employed for this purpose are RY-1, RY-3, RY-4, NH-1, HA-1, HA-2, HA-3, HA-4, SB-1, SB-5, SA-1, SA-2, SA-3, NP-1 and NB-1.

When producing tonal sounds, the new sirens will rotate or oscillate at a rate of 2-4 rpm. When broadcasting voice messages, they will be fixed in desired directions and the message sent. They will then be pointed in another direction and the message repeated, etc., to obtain complete coverage.

The seven existing sirens in the City of Newburyport are omni-directional mechanical sirens, and are not capable of sending a voice message. However, a new electronic siren to be installed on Plum Island in Newburyport (NP-1) will have voice capability, and people in downtown Newburyport will hear voice messages from electronic sirens in adjacent towns when the siren system is tested.

All of the new electronic sirens are battery operated, with a trickle charger permanently connected to the AC power distribution system. In the event of complete loss of distribution power, these sirens could operate in standby mode for several weeks, or with full sound output for 1/2 hour.

The warning system relies predominently upon sirens with a nominal rating of 125 dB(C) as observed 100 feet from the siren on the axis of the horn(s)*. These are the largest electronic sirens commercially available. Smaller 115 dB(C) sirens will be used at about 20% of the locations where terrain or other constraints make the use of the larger, more costly, sirens unnecessary. The existing mechanical sirens in Newburyport have an advertised output of 113 dB(C).

Detailed specifications for the sirens are given in the siren purchase specifications.

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* The actual advertised output is 124 dB(C) maximum. See Table 3.1.

3.4 Siren Coverage

3.4.1 Alert Tone

The area in which siren coverage is estimated to be 60 dB(C) or more is shown on Figure 3.2. The area covered by 70 dB(C) or more is shown on Figure 3.3 Both estimates are based upon circles having radii equal to the ranges in Table 3.1. However, the circles are truncated at hills that form the horizon as viewed from the siren.

The entire area within 10 miles of the plant is estimated to be covered by 60 dB(C) or more (Figure 3.2) except for a three lightly-populated regions in western Newburyport, southern West Newbury and southern Merrimac. If tests of the system indicate that coverage of residences in those areas needs to be supplemented, then either additional sirens or emergency-alerting radio receivers will be provided. See Sections 3.6 and 3.10.

As shown on Figure 3.3, the design allows for coverage of 70 dB(C) or more on the beaches and in essentially all populated areas within 5 miles of the plant. All of the areas in Table 2.2 in which population exceeds 2,000 p/sq. mi. are covered by 70 dB(C) or more.

3.4.2 Voice

It is assumed in this design that voice coverage is equal to the 70 dB(C) tonal coverage illustrated on Figure 3.3

The adequacy of voice coverage will be determined by the intelligibility of voice messages, as heard by observers some distance from the sirens. This intelligibility will depend upon the message content, the speaker's voice and his method of delivery. Intelligibility can be maximized by following these guidelines:

- Use a trained, male speaker with a "neutral" accent (such as a skilled radio announcer).

- o Prepare pre-recorded tape messages for various anticipated emergency action responses.

- o The speaker should speak very slowly, with pauses between words.

- o Keep the messages as brief and simple as possible, and repeat them.

- o Employ simple words from common usage. Use words that do not depend strongly on fricative or stop-consonent sounds to convey their meaning.

- o Test the messages for intelligibility and refine them under simulated field conditions. (This can be done in a suitably equipped audio laboratory.)

3.5 Siren Control

All sirens will be controlled by radio signal. In New Hampshire, the primary state control point for a radiological emergency at Seabrook Station will be at the Rockingham police dispatch center in Brentwood. In Massachusetts it will be at the State Police Troop A Headquarters in Framingham.

In addition, each of the 23 cities and towns will have their own, totally independent control transmitters for all sirens within their borders. See Tables 3.3 and 3.4. These town controls will serve as back-up for the State controls, and may also be used by the towns to activate the sirens for local purposes such as fire call-outs.

Each state will license one new RF frequency for siren control, so the operation of the sirens will not add to the traffic on existing communication channels.

RF modulation for siren control will be either dual-tone multi-frequency (DTMF) tone sequences (like a touch-tone phone), or 32 bit frequency-shaft-keyed (FSK) sequences. Each State will have a map display/status board showing the control codes sent to sirens within that state.

APPENDIX A

AMBIENT BACKGROUND NOISE LEVELS MEASURED IN THE SEABROOK EPZ

Note: The individual measurement sites are shown on Figure 2.3. The levels were measured in the 500 Hz octave band and converted to equivalent 1/3 octave band levels by subtracting 5 dB.

Site 1, Seabrook

% Time dB Level	Measured dB Level
0.1	60
1	55
2	53
5	50
10	48
20	46
50	44
90	42
99	41
Maximum	68
Minimum	39
LEQ	46

Notes:

10-25, 9:45 A.M. start. 200 yards off Route 1 on Lakeshore Road. Calm, cloudy, 45°F. Steady traffic on Route 1, occasional cars passing on Lakeshore.

Site 2, Salisbury

% Time dB Level	Measured dB Level
0.1	78
1	68
2	57
5	47
10	45
20	42
50	39
90	37
99	36
Maximum	80
Minimum	35
LEQ	55

Notes:

10-25, 10:45 A.M. start. 75 yards north of Route 1A in Salisbury, on Glenwood Avenue. Cloudy, 15 mph wind, cold. Barking dog beginning at 15 minutes of run. Moderate traffic on 1A, none on Glenwood. Dog barked for approximately 5 minutes.

Site 3, Salisbury

% Time dB Level	Measured dB Level
0.1	67
1	62
2	60
5	58
10	56
20	54
50	50
90	46
99	43
Maximum	69
Minimum	41
LEQ	53

Notes:

10-25, 11:15 A.M. Start. Intersection of Rabbit Road & Old Elm, about 1/4 mile NE of I-95 and 110 intersection. Mixed residential and commercial uses. Moderate traffic, background noise from I-95. Cold, cloudy, light wind. Traffic on Rabbit Road about 40 mph, many cars in acceleration.

Site 4, Merrimac

% Time dB Level	Measured dB Level
0.1	73
1	64
2	60
5	55
10	48
20	43
50	36
90	33
99	32
Maximum	83
Minimum	31
LEQ	53

Notes:

10-25, 1:00 P.M. start. 75 yards N of Route 110, on Bear Hill Road. Residential street with semi-rural character. Occasional cars on Bear Hill Road. Background noise from Route 110. A couple of tractors (noisy) passed by. Weather conditions same as sites 1, 2 and 3. Cars coming up a slight incline on 110, accelerating. Traffic on Route 110 includes several heavy dump trucks.

Site 5, Newburyport

% Time dB Level	Measured dB Level
0.1	69
1	56
2	53
5	48
10	45
20	42
50	39
90	36
99	35
Maximum	71
Minimum	33
LEQ	46

Notes:

10-25, 2:00 P.M. start. 75 yds N of Route 113 on Gypsy Lane. Residential area, with mixed field and woods on one side of Gypsy Lane. Moderate, intermittent traffic on Route 110, with occasional buses. Cold and cloudy, light breeze. Very little traffic on Gypsy Lane, but one bus went by (noisy). Barking dog at 22-23 minutes of run.

Site 6, Newburyport

% Time dB Level	Measured dB Level
0.1	68
1	61
2	58
5	55
10	52
20	49
50	45
90	41
99	39
Maximum	71
Minimum	38
LEQ	44

Notes:

10-25, 3:00 P.M. start. Cottage Court, one stoplight S of Route 113, just off Route 1. Residential, little traffic, except on Route 1 (steady). Cars idle at stoplignt, then turn onto Route 1. Upgrade 30 yards away - noise from acceleration. Students walking home and slightly more traffic at about 20 minutes of run.

Site 7, Newbury

% Time dB Level	Measured dB Level
0.1	66
1	60
2	58
5	54
10	50
20	46
50	39
90	33
99	32
Maximum	70
Minimum	31
LEQ	48

Notes:

10-25, 4:00 P.M. start. Elm Street, on campus of Governor Dummer Academy, 200 yards W. of Route 1. Cold, cloudy, very calm. Light traffic on both Elm Street and Route 1.

Site 8, Seabrook

% Time dB Level	Measured dB Level
0.1	72
1	63
2	61
5	57
10	55
20	52
50	48
90	44
99	42
Maximum	80
Minimum	40
LEQ	54

Notes:

11-1, 9:45 A.M. start. Clear, 50°F. Site is unnamed street on north side of Route 107, near New Zealand Road halfway between I-95 and Seabrook plant gate. Steady, moderate traffic on Route 107, background noise from I-95 and Route 1. Area mostly residential, including a condominimum development. Fuel trucks occasionally on Route 107 - noisy.

Site 9, Portsmouth

% Time dB Level	Measured dB Level
0.1	71
1	64
2	63
5	60
10	57
20	53
50	45
90	38
99	36
Maximum	79
Minimum	34
LEQ	54

Notes:

11-1, 11:15 A.M. start. Site is on Cass Street, between Islington and State in older residential neighborhood near Portsmouth Center. Light traffic, but a street sweeper went by in first five minutes of run.

Site 10, Portsmouth

% Time dB Level	Measured dB Level
0.1	68
1	64
2	62
5	60
10	58
20	56
50	53
90	45
99	43
Maximum	69
Minimum	41
LEQ	55

Notes:

11-1, 12 Noon start. Banfield Road, approximately 1/4 mile S. of Peverly Hill Road. Near sand and gravel mine, with heavy equipment operating continuously. Light traffic on Banfield Road.

TABLE 3.3

SUMMARY OF LOCAL SIREN CONTROL POINTS REQUESTED BY NEW HAMPSHIRE COMMUNITIES

Community	Control Location	Secure Power?	Manned 24 h/d?	Comment
Brentwood	Fire station,* Old Rt. 125	N	N	
East Kingston	Town Hall/Fire Station*	Y	N	The two buildings are side-by-side.
Exeter	Fire/Police Station,* Bow St.	Y	Y	
Greenland	Town Fire Station,* Tide Mill Rd.	Y	N	Also requested control by Exeter Dispatch.
Hampton	Fire Station on Winnacunnet Road*	Y	Y	
Hampton Falls	To be determined			
Kensington	Fire Station,* Rt. 150	N	N	Off-hours dispatch by Exeter
Kingston	Central Fire Station,* Main St. West and Rock Rimon Rd.	Y	N	Nighttime Fire Callout by Exeter
New Castle	Rockingham County Dispatch	Y	Y	
Newfields	Fire Station,* Piscassett Rd.	N	N	
Newton	Central Fire House, S. Main St. (Rt. 108)	Y	N	May change to Town Hall.* Police dispatch is by Rockingham County; fire dispatch by Atkinson.
North Hampton	Central Fire Station,* Atlantic Ave. (Rt. 101D)	Y	Y	
Portsmouth	Central Fire Station,* 170 Court	Y	Y	
Rye	To be determined			
Seabrook	Central Fire Station,* Collins and South Main	Y	Y	
South Hampton	Town Hall,* Hilldale St.	N	N	Amesbury (MA) handles fire dispatch and Rockingham County does police dispatch
Stratham	Fire Station,* Winnicut Rd. at Routes 101/108	Y	N	Newmarket dispatch provides 24 hour callout

* RERP EOC.

TABLE 3.4

SUMMARY OF LOCAL SIREN CONTROL POINTS REQUESTED BY MASSACHUSETTS COMMUNITIES

Community	Control Location	Secure Power?	Manned 24 h/d?	Comment
Amesbury	Police Sta. Friend and School Sts.	Y	Y	Xmit. to repeater on Pow Wow Hill
Merrimac	Fire/Police Station* Rt. 110 @ Broad St.	N	Y	Xmitter at station in valley
Newbury	Police Dispatch, High Rd and Morgan Ave.	Y	Y	
Newburyport	Fire Station, Greenleaf St. off State	Y	Y	EOC is at High School*
Salisbury	Police Station* Railroad Ave.	Y	Y	
West Newbury	Town Clerk's Off., Town Hall, Rt. 113	N	N	Xmitter is at Central Fire Sta. two blocks away. Nightime fire callout is by Haverhill. EOC is at CD office* several mi. to the east.

* RERP EOC

The siren control system is described in greater detail in Section 4.0 of the purchase specifications for sirens and controls.

3.6 Emergency Alerting Radio Receivers

Emergency alerting radio receivers will be provided to institutions within the EPZ that would have to internally coordinate their response to a radiological emergency at Seabrook. One hundred and fifty such institutions have been identified from local Emergency Plans and industry directories in New Hampshire and are listed on Table 3.5. Similarly, eighty-four have been identified in Massachusetts, and are listed in Table 3.6.

Additional receivers will be purchased for possible distribution to:

- Institutions similar to those listed in Tables 3.5 and 3.6, but not yet identified.
- Homes with an occupant who is hearing impaired.
- Isolated residences where tests indicate that siren coverage must be supplemented, and where the provision of additional siren coverage would be uneconomical.

All emergency-alerting radio receivers will be activated by an EBS tone on a commercial broadcast station. In New Hampshire, this will be WOKQ in Dover, New Hampshire, which is a 24-hour 50,000 watt FM station with coverage throughout the EPZ. In Massachusetts the activation station will be WCGY, a 50,000 watt FM station in Lawrence, MA. Upon activation, the audio capability of the receiver will turn on, and emergency messages from the activating station will be audible. Activation will also light a signal light on the receiver to notify those unable to hear audible information.

TABLE 3.5

LIST OF ORGANIZATIONS
TO RECEIVE EMERGENCY-ALERTING RADIO RECEIVERS
IN THE SEABROOK EPZ

NEW HAMPSHIRE

Location	Quantity
City/Town EOC's	17
State Civil Defense	2
Rockingham County Dispatch	1
Schools (see Table 3.5.1)*	69
Businesses with 50 or more employees (see Table 3.5.2)*	42
Medical Care Facilities (see Table 3.5.3)*	12
Other	
Pease AFB	1
Portsmouth Naval Shipyard	1
U.S. Coast Guard, Portsmouth	1
Rye Harbor State Park	1
Hampton Beach State Park	1
Tricklin Falls YMCA Camp (E. Kingston)	1
Seabrook Dog Track	1
Total	150

* Tables are in Appendix C.

TABLE 3.6

LIST OF ORGANIZATIONS
TO RECEIVE EMERGENCY-ALERTING RADIO RECEIVERS
IN THE SEABROOK EPZ

MASSACHUSETTS

Location	Quantity
City/Town EOC's	6
State Civil Defense	2
Schools (see Table 3.6.1)*	26
Businesses with 50 or more employees (see Table 3.6.2)*	29
Medical Care Facilities (see Table 3.6.3)*	17
Other	
Parker Wildlife Refuge	1
Salisbury Beach State Reservation	1
U.S. Coast Guard, Plum Island	1
Boy Scout Camp, Amesbury	1
Total	84

* Tables are in Appendix C.

The receivers operate from AC power, but have back-up battery power in the event of a power failure. They are described in detail in the purchase specifications for the receivers.

3.7 Public Notification and Instructions via Emergency Broadcast

The two state Civil Defense Organizations will assure that the EBS and other emergency broadcast stations are broadcasting emergency messages and information to the public at the time that sirens are activated. These emergency broadcast stations are WOKQ in Dover, New Hampshire, and WCGY in Lawrence, Massachusetts; the stations that will trigger the emergency alerting receivers in the EPZ.

The EBS will be used in accordance with the respective state Emergency Broadcast System Manuals.

For the Seabrook Station EPZ, the Common Program Control Station in New Hampshire (CPCS 1), WTSN 1270 AM, will be activated. This CPCS 1 station will in turn activate all primary stations in the area. The broadcast stations involved are:

WTSN[1]	Dover, NH	1270 AM	(CPCS 1)
WOKQ[2]	Dover, NH	97.5 FM	(First Primary)
WWNH[1]	Rochester, NH	930 AM	(Primary)
WHEB[2]	Portsmouth, NH	750 AM; 100.3 FM	(Primary)
WBBX	Portsmouth, NH	1380 AM	(Primary)
WKXR	Exeter, NH	1540 AM; 107.1 FM	(Primary)
WVNH	Salem, NH	1110 AM	(Primary)
WUNH	Durham, NH	91.3 FM	(Primary)
WPEA	Exeter, NH	90.5 FM	(Primary)
WENH	Durham, NH	Channel 11 TV	(Primary)

[1] Emergency Power

[2] 24-Hour Capability

Virtually all New Hampshire stations within and abutting the EPZ area have been selected for inclusion in the emergency information network. In this area each of the stations provide coverage of the entire New Hampshire portion of the EPZ.

Most of these stations are not operational on a 24-hour basis. For such stations, advanced notice is needed before broadcast can begin. For this reason, the New Hampshire EBS stations will be contacted by NHCDA at the ALERT level if current reactor status indicates that a SITE AREA EMERGENCY might be declared. This would allow for the broadcast of messages at any time that the public alert system is to be activated.

In Massachusetts, the activating emergency station, WCGY in Lawrence, is a 50,000 watt FM station on 93.7 MHz. It will be activated by Massachusetts Civil Defense prior to siren activation, as described in the Massachusetts State Radiological Emergency Plan.

3.8 Siren Activation Sequence

In the event of a Site Area Emergency at the Seabrook Station, the respective State Civil Defense organization will notify their State control points to activate all sirens in each state. The recommended activation sequence is as follows:

Winter: 3 minutes of the designated emergency tone, immediately followed by a second 3 minutes of tone.

This process should be repeated after 10-15 minutes, if necessary.

Summer: 3 minutes of the emergency tone, immediately followed by a second 3 minutes of the tone for sirens off the beaches.

The fifteen sirens to be used to alert and notify beach users should broadcast voice messages during the second 3 minutes of activation. These messages should be broadcast in each of the following directions: N, NE, SE, S, SW, W, and NW. Brief messages, repeated at least once, should be used. Foreign-language messages may be broadcast in every direction immediately after the English language message.

This process should be repeated after 10 to 15 minutes.

3.9 Siren System Tests

In accordance with the guidance in Appendix 3 of NUREG-0654/FEMA REP-1, the radio communication links for siren control will be tested at least once every two weeks. The sirens will not be sounded during these tests.

In addition, every siren will be sounded briefly at least once every three months in order to verify that it is fully operational.

Finally, the entire siren system will be exercised fully at least once a year. For these annual exercises, the following sequence of operation is recommended.

a. A voice broadcast of the message "This is a Test, This is a Test" in each of eight directions from all sirens.

b. Three minutes of the Alert Tone on all sirens.

c. Repeat of the voice message, a., on all sirens.

d. Repeat of b.

e. Repeat of a.

3.10 Provisions for Alerting System Improvements, if Required

The design objective of the public alerting system for the Seabrook EPZ has been to provide coverage to essentially 100% of the populated area of the EPZ, in accordance with Appendix 3 of NUREG-0654/FEMA REP-1. The NRC recognizes that "this design objective does not, however, constitute a guarantee that early notification can be provided for everyone with 100% assurance or that the system when tested under actual field conditions will meet the design objective in all cases." For this reason, system tests may indicate the need for corrective measures.

Emergency-alerting radio receivers will be available for isolated residences in the event that siren coverage must be supplemented at their locations (see Section 3.6). In the unlikely event that testing reveals heavily-populated areas where siren coverage needs to be supplemented, additional sirens will be installed. The control system has the capability to operate additional sirens.

4. ANALYSES OF SYSTEM PERFORMANCE

4.1 Activation Time

The time to activate the sirens from a State control point, using an all-call code, is about 0.4 seconds.

4.2 Siren Coverage

Of course, siren coverage varies with weather conditions. It is useful, therefore, to examine the coverage of the EPZ under a variety of weather conditions. This has been done using HMM Associate's SIREP computer program. The computational algorithms for SIREP, and their origins in the technical literature, are described in Appendix D.

Four sets of meteorological conditions, listed in Table 4.1, have been analyzed. The first of these is representative of average summer daytime conditions, with a SE wind, C stability, and 80°F temperature. The second condition modeled is that typical of summer nighttime. Because of the light wind and strong temperature inversion, the coverage for this condition is greater than that for any of the other conditions.

The third condition is typical of a stormy spring or fall day: a "northeaster". The fourth condition modeled is that of a clear, windy ("blustery") winter day.

TABLE 4.1

REPRESENTATIVE WEATHER CONDITIONS MODELED
FOR SIREN COVERAGE ESTIMATES

Weather Parameter	Condition 1	2	3	4
General	Summer Average Day	Summer Clear Night	Spring/Fall Stormy "Northeaster"	Winter "Blustery" Day
Wind Speed, mph	10	5	20	15
Wind Direction, T	135	225	45	315
Stability	C	F	D	A
Temperature, ^{o}F	80	70	50	40
Relative Humidity, %	70	90	99	20
Barometric Pressure, in.Hg	29.92	29.92	29.92	29.92
See Figure	4.1	4.2	4.3	4.4

The 60 dB(C) and 70 dB(C) coverage estimates computed for each of these four conditions are shown on Figures 4.1 through 4.4.

Site 11,Rye

% Time dB Level	Measured dB Level
0.1	74
1	70
2	67
5	62
10	58
20	52
50	42
90	34
99	32
Maximum	76
Minimum	31
LEQ	56

Notes:

11-1, 1:15 P.M. start. Washington Road, near intersection of Route 1 and Dow Lane. Residential, with woods and open fields. Very light traffic on Washington Road, with exception of several large trucks. Two jets from Pease AFB flew over.

Site 12, North Hampton

% Time dB Level	Measured dB Level
0.1	66
1	57
2	55
5	53
10	51
20	48
50	40
90	31
99	31
Maximum	72
Minimum	30
LEQ	47

Notes:

11-1, 2:15 P.M. start. Ocean Boulevard (Route 1A) at Willow Avenue. Quite residential area of large homes. Very little traffic.

Site 13, Stratham

% Time dB Level	Measured dB Level
0.1	68
1	59
2	57
5	53
10	50
20	46
50	43
90	40
99	36
Maximum	70
Minimum	36
LEQ	48

Notes:

11-1, 3:20 P.M. start. Stratham Heights Road, approximately 200 yards E of Route 108, near intersection of Routes 108 and 51. Steady, moderate traffic on Routes 108 and 51. Light, occasional traffic on Stratham Heights Road. Area is residential, with some fields and farms and new commercial development (gas stations, shopping centers, etc., on Route 108).

Site 14, Salisbury

% Time dB Level	Measured dB Level
0.1	69
1	62
2	59
5	56
10	53
20	50
50	45
90	41
99	38
Maximum	73
Minimum	36
LEQ	51

Notes:

11-7, 9:50 A.M. start. 45°, clear and windy. Old County Road, just off 1A. Light, occasional traffic on 1A and Old County. Adjacent to a mobile home park on Old County. Subdivision on far side of 1A.

Site 15, Amesbury

% Time dB Level	Measured dB Level
0.1	69
1	63
2	61
5	58
10	55
20	50
50	43
90	39
99	38
Maximum	71
Minimum	37
LEQ	51

Notes:

11-7, 11:00 A.M. start. Residential street just off downtown area. Warehouse/abandoned factory on one side of street. Very light traffic. Location is on High Street, 75 yards from Market Street in central Amesbury.

Site 13, Stratham

% Time dB Level	Measured dB Level
0.1	68
1	59
2	57
5	53
10	50
20	46
50	43
90	40
99	36
Maximum	70
Minimum	36
LEQ	48

Notes:

11-1, 3:20 P.M. start. Stratham Heights Road, approximately 200 yards E of Route 108, near intersection of Routes 108 and 51. Steady, moderate traffic on Routes 108 and 51. Light, occasional traffic on Stratham Heights Road. Area is residential, with some fields and farms and new commercial development (gas stations, shopping centers, etc., on Route 108).

Site 16, Exeter

% Time dB Level	Measured dB Level
0.1	63
1	58
2	57
5	55
10	53
20	51
50	48
90	43
99	40
Maximum	83
Minimum	37
LEQ	52

Notes:

11-7, 12:30 P.M. start. Mixed commercial and residential area on Center Street, approximately 80 yards off Water Street. Moderate traffic on Water Street. Light traffic on Center Street, but occasional noise from cars leaving parking spaces and drive-in windows at bank. Ambulance siren near end of run.

Site 17, Newbury

% Time dB Level	Measured dB Level
0.1	63
1	58
2	56
5	52
10	49
20	46
50	40
90	36
99	33
Maximum	66
Minimum	32
LEQ	47

Notes:

11-7, 1:45 P.M. start. Newbury Neck Road, 100 yards E of Route 1A, just south of the Parker River. Residential, with mixed woods and open fields. Intermittent chain saw motors in background. Very light traffic on both 1A and Newbury Neck Road.

APPENDIX B

SIREN SITES IN NEW HAMPSHIRE (TABLE 1) AND MASSACHUSETTS (TABLE 2)

TABLE 1

SIREN REQUIREMENTS AND LOCATIONS IN THE

STATE OF NEW HAMPSHIRE

SIREN SITES IN THE TOWN OF BRENTWOOD, NEW HAMPSHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
BR-1	125	West side of Pickpocket Road 400 ft. south of Rowell Road	53	2 spans south	Set just south of dirt drive to east. Avoid trees.
BR-2	125	South side of Middle Road (Route 111A) approximately 500 ft. east of Prescott Road	48	3 spans east	Set by northwest corner of cemetary.
BR-3	125	Replace guy pole 3/40S, 39S on north side of South Road, approximately 1000 ft. west of Route 125	J-39	1 span west	
BR-4	125	200 ft. south of intersection of North and Prescott Roads, on on west side of Prescott Road	10A/1, 34C/1	2 spans south	Set north, clear of pine tree.
BR-5	125	South side of Route 101 approximately 3200 feet east of North Road	166	2 spans west	Locate to east of opening in stone wall, west of drive-in screen.

SIREN SITES IN THE TOWN OF EAST KINGSTON, NEW HAMPSHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
EK-1	125	South side of Route 107 approximately 1,000 ft east of of Route 108	12, 357	5 spans east	May need distribution transformer.
EK-2*	125	Replace existing Town-owned service pole behind Town Hall on Main Street	NETCO 37, 72	37, 72 and pole to be replaced	
EK-3	125	South side of Route 107A just east of railroad overpass	40/72X, 398	40/72X, 398	
Ek-4	115	East side of Exeter Road (Rt. 108) approximately 0.2 mile south of Giles Road	486/496	1 span south	

* Existing audible alerting device is installed at this site.

SIREN SITES IN THE TOWN OF EXETER, NEW HAMPSHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
EX-1	115	West side of Guinea Road approximately 100 ft north of Hampton Road (Rt. 101C)	2786, 945-1/2	1 span south	Locate by telephone connector panels
EX-2	125	West side of Drinkwater Road approximately 200 ft south of High Street (Rt. 101C)	1389, 14/1	2 spans north	Locate at end of fence which appears to be a property line
EX-3	125	West side of Jody Hill Avenue just north of Douglas Way	27, 1160	27, 1160	Clear shrubs. Locate on extended property line of Country Club.
EX-4	125	Northwest corner of parking lot behind Town Office Building, 10 Front Street	805	805 (light)	
EX-5	125	West side of Linden Street, 300 ft north of Gary Lane	28/165	28/165	Locate adjacent to swampy area
EX-6	125	North corner intersection of Epping Road, and East Industrial Park Road	939, 29	939, 29	Stay west of large trees
EX-7	125	South side of Epping Road approximately 800 ft east of Route 101	J/113/59, 1481	1 span East	
EX-8	125	Southeast side of Kingston Road (Rt. 111) just west of John West Road	148/41	148/41	Locate west clear of trees
EX-9	115	East side of Newfields Road (Rt. 83) approximately 1/2 mile north of Rt. 101	758, 1322	758, 1322	
EX-10	125	North side of Beech Hill Road, approximately 1/4 mile east of Old Town Farm Road	58, 1988 on E. 1989, 59 on W.	2-1/2 spans west	Locate by large stump just west of gate in stone wall

PROPOSED SIREN SITES IN THE TOWN OF GREENLAND, NEW HAMSPHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
G-1	115	Southeast side of Portsmouth Avenue and opposite Newington Rd.	NETCO 179	1 span E.	Pole may be on old mill dam
G-2*	125	West side of Cemetary Lane south of dump entrance	10/3	1 span N.	Locate between sugar maples to minimize tree cutting
G-3	125	North side of Dearborn Road 300 ft. west of Great Bay Road	17/3,3	1 span E.	
G-4	125	North side of Breakfast Hill Road just east of I95 and transmission line	84/4	1 span E.	Locate north of guard rail

SIREN SITES IN THE OF HAMPTON, NEW HAMPSHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
HA-1*	125	At north side of entrance to town parking lot south of Fire Station, Ashworth Road and F Street	1207	1207	Pick up support of secondary street light wires overhead
HA-2	125	In island of Route 1A just south of Boars Head Terrace	2207, 841-2	2207, 841-2	Keep clear of buried street-light wiring
HA-3	125	South side of sewage pumping station at Kings Highway and 12th Street	1137, 8-92	1137, 8-92	
HA-4	125	Southwest corner of intersection of Route 1A and North Shore Road	21/123, 550	21/123, 550	
HA-5	115	Replace street light pole #3339 at intersection of North Shore and Woodland Roads	2775, 225/22/25	3339 and 2775, 225/22/25	Remount existing street light
HA-6	125	Tide Mill Road, south of gate to sewage disposal facility at end of Tide Mill Road	1892/15	3 spans east	
HA-7*	125	Replace street light pole #3483 in parking lot behind town offices, Winnacunnet Road and Academy Street	2/219	3483 and 2/219	Remount existing street light
HA-8	125	West side of Lafayette Road, (Route 1A) opposite Lamson Lane	15/59	1 span south	Locate on extended property line of pool supply business
HA-9	125	West side of Drakeside Road, 200 feet south of Towle Farm Road	3330	1 span north	Place north of curve in Drakeside Road
HA-10	125	Northeast side, Hilltop on Exeter Road (101C), approximately 2/10 mile southeast of Exeter town line	892J	892J	Cut small trees; locate on extended property line indicated by stone wall

* An existing audible alerting device is installed at this site.

SIREN SITES IN THE TOWN OF HAMPTON FALLS, NEW HAMPSHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
HF-1	125	West side of Rt 1 approximately 300 ft north of Town Common - just south of blocked drive to west.	NETCO 106, 5/9	1 span north	
HF-2	125	North side of Lampry Rd approximately 500 ft west of Crank Rd	4/718	1 span east and west	
HF-3	125	West side of Rt 88, approximately 300 ft north of Brown and Nason Roads	147,541	1 span north	
HF-4	115	North corner of cemetery on east side of Rt 88 approximately 1/10 mile south of power lines	471, NETCO 4	471, NETCO 4	
HF-5	115	North side of Frying Pan Lane (Sanborn Rd extn.) approximately 900 ft west of King Street	1088, 1420/5	1088, 1420/5	

SIREN SITES IN THE TOWN OF KENSINGTON, NEW HAMSPHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
KE-1	115	East side of Amesbury Road (Rt. 150) 300 ft south of Cottage Road	2/42, 255	2/42, 255	Locate in gap in trees south of American Legion Building
KE-2	125	North side of Route 107 opposite Highland Avenue	1130/1,438	2 spans west	
KE-3	125	North side of Osgood Road, approximately 1/4 mile east of Amesbury Road (Rt. 150)	8/765	1 span west	Locate clear of trees. Some branches may have to be cut.
KE-4	115	West side of Drinkwater Road, just south of transmission line crossing	79/22	2 spans north	Locate south of culvert under road
KE-5	125	West side of Shaws Hill Road opposite Brewer Street	22,370	1 span north	Locate by old stump clear of trees

SIREN SITES IN THE TOWN OF KINGSTON, NEW HAMPSHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
KI-1	125	East side of parking lot east of South Fire Station on Hunt Road, just west of intersection with Main Street	NETCO 4,834	NETCO 4,834	Hunt Road to be widened. Set pole north to set-back of fire station
KI-2	125	Northeast corner of parking lot north of Public Works Garage on Main Street	72,150	72,150	Set pole to clear tall pine trees
KI-3*	125	Southwest corner of pavement west of Central Fire/Police Station, Main Street West and Rock Rimon Road	NETCO 26,1561	NETCO 26, 1561	Set pole to clear trees
KI-4	125	South side of Little River Road, approximately 500 feet west of Exeter Road (Route 111)	1935, NETCO 11/2	2 spans east	

* An existing audible alerting device is installed at this site.

SIREN SITE IN THE TOWN OF NEW CASTLE, NEW HAMPSHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
NC-1	125	Town Common, (on Wentworth Road - Route 1B) approximately 200 feet east of Rifle Range Building	No pole number (old military pole with light.)	Same	Set pole 20 feet north of paved area. May have to set pole in ledge. Arrange with town for gate key to Common, and to plow access, per Peter Gamester, Ch. Bd. of Sel.

SIREN SITES IN THE TOWN OF NEWFIELDS, NEW HAMPSHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
NF-1*	125	Replace light pole 18-3-14B on north side of Central Fire Station, Piscassic St.	18-3-14B	18-3-14B (3,23/81 on street)	New pole set but not connected 11/17/83
NF-2	125	North side Piscassic Road (Route 87), approximately 1/2 mile east of RR Crossing in Littlefield	NETCO 81-105 NHG+E 14-2-116	3 spans W.	Clear small trees.

* Existing audible alerting device is installed at this site.

SIREN SITES IN THE TOWN OF NEWTON, NEW HAMPSHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
NE-1	125	North side of Goulds Hill Road, approximately 700 feet west of Amesbury Road	1201/20551	1201, 20551	Approximately 200 feet west of last house on south side
NE-2*	125	Southeast corner of Fire Station lot on South Main Street (Route 108)	91/45	91/45	Mount clear of trees to south and east
NE-3	125	East side at height of Smith Corner Road, approximately 4/10 mile south of Peaslee Crossing Road	2-25, 225	1 span north	
NE-4*	125	Behind Fire Station on West Main Street adjacent to school parking lot to southwest	1003	1003	Secondaries may be 440V.
NE-5	125	North side of Pond Street, just east of railroad tracks	27/77, 423	27/77, 432	Mount clear of trees on inside of curve in road

* An existing audible alerting device is installed at this site.

SIREN SITES IN THE TOWN OF NORTH HAMPTON, NEW HAMPSHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
NH-1	125	East side of Old Lock Road approximately 1000 ft north of Chapel Street	38	1 span south	locate between large trees
NH-2	125	East side Woodland Road, approximately 200 ft north of Atlantic Avenue (Route 101D)	9/32	1 span north	locate just south of stream crossing
NH-3*	125	Replace existing light pole 2,38C1 behind police station, Atlantic Avenue (Route 101D)	2,38C1	2,38C1	remount light
NH-4	115	East side Lafayette Road (Route 1), approximately 0.1 mile north of North Road to East	573,1/27	574,1/27	locate north of property line in trees
NH-5	125	North side of Walnut Avenue on Hilltop approximately 3,000 ft	NETCO 38(?) NHG&E 19-17-44	NETCO 38(?) NHG&E 19-17-44	locate on inside of curve between large pine trees
NH-6	125	South side of North Road approximately 1000 ft north of Route 151	NETCO 8 NHG&E 19-15-8	1 span north	locate by southwest corner of parking lot

* Existing audible alerting device is installed at this site.

SIREN SITES IN THE CITY OF PORTSMOUTH, NEW HAMPSHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
P-1	125	North side Longmeadow Road, 30 feet east of Lafayette (Route 1)	30T-146-126	30T-146-126	Remove small trees
P-2	125	Northwest corner of PSNH property on Layafette Road (Route 1) north of gate to quarry	Light pole (no number)	Light pole (no number)	Replace existing light pole, or as directed by PSNH
P-3	125	West side Barthwick Avenue, approximately 500 feet north of Sherburne Drive	175, 182-4 NETCO 7804-4	175, 182-4 NETCO 7804-4	
P-4	125	West side of Circuit Road Extension just north of armory and south of proposed Market Street Extension	912A7, 20T266-6 NETCO 912-6	912A7, 20T266-6 NETCO 912-6	Verify clearance from proposed Market Street Extension
P-5*	125	Park Department Building west of intersection of Albany Street and Jewles Court	2-37D NETCO 4	2-37D NETCO 4	North of fence gate
P-6	125	South side of South Street approximately 200 feet west of Marston Street	21-5-51 NETCO 56-50	21-5-51 NETCO 56-50	By fire plug on lot-line extended
P-7	125	East side of Miller Avenue, 50 feet south of Cliff Road	59D, 21-138-41 NETCO 59-40	1 span north on NETCO 39	Ledge exposed. Pole may have to be set in rock
P-8*	125	Roof of Central Fire Station, 170 Court Street, at location of existing air horn	15T-4-161/2	1 span west on 21-4-17, 149-9	Accessible from parking lot on south side of building. Location OK with Fire Chief Paul Long. Analyze/reinforce structure as required

* An existing audible alerting device is installed at this site.

SIREN SITES IN THE TOWN OF RYE, NEW HAMPSHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
RY-1	125	Southeast corner of Intersection of Ocean Blvd. (Rt 1A) and Old Beach Rd	NETCO 93	NETCO 93	
RY-2	125	At substation on Lafayette Road (Rt 1) approximately 30 ft north of station fence	PSNH 81/2	PSNH 81/2	Discuss siting with substation manager
RY-3	125	East side of Ocean Blvd. (Rt 1A) opposite Washington Rd	NETCO 70/101 23-7-168	NETCO 70/101 23-7-168	Place close to seawall to east.
RY-4	125	East side of Parsons Rd approximately 500 ft south of of intersection at Ocean Blvd.	38/23	38/23	Place by vacant lot west of Tower.
RY-5	125	Replace guy pole 123S on west side of Sagamore Road approximately 500 ft north of Clark	NETCO 123, NHG&E 23-43-45	1 span south	
RY-6	125	By small cemetery north side of Lang Rd approximately 500 ft Northwest of Washington St.	NETCO 3	1-1/2 spans southeast	
RY-7	125	West side of Woodland Rd just north of Hampton Town Line	NETCO 40/2	NETCO 40/2	

SIREN SITES IN THE TOWN OF SEABROOK, NEW HAMPSHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
SB-1	125	West side of Route 1A between Newbury and Groveland Streets	9,290	9,290	Set N of gas station
SB-2	125	North side of South Main Street at W. corner of Exeter and Hampton substation	58-507	1 Span W + 2 Span E	
SB-3*	125	Central Fire Station, Rear (South side) at edge of pavement	NETCO 6-?	NETCO 6-?	Set just east of water tower
SB-4	125	Near Education Center, Seabrook Station	Site to be selected with PSNH		
SB-5	125	West side of Route 1A at south boundary of PSNH barge dock	997S	997S	
SB-6	125	Southwest Corner of Intersection of route 107 and Batchelder Road, just southwest of right-turn lane	1496, NETCO 65-1	1 Span South	(Secondaries may be 440V3Ø)
SB-7	125	East side of Lafayette Road opposite Lakeshore Drive	27S, 1126	27S, 1126	Could replace existing service pole 27S, 1126 with tree cutting. Keep siren close to property line.
SB-8	115	South side of Black Snake Road approximately 200 feet west of True Road	NETCO 12, 890	NETCO 12, 890	Locate approximately midway between houses on north side of street

* An existing audible alerting device is installed at this site.

SIREN SITES IN THE TOWN OF SOUTH HAMPTON, NEW HAMSPHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
SH-1	125	South side of Highland Street approximately 500 ft. west of Route 150	Between 11/1, 433 and 434, 2	11/1, 433	Stay within line of trees. Stay within commercial zone.
SH-2*	125	Behind southwest corner of Town Hall on Hilldale Avenue	1-36/1, 36	1-36/1, 36	To north of dumpster.
SH-3	125	East side of South Road approximately 400 ft. north of 107A	427	1 span south	Avoid large trees.
SH-4	115	South side of Hilldale Avenue, just east of turnout by pond (approximately 7000 ft. west of Town Center)	NETCO 52 (phone lines only)	5 spans east	May have to string primaries.

* Existing audible alerting device is installed at this site.

SIREN SITES IN THE TOWN OF STRATHAM, NEW HAMSPHIRE

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
ST-1	125	North corner of intersection of Winnicut Road and Union Road	507/70, 542, "155"	507/70, 542, "155"	
ST-2	125	West side Routes 101/108 400 ft north of Frying Pan Lane	5/75, 39	5/75, 39	Locate on extended property line indicated by fence and trees
ST-3	125	North side of Winnicut Road at High Street	507/22, 530	1 span NW and 2 spans SE	Locate just south of small trees
ST-4*	115	Central Fire Station, 4 Winnicut Road	2,509	2,509	Locate at edge of pavement behind fire station, or as directed by Town
ST-5	115	East side of Route 101 just south of power line crossing, 1/4 mile north of Squampscott Road	985, 5/175	985, 5/175	
ST-6	125	South side of Heights Road, approximately 1/2 mile east of Guinea Road	502/66	502/66	Locate clear of large tree. Some branches may need to be cut. Locate just east of dirt drive to north

TABLE 2

SIREN REQUIREMENTS AND LOCATIONS IN THE

COMMONWEALTH OF MASSACHUSETTS

SIREN SITES IN THE TOWN OF AMESBURY, MASSACHUSETTS

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
AM-1	125	By fire plug, east side, end of Dewey Street off Bow Street	MECO 4	MECO 4	1. Verify location is on public ROW 2. Tortuous access. May have to bring pole in by air
AM-2*	125	North side of parking lot for Town Hall Annex, School Street	MEE 3F, 2	MEE 3F, 2	
AM-3	125	East side, end of Pow Wow Road, top of hill	MECO 105-24	MECO 105-24	Pick up secondaries overhead
AM-5**	125	Replace service pole NETCO 185 on east side of Hillside Avenue (Rt. 150) just north of intersection with Route 110	185	185	
AM-6	125	East of gate, east side of Amesbury Sewage Treatment plant	MECO 6-4, 1	Across road to south	
AM-7	115	North side of Pleasant Valley Rd. approximately 4600 feet east of Buttonwoods Road	NETCO 52	1 span east	Locate on apparent property line extension between houses on north side of road
AM-8	125	Pond Hill, south side of Old Country Road opposite Fifth Street	MEE 157-6	MEE 157-6	
AM-9	125	North side of Kimball Road approximately 1000 feet southeast of Lions Mouth Road	133-45	133-45	Between apple trees
AM-10	115	East side of Market Street (Route 150) 100 feet north of Fern Avenue	HELCO 5-55	HELCO 5-55	Locate just north of guard rail
AM-11	115	East of Congress Street approximately 1000 feet southwest of Fern Street	1-34	1-34	Locate about 10 feet north of drain

* An existing audible alerting device is installed at this site.
**There is no Siren AM-4.

SIREN SITES IN THE TOWN OF MERRIMAC, MASSACHUSETTS

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
MM-1	115	South side of Middle Road on Hillside, approximately 900 feet east of River Road	NETCO 76-21	1 pole west, no pole number	
MM-2	125	North side of Liberty Street Extension 70 feet east of Church Street on south side of cemetery	MEL-37	MEL-37	Stay west of tree
MM-3	125	Northeast side of Bear Hill Road, approximately 800 feet northwest of hilltop	2-59+2-60	1-1/2 spans south on pole 2-58	
MM-4	115	North side River Road, 200 feet east of Merrimac Street	NETCO 6-77	NETCO 6-77	Poor parking for maintenance vehicle
MM-5	115	South side of Highland Street, approximately 1200 feet north of Harriman	47	47	
MM-6	115	West side of Heath Road, approximately 500 feet north of Birch Meadow Road	NETCO 64-1 + MEL 8-25X	3 spans north or 3 spans south	

SIREN SITES IN THE TOWN OF NEWBURY, MASSACHUSETTS

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
NB-1	125	Replace existing service pole at summer police station site, intersection of Plum Island Turnpike and Northern Boulevard	No number on service pole. 48-1, 1	service pole	
NB-2*	125	Northeast corner of rear lot of Highway Department Garage at intersection of High Road (Route 1A) and Old Pine Island Road	NETCO 81-1, 1	81-1, 1	
NB-3	115	West side of Newbury Neck Road at intersection with High Road	139	139	Stay in ROW. Clear branches.
NB-4*	125	Southeast corner of parking lot, rear between Town Hall and Central Fire Station, Morgan Avenue	NETCO 26/1	26/1	On land of Vol. Fire Association
NB-5	125	West wide of Route 1 approximately 800 ft. south of intersection with Boston Street	1178/92	-	Primaries only. Dist. Xfmr. needed.
NB-6*	125	Rear between Fire Station and and Town Hall, Byfield	88	88	May require additional service pole.
NB-7	125	South side of Elm Street approximately 100 ft. west of School Street	8/65	1 span east	Avoid large trees.

* Existing audible alerting device is installed at this site.

SIREN SITES IN THE CITY OF NEWBURYPORT, MASSACHUSETTS

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
NP-1	125	South side of Plum Island Fire Station	NETCO 2, MEE 17	1ØP+120/240	Remove existing 115dB mechanical siren at this site. Install 125dB electrical siren 50 feet above ground
NP-2*	113	North side of Hale Street, 4600 feet west of Low Street, by unpaved drive to south	14	1ØP only, secondaries available 1-1/2 spans west	Install 115dB mechanical siren relocated from Plum Island Fire Station.
NP-3*	113	Between Winter Street and Route 1 just north of Route 113 (High Street) overpass	NETCO 66-1	1ØP & 120/240	Install 115dB mechanical siren relocated from 53rd Street and Southern Boulevard on Plum Island.
NP-4	113	South side of High Street opposite Bromfield Street	NA	NA	Existing siren
NP-5	113	By Cemetary on Noble Street	NA	NA	Existing siren
NP-6*	113	East side of Turkey Hill Road approximately 500 feet south of Bayberry	MECO 18	3ØP+120/240	Remove existing 115dB mechanical siren at end of Everette Street and relocate to this point.
NP-7	113	South side of Low Street opposite Johnson Street	NA	NA	Existing siren
NP-8	113	North end of Dawes Street loop off Ashland Street	NA	NA	Existing siren

* Relocations of existing sirens.

SIREN SITES IN THE TOWN OF SALISBURY, MASSACHUSETTS

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
SA-1	125	Replace existing pole 54/1 on Salisbury Beach State Reservation, northwest corner of Reservation Rd. and entrance to campground	54/1	54/1	May require permission from Comm. of Mass.
SA-2	125	Replace existing light pole 2/98X on south side of Beach Road (Rt. 1A) west of entrance to town parking lot.	2/98X	2/98X	
SA-3	125	West side of North End Boulevard, opposite house Nos. 348/350	48	48	
SA-4	125	Replace Guy pole, 49S on north side of Beach Road 1900 ft. west of Old County Road	49	49	Place new pole closer to road but behind guard rail
SA-5	125	East side of Bridge Road (Rts. 1, 1A) approximately 300 ft north of Ferry Road	61	61	Set approx 20 ft north of fire plug
SA-6	125	East side of Railroad Avenue Extension just inside Town Park at end of road.	18	18	
SA-7	125	North side of Main St. 200 ft east of Old Locust St.	48	48	
SA-8	125	SW corner of Intersection of Elm Street (Rt 110) and Merrill St.	66/4	66/4	
SA-9	125	South side of Foley Mill Road approximately 3/10 mile north of Elmwood Street	65/10	65/10	

SIREN SITES IN THE TOWN OF WEST NEWBURY, MASSACHUSETTS

Designation	Rating	Site	Nearest Utility Pole	120/240V Secondaries	Comment
WN-1	125	Main Street (Route 113) at School and Town Offices 20 feet north of town garage and 50 feet south of Water and Civil Defense Office	MECO-3	MECO-3	Install on 60 ft A/G to clear buildings (15.80 ft. pole required)
WN-2	125	Dip in Turkey Hill Street 1,000 feet south of Pikes Bridge on south side	Haverhill Electric 31-36	1-1/2 spans southeast	
WN-3*	125	Replace existing unused pole MEC-37 behind fire station	MEC 2 and no pole number on Bachellor Street	2 spans to MEC-2	Replace existing unused pole MEC-37
WN-4	125	North side of Crane Neck Road 2,000 feet east of Middle Street	MECO-66	2 spans east on MECO-68	
WN-5	115	Divider between Pawtucket Regional High School entrance and Farm Lane, 200 feet west of Route 113	MECO 50-1	MECO 50-1	
WN-6	115	East Side Main Street (Rt. 113) 200 feet south of Pleasant Street	(numbers damaged)	(numbers damaged)	Next pole south is MECO-44, NETCO 51/350

* An existing audible alerting device is installed at this site.

APPENDIX C

Tables 3.5.1
3.5.2
3.5.3
3.6.1
3.6.2
3.6.3

ORGANIZATIONS TO RECEIVE EMERGENCY ALERTING RADIO RECEIVERS

TABLE 3.5.1

SCHOOLS IN THE NEW HAMPSHIRE PORTION OF THE SEABROOK EPZ

TOWN/CITY	
Brentwood	
	Brentwood Schools
	Brentwood Country Day School
East Kingston	
	East Kingston Schools
	Mrs. Lavallee's Day Care Center
	Mrs. Kemp's Day Care Center
	Grace Bible Church Day Care Center
Exeter	
	Exeter Schools
	Phillips Exeter Academy
	Exeter Head Start
	Exeter Child Care Center
	Exeter Day School
	ABC Preschool
	Richie McFarland Childrens Center
	The Little School
	Montessori School of Exeter
Greenland	
	Greenland Schools
	Mrs. Gowen's Private Kindergarten
Hampton	
	Hampton Schools
	Happy Apple Nursery School

SCHOOLS IN THE NEW HAMPSHIRE PORTION OF THE SEABROOK EPZ
(continued)

TOWN/CITY	
Hampton (cont.)	
	Sacred Heart School
	Hampton Christian School
	The Taylor School
	Aslan's Pride Nursery School
Hampton Falls	
	Hampton Falls Schools
	Hampton Falls Child Care Center
	Hampton Falls Kindergarten and Nursery School
Kensington	
	Kensington Schools
Kingston	
	Kingston Schools
	Spring Hill School
	Holiday Kindergarten
	Sanborn Regional School
	South Road Kindergarten
	Kingston Children's Center
New Castle	
	New Castle Schools
	Great Island Nursery School
Newfields	
	Newfields Schools

SCHOOLS IN THE NEW HAMPSHIRE PORTION OF THE SEABROOK EPZ
(continued)

TOWN/CITY	
Newton	
	Newton Schools
	Teddy Bear Nursery School
	Happy Hour Nursery School
North Hampton	
	North Hampton Schools
	Busy Beaver Kindergarten
	Montessori Early Learning Center
	The Whole Child School
	North Hampton Nursery
Portsmouth	
	Portsmouth Schools
	Country Nursery
	The First Step
	Agape Preschool
	Community Day Care Center
	Happy Day Nursery
	Children's Garden School
	St. Patrick's School
	Bethel Christian Academy
	Alpha Academy
Rye	
	Rye Schools
	Sunshine and Buttercups

SCHOOLS IN THE NEW HAMPSHIRE PORTION OF THE SEABROOK EPZ (continued)

TOWN/CITY

Rye (cont.)

- Rye Center for Early Learning
- Briar Patch Nursery School

Seabrook

- Seabrook Schools
- Seabrook Day Care Center
- Gingerbread House Creative Center

South Hampton

- South Hampton Schools

Stratham

- Stratham Schools
- N.H. Vocational Technical School
- Acorn School
- The Kids Stop
- Country Kids
- Bayview Nursery School
- Pumpkin Patch Nursery School

TABLE 3.5.2

BUSINESSES WITH 50 OR MORE EMPLOYEES IN THE NEW HAMPSHIRE PORTION OF THE SEABROOK EPZ

Exeter

Alrose Shoe Co.
1 Rockingham Street
(120)

Donnelly Manufacturing Co.
Exeter Industrial Park
(200)

Exeter & Hampton Electric Co.
225 Water Street
(101)

Exeter Footwear Co. Inc.
93 Court Street
(75)

GTE Products Corp.
Portsmouth Avenue
(600)

Nike Inc.
156 Front Street
(275)

Exeter Newsletter
255 Water Street
(158)

Palmer & Sicard Inc.
140 Epping Road
(62)

Blue Ribbon Sports, Inc.
156 Front Street
(110)

Rockingham County Newspapers Inc.
P.O. Box 250
(100)

Milliken and Co.
Chestnut Street
(200)

Exeter (Cont'd)

Tyco Laboratories Inc.
Tyco Park
(5,170)

Greenland

GTE Products Corp.
Route 101
(94)

Hampton

Palmer & Sicard
Lafayette Road
(62)

Complex Inc.
1 Lafayette Road
(65)

Wheelabroter-Frye Inc.
Liberty Lane
(180)

Foss Manufacturing Co. of NH
Foss Lane
(70)

Pearse Leather Products Co., Inc.
7 Kershaw Avenue
(60)

Kingston

Kellogg American, Inc.
Route 125
(150)

Newfields

Kingston Warren Corp.
Route 85
(750)

Portsmouth

Post Machinery Company
Post Road
(150)

Varney Wesley Inc.
225 Union Street
(70)

Artisan Specialty Co. Inc.
Artisan Building
72 Mirona Road
(50)

Booth Fisheries
1 Booth Avenue
(410)

Chadwick & Trefetnen Inc.
50 Borthwick Industrial Park
(2,025)

Diaphragm Industries Inc.
1001 Islington Street
(140)

Erie Scientific Co.
Portsmouth Industrial Park
(250)

John LaFolla Co. Inc.
Peverly Hill Road
(150)

The Morley Company
909 Islington Street
(50)

National Gypsum Company
Freeman's Point
(110)

New England Homes Inc.
Freeman's Point
(70)

New Hampshire Provision
698 Islington Street
(60)

Portsmouth Herald/Div. of
Thompson
111 Maplewood Avenue
(80)

Seabrook

Bailey Corporation
Route 1
(1,000)

Hysol Division of the
Dexter Corp.
Folly Mill Road
(81)

O'Brien D.G. Inc.
One Chase Park
(100)

Protective Materials Co.,
Inc.
Folly Mill Road
(100)

Spherex Inc.
Walton Road
(53)

Tower Press Inc.
Folly Mill Road
(60)

Welpro Inc.
New Zealand Road
(300)

Public Service Co. of
New Hampshire

TABLE 3.5.3

MEDICAL FACILITIES IN THE NEW HAMPSHIRE PORTION OF THE SEABROOK EPZ

Location

Exeter

Exeter Hospital
Eventide of Exeter
Goodwins of Exeter
Exeter Health Care

Hampton

Seacoast Health Center
Odyssey House
22 Tuck Road

Portsmouth

Wentworth Home
Portsmouth Hospital
Home for Aged Women
Clipper Home
Edgewood Manner
Chase Home for Children

TABLE 3.6

PRELIMINARY LIST OF ORGANIZATIONS
TO RECEIVE EMERGENCY-ALERTING RADIO RECEIVERS
IN THE SEABROOK EPZ

MASSACHUSETTS

Location	Quantity
City/Town EOC's	6
State Civil Defense	2
Schools (see Table 3.6.1)	26
Businesses with 50 or more employees (see Table 3.6.2)	29
Medical Care Facilities (see Taole 3.6.3)	17
Other	
Parker Wildlife Refuge	1
Salisbury Beach State Reservation	1
U.S. Coast Guard, Plum Island	1
Boy Scout Camp, Amesbury	1
Total	84

TABLE 3.6.1

SCHOOLS IN MASSACHUSETTS PORTION OF THE SEABROOK EPZ

TOWN/CITY	
Amesbury	
	Amesbury Schools
	Horace Mann School Congress Street
	Amesbury Country Day School 186 Market
	Seventh Day Adventists School Monroe Street
	Charles C. Cashman Friend Street
	Harbor Schools, Inc. (2 units) Pleasant Valley Road
	Miss Rose's Child Care Center Route 110 & Main Street
Merrimac	
	Merrimac Schools
	Whittier Regional School
Newbury	
	Newbury Schools
	Harbor School 24 Rolfe's Lane
	Harbor School 28 Rolfe's Lane
	Governor Dummer Academy
Newburyport	
	Newburyport Schools
	Immaculate Conception Green & Washington Streets

SCHOOLS IN MASSACHUSETTS PORTION OF THE SEABROOK EPZ (continued)

TOWN/CITY	
Newburyport (cont.)	Kinder-Care Learning Center
	My School YMCA - State Street
	Spring Street Montessori
	The Children's House 23 Chapel Street
	Murray's Nursery School 13 Federal Street
Salisbury	Salisbury Schools
	Kiddie Corner Nursery 16 John Street
West Newbury	West Newbury Schools
	Pawtucket Regional
	The First School 893 Main Street, W. Newbury

TABLE 3.6.2

BUSINESSES WITH 50 OR MORE EMPLOYEES
IN THE MASSACHUSETTS PORTION OF THE SEABROOK EPZ

Amesbury

Amesbury Metal Products Corp.
39 Oakland Street
(100)

Amesbury Plastic Inc.
Noel Street
(200)

Associated Environmental Systems
10 Industrial Way
(450)

Brazonics Inc.
Haverhill Road
(80)

Cado Fabrications
144 Elm Street
(65)

Cargocaire Engineering Corp.
79 Monroe Street
(150)

Essex County Gas Co.
7 North Hunt Road
(113)

Flexaust Company
Chestnut Street
(50)

Henschel Corporation
14 Cedar Street
(150)

Lebanon-Bonney Co.
6 Chestnut Street
(55)

Merrimac Valley Foundry Co.
58 Mill Street
(50)

Amesbury (cont'd)

Microfab, Inc.
Haverhill Road
(200)

Maple Wood Products Co.
60 Merrimac Street
(56)

North Shore Weeklies, Inc.
21 Elm Street
(60)

R&G Mfg. Co. Inc.
63 Clinton Street
(65)

Alexander Syvinski
38 Collins Avenue
(99)

Haverhill Gas Co.
Chestnut Street
(139)

Merrimac

Engel-Lewis Counter Co., Inc.
Liberty Street
(150)

Newburyport

Berkshire Manufactured Products Inc.
116 Parker Street
(90)

Newbury Tanning Corp.
12 Federal Street
(80)

Gould Inc.
374 Merrimac Street
(500)

Newburyport (cont.)

Stride Rite Corp.
Perkins Way
(100)

Leary's Beverages Inc.
504 Merrimac Street
(80)

L&V Electroplating Corp.
5 Greenleaf Street
(65)

Owens-Illinois Inc.
Parker Street
(200)

S. Starensier Inc.
5 Perkins Way
(99)

Towle Mfg. Company
260 Merrimac Street
(1800)

Amesbury Specialty Co.
Parker Street
(50)

Salisbury (MA)

Vaughn Corp.
386 Elm Street
(65)

TABLE 3.6.3

MEDICAL FACILITIES IN THE MASSACHUSETTS PORTION OF THE SEABROOK EPZ

Location

Amesbury

Amesbury Hospital
Highland Avenue

Amesbury Nursing and Retirement Home
22 Maple Street

Hillside Nursing Home
29 Hillside

Maplewood Manor Nursing Home
Morrill Place

Eastwood Rest Home
39 High Street

North Eastwood Rest Home
276 Main

Parkside Rest Home
56 Sparnawk

Merrimac

Merrimac Home

Merrimac Dialysis Facility

Newburyport

Anna Jacques Hospital
Highland Avenue

Brigham Manor Nursing Home
77 High Street

Country Manor Convalescent Home, Inc.
Low Street

Port Manor Nursing Home

Home for Aged Men (Newburyport Society)
361 High Street

Location

Newburyport (cont.)

Home for Aged Women (West)

Home for Aged Women (East)

Salisbury

Greenleaf House Nursing Home
335 Elm Street

APPENDIX D

SIREP COMPUTATION PROCEDURES USED FOR THE ANALYSIS OF SIREN COVERAGE

SIREP COMPUTATION PROCEDURES

For each of 16 compass bearings from a siren, SIREP tries a series of different ranges, starting as close to the siren as 150 feet and going out to a maximum of 20,000 feet. The sound loss (attenuation) for each range is computed and subtracted from the siren level at 100 feet. It is then determined whether or not one of the desired levels of 60 dB or 70 dB has been passed. If so, the range to that level is placed at half the distance between the present range and the prior one.

Successive range steps are separated by a factor of 10 exp ((log 2)/10), which yields approximately a 1 dB step in attenuation.

SIREP computes and sums the effects of the following sources of sound attenuation:

Spherical Divergence

The siren is treated as a point source radiating energy into space, so the sound intensity decreases with the square of the distance from the source ("inverse square law"). This creates a loss of 6 dB for each doubling of distance from the 100 ft. reference level. See Ref. 1.

Atmospheric Absorption

Atmospheric absorption is computed using the equations of ANSI S1.26-1978 (Ref. 2).

Attenuation by Forests

Attenuation through forests is a strong function of frequency, and depends upon the types of plants in the forest. Experimental data are quite variable (Ref. 3) and available theory is not practical to apply in practice (Ref. 4).

In the frequency range at which most outdoor acoustic warning devices operate, forest attentuation results from scattering by tree trunks, and accumulates to a maximum within the first few hundred feet of forest. Computations by SIREP are an adaptation of the attenuation rates proposed by Keast (Ref. 5), with the attenuation as a function of frequency established on the basis of the range of tree trunk diameters typical of the site (generally 6 in.-18 in. in the northeastern U.S.).

SIREP accumulates forest attenuation linearly in the first 250 feet of forest, up to a maximum of 10 dB (Ref. 6).

Ground Absorbtion

Ground absorbtion results from the interference between the direct sound wave from the siren to the listener and other sound waves reflected off the ground. It is a detailed function of local geometry, ground impedance at the point(s) of refection, and sound frequency. The theory (Chessel, Ref. 7) is well developed but impractical to apply except at very short ranges over uniform ground.

SIREP uses an empirical algorithm based upon the data of Parkin and Scholes (Refs. 8, 9) and other experimental data. Ground absorbtion is accumulated linearly up to 1000 feet from the siren, and is fixed beyond that distance. Ground absorbtion is accumulated linearly up to 1000 feet from the siren, and is fixed beyond that distance. Ground absorption is a function of siren frequency. It is ignored above 1000 Hz, and increases with decreasing frequency below 1000 Hz to a maximum of about 10 dB.

Wind Shadow

To compute wind-shadow effects, SIREP assumes level ground and a horizontally uniform, vertically stratified atmosphere with constant wind direction, while temperature and wind speed vary with the logarithm of height. The method of Nyborg and

Mintzer (Ref 10) is then applied to compute the distance to the shadow, if any, as a function of azimuth. Within the shadow, attenuation is accumulated with range as reported by Wiener and Keast (Ref. 11) to a maximum of 20 dB.

Built Up Areas

SIREP assumes a fixed 10 dB loss in built-up areas to account for reflection and refraction by buildings and loss of line of sight to the siren. This empirical number is based upon traffic-noise studies (Ref. 6). It gradually disappears in upwind shadows.

Hills and other Large Barriers

SIREP computes attenuation behind hills and other large barriers by applying the method of Maekawa (Ref. 12). Level ground is assumed except for the barrier. When the user enters a barrier height that is below siren level, such as could occur in sloping terrain, SIREP assumes the barrier is 5 feet above the siren elevation.

Barrier attenuation is reduced downwind to allow for downward curvature of the sound paths.

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8. Parkin, P.H. and W.E. Scholes, "The Horizontal Propagation of Sound from a Jet Engine Close to the Ground, at Radlett", J. Sound and Vibration, 1, pp. 1-15, 1964.

9. Parkin, P.H. and W.E. Scholes, "The Horizontal Propagation of Sound from a Jet Engine Close to the Ground, at Hatfield", J. Sound and Vibration, 2 (4), pp. 353-374, 1965.

10. Nyborg, W.L. and D. Mintzer, "Review of Sound Propagation in the Lower Atmosphere", WADC Technical Report 54-602, Sect. 1.5.5, p. 50 et seq., May 1955.

11. Weiner, F.M. and D. N. Keast, "Experimental Study of the Propagation of Sound Over Ground", J. Acoust. Soc. Amer., 31, 724-733, 1959.

12. Maekawa, Z., "Noise Reduction by Screens of Finite Size", Memoirs of Faculty of Eng., Kobe Univ., Japan, 12 1-12, 1966. See also Ref. 1, Sec. 7.6.

FIGURE 2.1

TOPOGRAPHIC MAP OF THE PLUME EXPOSURE PATHWAY

EPZ FOR SEABROOK STATION

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FIGURE 2.2

LOCATIONS WHERE THE NEED FOR AT LEAST 70 dB (C)

COVERAGE HAS BEEN ASSUMED

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FIGURE 2.3

SITES AT WHICH AMBIENT BACKGROUND NOISE

WAS MEASURED

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FIGURE 3.1

LOCATIONS OF SIRENS TO BE USED FOR PUBLIC

ALERTING IN THE SEABROOK EPZ

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FIGURE 3.2

AREAS WHERE COVERAGE IS ESTIMATED TO BE

60 dB(C) OR LESS WITHIN THE SEABROOK EPZ

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FIGURE 3.3

AREAS WHERE COVERAGE IS ESTIMATED TO BE

70 dB(C) OR LESS WITHIN THE SEABROOK EPZ

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FIGURE 4.1

COMPUTED SOUND LEVEL CONTOURS FOR TYPICAL

SUMMER DAYTIME CONDITIONS (SE WIND)

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FIGURE 4.2

COMPUTED SOUND LEVEL CONTOURS FOR TYPICAL

SUMMER NIGHTTIME CONDITIONS (SW WIND)

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FIGURE 4.3

COMPUTED SOUND LEVEL CONTOURS FOR STORMY

SPRING/FALL CONDITIONS ("NORTHEASTER"-NE WIND)

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FIGURE 4.4

COMPUTED SOUND LEVEL CONTOURS FOR A "BLUSTERY"

WINTER DAY (NW WIND)

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