September 17, 1988

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

before the

ATOMIC SAFETY AND LICENSING BOARD

In the Matter of PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE, et al. (Seabrook Station, Units 1 and 2)	Docket Nos. 50-443-OL-1 50-444-OL-1 (On-Site Emergency Planning and Safety Issues)

AFFIDAVIT OF DONALD E. JOHNSON

I, Donald E. Johnson, being on oath, depose and say as follows:

1. I am a Senior Mechanical Engineer for Yankee Atomic Electric Company (YAEC) in Framingham, Massachusetts. Since March of 1988 I have had the responsibility for specific structural design aspects of the VANS vehicle (i.e., crane-truck assembly, siren support and supports for crane boom and electrical cabinets/panels) for the Massachusetts Public Alert and Notification System. A statement of my professional qualifications is attached hereto and marked "A".

2. The purpose of this affidavit is to address allegations in Contention Bases A.4 and A.6 regarding the Applicants' VANS vehicles. The allegations I address are: (1) the weight distribution with the siren fully extended will cause the equipment to fall and/or the lifting mechanism to bend or break under heavy wind or precipitation conditions [Basis A.4]; (2) the telescopic crane will not reliably lift the siren to its fully extended position because of the weight of the siren and the capacity of the crane [Basis A.4]; and (3) that snowy or icy weather conditions will impede extension of the sirens to their operational position [Basis A.6].

3. The VANS vehicle design is comprised mainly of a telescoping hydraulic crane mounted on a commercial grade truck. The telescoping crane is a with minor modifications. The crane boom consists of three sections (one fixed and two sections telescope out). The truck is a ; its specifications satisfy the National Crane requirements. The VANS vehicle is stabilized by two sets of A-frame outriggers. One set is integral to the crane unit and provides a 15-foot stability stance. The other set, located behind the rear wheels, is securely mounted to the truck chassis and provides a 10-foot stability stance.

4. At each acoustic location, the following steps are taken by the truck driver regarding truck stability and lifting the siren package:

- Deploy front and rear A-frame outriggers to stabilize and level vehicle;
- Raise the crane boom and siren package from the stored position to the 80° position (*i.e.*, 80° from the horizontal). During this raising of the boom, the two outer sections are fully retracted;
- While at the 80° position, extend the two outer sections until all boom sections are extended.

5. When the first boom section is fully raised to the 80° position, the height of the crane boom above the ground is approximately 29 feet. When all boom sections are fully extended, at the 80° position, the height of the crane boom above the ground is approximately 56 feet. These correspond to center-line elevations of the sirens above the ground of approximately 25 feet and 51 feet respectively.

Basis A. 4: Adequacy of VANS Vehicles

6. As discussed in the following paragraphs, when the crane is fully extended, the equipment will not fall nor the lifting mechanism fail under heavy wind or precipitations conditions. In regard to the lifting mechanism, displacement or bending of the boom is not failure. Bending is a normal phenomena associated with the mechanical properties of structural materials. Structural failure is, generally

speaking, when the stresses developed by the loads imposed exceed the allowable stress values specified in governing industry standards or codes.

7. Two analyses were performed under my direction to demonstrate that under environmental loading conditions the VANS vehicle will remain stable, the hydraulic crane when fully extended will not fail structurally, and the operability of the crane will not be affected. One analysis, performed at YAEC, evaluated the following three environmental conditions to determine which would be the governing design loading condition: (1) high speed winds (gale force/violent storm); (2) ice and wind; and (3) snow and wind. The results of this analysis, i.e., the load imposed by the governing environmental loading condition, were provided to who performed the second analysis, the structural analysis of the VANS vehicle.

8. In order to determine what high wind speed conditions should be considered in the design of the VANS vehicle, I requested the YAEC Environmental Sciences Group to determine various fastest-mile wind speeds and the associated probability that these wind speeds would not be exceeded over a random one-hour period, a one-day period and a three-day period (see Affidavit of George A. Harper at ¶¶ 3-9). From this information, I concluded that the design fastest-mile continuous windspeed of 51 mph should be used, which would correspond to a probability of about 99.4% that this wind

speed would not be exceeded in any random three-day period. In addition, for purposes of establishing the VANS vehicle wind design margin (i.e., the additional wind capacity), I also decided to have analyze a second fastest-mile continuous windspeed of 60 mph, which would correspond to a probability of about 99.8% that this wind speed would not be exceeded in any random three-day period.

9. In order to determine the governing ice and wind loading condition, I requested the YAEC Environmental Sciences Group to determine the ice and wind loading combination which would correspond to a probability of about 99.8% that the loading combination would not be exceeded in a random three-day period (see Affidavit of George A. Harper at ¶¶ 10-13). This probability of non-exceedence is consistent with the probabilities on non-exceedence for the high speed wind conditions discussed above in paragraph 8. From this review, I obtained the following loading information; ice load 0.6 inches (or 3 psf) with an accompanying wind gust of 45 mph.

10. As provided in paragraph 8 above, two continuous high speed wind conditions were to be considered in the analysis. In accordance with industry practices for designing structures, a dynamic loading factor was used to account for wind gusts. Accordingly, the two wind speed conditions analyzed were (1) a continuous design wind speed of 51 mph with wind gust effects up to 61 mph and (2) a

continuous wind speed of 60 mph with wind gust effects up to 72 mph. These wind speeds were converted to wind forces using the accepted industry standard American National Standards Institute A58.1 "Minimum Design Loads on Building and Other Structures."

11. The ice and wind loads of 0.6 inches (or 3 psf) and 45 mph wind gusts were applied to the siren package and the crane boom when the crane is fully extended. The calculated total weight of ice is approximately 1,100 pounds. The gravity loads (i.e. deadweight and ice) are supported by the crane's hydraulic system and the wind loads are supported by the crane boom's box section design. It should be recognized that any ice on the truck would increase the vehicle's counterweight and thereby increases the vehicle's overall stability.

12. A snow load of 24 pounds per square foot (represents 4.6 inches of water) was considered which represents the worst 24 hour storm for a 100 year period [see FSAR Section 2.3.1.2, excerpt attached and marked "B"]. The wind speed considered in conjunction with this snow load is the same wind speed of 45 mph considered in the ice loading condition discussed above in paragraph 10. The snow and wind load is applied to the siren package and the crane boom when the crane is fully extended. The calculated total weight of the snow is approximately 300 pounds. The gravity loads (i.e., deadweight and snow) are supported by the crane's

hydraulic system and the wind loads are supported by the crane boom's box section design. It should be recognized that the snow load on the truck would increase the vehicle's counterweight and thereby increases the vehicle's overall stability. For any appreciable wind speed the snow load will become negligible.

13. A review of the three loading conditions discussed in paragraphs 10, 11 and 12 above concluded that the high speed wind load conditions would be the governing loading condition for the design of the VANS vehicle truck-crane combination. Design forces developed for this condition are considerably higher than the forces developed for the load conditions discussed in paragraphs 11 and 12.

14. As indicated above in paragraph 7, the forces developed for the high speed wind conditions were provided to to be used in the detailed analysis of a mounted to a truck to determine the crane's adequacy to lift and support the siren package for the wind loads.

15. The wind loads were applied to the siren package and the crane boom when the crane is fully extended. Both wind loading conditions (i.e., 51 mph with 61 mph gusts and 60 mph with 72 mph gusts) were analyzed. The gust wind loads were treated as steady-state (i.e., constant) wind loads in the analysis. In addition, the code provisions to increase allowable stresses for gust wind

conditions were not used. The wind was applied perpendicular to the boom's axis (weakest boom design properties) with the siren facing into the wind (the largest wind sail area). In order to assure that the crane design would be well within code allowables, some minor modifications to the standard designs of the turret and the boom foot pin were made.

16. Based on my review of the analysis, I concluded that the VANS vehicle truck-crane combination will raise and support the siren package in the raised position under the wind loads described in paragraph 15 *supra*.

17. In addition to the analysis described above, early during the design concept phase of the VANS vehicle, a wind pull test was performed on a hydraulic crane, which is an earlier version of the crane used in the VANS vehicle. The purpose of this test was to determine the feasibility of the truck-crane combination to withstand projected high speed winds on the order of 51 mph. No structural or stability deficiencies were observed during and after the pull test. As such, this testing provides additional assurance that the VANS vehicle will not fail when subjected to high speed wind conditions.

18. As discussed in the following paragraph, the siren support, which supports the siren package off the crane boom tip has also been designed to withstand the loads imposed by

environmental conditions (e.g. wind, ice and wind, snow and wind) and therefore will not fail structurally.

19. An analysis was performed under my direction to demonstrate the adequacy of the siren support when subjected to the design wind load conditions which govern the structural design of the siren support. The results of this analysis demonstrate that, for both design wind conditions, the applied stresses on the siren support components were below code allowable stress limits. As discussed in paragraph 15 above, the gust wind loads were treated as steady-state (i.e., constant) wind loads and the code provisions to increase allowable stresses for gust wind conditions were not used.

20. As provided in the following paragraphs, the crane has sufficient capacity to lift the siren package under varying weather conditions.

21. The calculated weight of the siren package (i.e., dual sirens, rotor, support and electrical cables) is approximately 1400 pounds. The calculated total weight of ice when the crane is in the stored position is approximately 750 pounds. The combined weight of the ice load and the siren package is approximately 2150 pounds. The calculated total weight of snow when the crane is in the stored position is approximately 1000 pounds. The combined weight of the snow load and the siren package is approximately 2400 pounds.

Based on this, the maximum design load the crane could be expected to lift is approximately 2400 pounds.

22. As described in paragraph 4, this load will be lifted with the outer two boom sections fully retracted, from the stored position, to the 80' position. The hydraulic crane's rated capacity to lift this load from the stored position on the truck is 5200 pounds. As also described in paragraph 4, this load is next lifted to its maximum height by means of extending the outer two boom sections. The rated capacity of the hydraulic crane when fully extended at the 80' position is 6400 pounds. [See letter attached and marked "C".] Therefore, the crane boom has sufficient capacity to lift the siren package plus the design ice or snow loads from its stored position to the 80' fully extended position.

Basis A-6: Siren Operation in Snowy, Icy and Cold Weather Conditions

23. As provided in the following paragraphs, the extension of the sirens to their operational position will not be impeded by snowy or icy weather conditions.

24. From the discussions above in paragraphs 21-23, the maximum design load is considerably less than the rated capacity of the crane. It necessarily follows that this excess capacity of the crane is available to overcome the effects of any snow or ice that may have accumulated on the crane boom.

25. Furthermore, the rated capacity of the crane with just one of the outer boom sections extended at the 80'

position is 10,500 pounds, which is over four times greater than the maximum design load. Since extension of the two outer sections occurs after the first boom section has been raised to the 80' position, a force of at least 8,000 pounds is available to overcome the effects of accumulated snow or ice.

26. Based on the excess capacities available, extension of the crane boom will not be impeded by accumulation of snow or ice.

27. Based on the foregoing paragraphs, I have concluded that:

(a) the siren package will not fall when crane is raised and fully extended;

(b) the lifting mechanism will not fail structurally because of environmental loading conditions, such as wind, snow or ice;

(c) there will be no stability problems for the design wind loading conditions;

(d) The siren support will not fail structurally because of environmental loading conditions such as wind, snow or ice;

(e) the crane has sufficient capacity to lift the siren package, even when coated with ice equivalent to a weight of 1100 pounds, from its stored position to the fully extended 80' position;

(f) the excess crane capacity can handle accumulation of ice or snow without impeding the operation of the crane.

Donald E. Johnson

September __, 1988

The above-subscribed Donald E. Johnson appeared before me and made oath that he had read the foregoing affidavit and that the statements set forth therein are true to the best of his knowledge.

Before me,

Notary Public
My Commission Expires:

MARY T. BATTAGLIA, Notary Public
My Commission Expires September 16, 1994

Johnson Attachment A, 1 of 1

DONALD E. JOHNSON P.E.
Senior Mechanical Engineer

Education

B.S. Civil Engineering, Northeastern University, Boston, Massachusetts, 1974

M.S. Civil Engineering, Northeastern University, Boston, Massachusetts, 1979

Professional Memberships

American Society of Civil Engineers
American Institute of Steel Construction
American Concrete Institute

Experience

Mr. Johnson joined Yankee Atomic Electric Company in October 1983 as a Senior Engineer in the Mechanical Group of the Seabrook Project. He is a Registered Professional Engineer in the State of Massachusetts. He has sixteen years of experience in the structural design and analysis of building structures and support structures for building systems (piping, HVAC and electrical).

Previous to working at Yankee Atomic, Mr. Johnson worked for 5 years at CYGNA Energy Services, an engineering consulting firm in Boston and 6 years at Stone & Webster Engineering Corporation, an architectual/engineering firm also in Boston.

force. The site, therefore, may be affected by a hurricane, including associated heavy rainfall, high winds and high tides.

2.3.1.2 Regional Meteorological Conditions for Design and Operating Bases

a. Regional Climatological Data Stations

Figure 2.3-1 shows the locations of the Seabrook site and weather stations in the general area from which climatological data were obtained. The general location and type of data available from these weather stations are as follows:

Portland International Jetport National Weather Service Office (Portland NWS). This station is located about 59 miles north-northeast of the site just inland from the Atlantic Ocean and is a primary source of regional meteorological data for the site. The Portland NWS collects complete meteorological data on a continuous basis.

Boston Logan International Airport National Weather Service Office (Boston NWS). This station is located about 38 miles south-southwest of the site on a land fill that extends into Boston Harbor, which is part of the Atlantic Ocean. It is a primary source of regional meteorological data on a continuous basis.

Concord Municipal Airport National Weather Service Office (Concord NWS). This station is located about 40 miles west-northwest of the site. The Concord NWS collects complete meteorological data on a continuous basis.

Pease Air Force Base Air Weather Service Station (Pease AFB). This station is located about 13 miles north-northeast of the site in Portsmouth.

Instrumentation information regarding the above offsite NWS and military weather stations is presented in Table 2.3-1.

Data from the following cooperative weather stations was also utilized:

Portsmouth, New Hampshire. This station is located about 13 miles north-northeast of the site and is maintained by the Department of Public Works, a cooperative weather observer.

Rockport Massachusetts National Weather Service Climatological Station. This station is located about 27 miles southeast of the site. This station collects daily maximum and minimum temperature and precipitation data.

Sanford Maine National Weather Service Climatological Station. This station is located approximately 35 miles north of the site. Daily maximum and minimum temperature and precipitation data are recorded at this station.

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Johnson Attachment B, 2 of 12

Greenland New Hampshire National Weather Service Climatological Station. This station is located about 7 miles north of the site and collects daily maximum and minimum temperature and precipitation data. 53

b. Regional Severe Weather Climatology

1. Hurricanes

Atlantic hurricanes are most common during late summer and early fall. During the period 1871-1977, approximately 43 tropical cyclones passed within 100 nautical miles (115 statute miles) of the site. Of these, 22 storms were classified as hurricanes, and only 3 retained full hurricane state within 100 nautical miles of the site (Reference 2).

Tropical storms or hurricanes that reach the New England area usually pass northward west of the site or on a northeast track south of the site. Since, to date, the only hurricanes or tropical storms to reach the Seabrook area have had to travel a substantial distance overland, the potential impact of such storms is significantly reduced. Potential impact is usually confined to the effects of high tides and heavy rainfall (Reference 1).

2. Tornadoes and Waterspouts

Tornadoes have occurred in all the New England States. The mean annual number of tornadoes per 10,000 square miles for the period 1953-1976 in New Hampshire, Maine and Massachusetts are 2.5, 0.8 and 5.2, respectively (Reference 3).

A National Severe Storms Forecast Center (NSSFC) listing of tornadoes within a 50 nautical mile radius of the site indicates that 69 tornadoes occurred during the period 1950 through 1977, with a mean path area of 0.124 square miles (Reference 4). 56

Thom (Reference 5) has developed a procedure for estimating the probability of a tornado striking any point from an analysis of mean path length and width and the frequency of tornado occurrence in the area. Applying Thom's procedure to the NSSFC data gives an annual probability of a tornado striking any point within 50 miles of the site of 7.8×10^{-5} with a mean recurrence interval of about 12,900 years. (The calculation excluded the water area within the area of interest.)

In spite of the low probability of a tornado occurrence, seismic Category I structures at the Seabrook site, except for the refueling water tank spray additive tank enclosure and cooling tower, are designed to withstand the "Standard Tornado" as described in NRC Regulatory Guide 1.76 (Reference 6). This design basis tornado has the following characteristics:

(a) A maximum wind speed of 360 miles per hour

(b) A rotational speed of 290 miles per hour

(c) A maximum translational speed of 70 miles per hour

(d) A minimum translational speed of 5 miles per hour

(e) A radius of maximum rotational speed of 150 feet

(f) A pressure drop of 3.0 pounds per square inch

(g) A rate of pressure drop of 2.0 pounds per square inch per second

In an analyses of waterspout occurrences using Storm Data Reports (1959-1973) and ship log reports (1850-1940), a total of 14 waterspouts were reported off the coast between Boston and Portsmouth of which 3 were considered to have caused coastal damage (Reference 7). A waterspout coming ashore and striking the site would not have a destructive effect greater than that of a tornado. This is based on the wind speed of a waterspout not being greater than the design basis tornado of Regulatory Guide 1.76. With exactly the same wind speeds, it is concluded that a waterspout would be less destructive than a tornado as it would contain less solid debris than a tornado that had been traveling overland.

(3) Thunderstorms, Lightning and Hail

Table 2.3-1a shows the mean number of days with thunderstorms for various weather stations in the general Seabrook area. 53 Thunderstorms have occurred during every month of the year, with the maximum during the summer. Pease AFB data can be considered most representative of the Seabrook site, showing a thunderstorm frequency of about 19 per year with a maximum monthly mean of about 5 in July (Reference 11).

Using the thunderstorm frequencies shown in Table 2.3-1a for Pease AFB and statistics relating to thunderstorm occurrence and to the probability of cloud-to-ground lightning as presented by Viemeister (Reference 12), estimates of the frequency of occurrence of cloud-to-ground lightning were derived for the site on a seasonal and annual basis for objects extending 53 to heights of 50, 100, 200 and 500 feet above grade. These results are provided in Table 2.3-2.

Marshall (Reference 12a) presents an alternative methodology for estimating lightning strike frequencies which includes consideration of the attractive area of structures. Marshall's method consists of determining the number of lightning flashes to earth per year per km^2 and then defining an area over which the structure can be expected to attract a lightning strike. Assuming that there are 0.135 flashes to earth per thunderstorm days per km^2 near the Seabrook site (Reference 12a) and that the Seabrook site experiences 19 thunderstorm days per year (Pease AFB data, Table 2.3-1a), there are approximately 2.57 flashes to earth per year per km^2 around the Seabrook site 56 area. If the length of a structure is L, its width W, and its height H, Marshall defines the total attractive area A of that structure for lightning flashes with a current magnitude of 50% of all lightning flashes as:

$$A = LW + 4H (L + W) + 12.57 H^2$$

The following building complex dimensions were used to conservatively estimate the attractive areas: 53

Unit #1: L = 200m, W = 120m

Defined roughly by a rectangle outlined by the turbine building, administrative building, fuel storage building, and containment structure.

H = 56m

Defined by the height of the primary vent stack.

$A = 0.135\ km^2$

Unit #2: L = 200m, W = 90m

Defined roughly by a rectangle outlined by the turbine building, control building, tank farm areas, primary auxiliary building, fuel storage building, and containment structure.

H = 56m

Defined by the height of the primary vent stack.

$A = 0.122\ km^2$

Lightning strike frequencies computed using Marshall's methodology are given as 0.35 and 0.31 flashes/year, respectively, for both Unit 1 and Unit 2. 56

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Table 2.3-3 lists the total number of days with hail over a 40 year period for Boston, Portland and Concord. The data indicate that, on the average, the site should expect less than one day per year with hail (Reference 13). Hailstorms in the Seabrook area are seldom severe, although large hail has been reported. During the 13 year period between 1955 and 1967, an average of 0.2, 0.6 and 1.3 storms per year with hailstones 1.5 inches in diameter or larger have been reported for New Hampshire, Maine and Massachusetts, respectively (Reference 14).

(4) Strong Winds

Table 2.3-4 lists the fastest mile wind speeds recorded at Boston, Portland and Concord. The data indicate that wind speeds over 40 mph can occur during any month of the year. During the winter these speeds are normally caused by northeasters that move up along the coast. During the warmer months, high winds are normally associated with thunderstorms and squall lines that pass through the area. Hurricanes could produce high wind speeds during the late summer and early fall.

Thom (Reference 15) plotted isotachs of annual extreme-mile wind speeds at 30 feet above ground for several recurrence intervals across the United States. Table 2.3-5 shows the annual extreme-mile wind speeds derived from Reference 15 for the Seabrook site for four recurrence intervals and indicates a sustained 95 mph wind speed can be expected with a 100 year recurrence interval. Other studies (References 15a, 19), which also plotted isotachs for fastest mile of wind at 30 feet above ground across the United States, indicate a fastest mile of wind for a 100 year probable period of recurrence of 110 mph and 100 mph, respectively, for the Seabrook site.

The more conservative value of 110 mph is used as the 100 year period of occurrence design wind velocity for seismic Category I structures at 30 feet above ground. The vertical wind velocity profile and the appropriate gust factor used for seismic Category I structure wind loading analyses are discussed in Section 3.3.1.

(5) Snowload

The American National Standards Institute, Inc. (ANSI) gives the 100-year recurrence interval snow load on the ground in the Seabrook area as 42 pounds per square foot (Reference 19). The maximum 24-hour precipitation amount observed in the site during the snow season (November through April) is 5.4 inches of water, as shown in Table 2.3-17. From this value, a conservative 48-hour probable maximum snowfall is defined as having twice the water content of the maximum 24-hour storm, or 10.8 inches. As required by Regulatory Guide 1.70 (Reference 20), the Probable Maximum Winter Precipitation was determined, which resulted in a 48 hour precipitation of 16.1 inches (Reference 21). Assuming this amount of precipitation fell on top of the 100 year recurrence interval snow pack of 42 psf, as given by ANSI, it would result in a compacted snow load of 125.7 psf. This is considered an "unusual" load condition as described in Chapter 3. Roof loading for safety-related structures due to precipitation, including ice, snow and rain, are discussed in Subsection 2.4.2.3.

The February 6-8, 1978 snowstorm which struck New England was one of the most intense, persistent, severe winter storms on record (Reference 22). The highest melted precipitation associated with the storm was 4.55 inches reported at Pembroke, Massachusetts (Reference 16). The New England climatologist, Robert E. Lautzenheiser, had previously stated that the February 23-28, 1969 snowstorm was probably the worst storm in 100 years. The highest melted precipitation associated with the storm was 4.62 inches reported at Rockport, Massachusetts. The 4.62 inch value is equivalent to a snowfall load of 24 psf. When this is combined with the 100 year probable maximum snowpack of 42 psf, it results in a total snow load on the ground of 66 psf.

(6) Ice Storms

Freezing precipitation, or glaze ice, does occur in the Seabrook area. Data for freezing rain at Portsmouth (Reference 23) are presented in Table 2.3-6. Mapped data for the period 1928 to 1937 indicates that the site averages 2-3 ice storms per year. For the nine year period of study, about 12 storms occurred resulting in ice with a thickness of 0.25 inch or more, of which about 6 storms had ice of 0.5 inch or more (Reference 24). More recent mapped data for the period of 1950 to 1969 (Reference 25), indicates that the site averages about 8 ice storms per year.

(7) High Air Pollution Potential and Mixing Heights

The Seabrook site is not in an area of frequent air pollution episodes or alerts. A study of synoptic weather map analysis for 1936 through 1975 shows high pressure stagnation conditions lasting four days or more over the site occurring 12 times with an average of 4.4 stagnation days per case (Reference 26).

Holzworth (Reference 27) analyzed five years of data to determine occurrences in the United States of episodes of meteorological conditions unfavorable for atmospheric dispersion. Holzworth indicated episodes of high air pollution potential as periods with low mixing depth and light winds. A summary of the Holzworth data as it applies to the site appears in Table 2.3-7. The data indicate that prolonged periods with a combination of low wind speed and low mixing height are uncommon in the site area.

Holzworth (Reference 27) also plotted isopleths of mean seasonal and annual morning and afternoon mixing heights across the United States from the same five years of data. For the Seabrook site, the seasonal and annual values of the mean daily mixing heights occurred as follows:

Mean Daily Mixing Heights

Season	Morning	Afternoon
Spring	710 m	1400 m
Summer	450 m	1400 m
Autumn	590 m	1100 m
Winter	700 m	900 m
Annual	600 m	1200 m

The above data represent estimates of the average depth of vigorous vertical mixing, which give an indication of the vertical depth of atmosphere available for mixing and dispersion of effluents.

(8) Ultimate Heat Sink

Data collected at Pease AFB for the 10 year period 1961-1970 and at Boston NWS for the 29 year period 1945-1973 were used to evaluate the performance of the Ultimate Heat Sink with respect to maximum evaporation and drift loss, and minimum water cooling.

Maximum evaporative and drift loss was defined to occur during periods of large differences between the ambient dry bulb and wet bulb temperatures. The functioning of the ultimate heat sink cooling tower has been analyzed under the condition of the maximum 30 day average hourly difference between dry bulb and wet bulb temperatures. Data from Pease AFB and Boston NWS shows that the maximum 30-day average hourly difference between dry bulb and wet bulb temperatures occurred as follows:

30-Day Average Maximum Dry Bulb Minus Wet Bulb Difference

Location	Starting Date	Average Dry Bulb	Average Wet Bulb	DB-WB Difference
Pease AFB	6/19/64	64.7°F	55.0°F	9.7°F
Boston NWS	7/28/57	73.9°F	63.4°F	10.5°F

Minimum heat transfer to the atmosphere was defined to occur during periods of high wet bulb temperature. For the purpose of the ultimate heat sink cooling tower analysis, a review of meteorological data from Pease AFB and Boston NWS showed that the maximum average wet bulb temperature for a 24-hour and a 30-day period of record occurred as follows:

Maximum Wet Bulb Temperatures

	24-Hour Average		30-Day Average	
Location	Date	Average	Starting Date	Average
Pease AFB	6/16/68	74.6°F	7/22/70	67.2°F
Boston NWS	8/17/59	75.5°F	8/21/55	59.4°F

A review of the above meteorological data analyses led to the design parameters for the ultimate heat sink cooling tower. These design parameters include 10.5°F for the tower dry bulb minus wet bulb difference and 75°F for the tower wet bulb temperature (see Section 9.2.5).

2.3.2 Local Meteorology

2.3.2.1 Normal and Extreme Values of Meteorological Parameters

Monthly and annual summaries of meteorological parameters from long-term data stations representative of the area are presented in this section. Summaries of on-site meteorological data collected at Seabrook from November 1971 through March 1973 are also provided in this Section and in Appendix 2A. A new onsite meteorological tower has been erected at the same location as the old tower and became fully operational in April 1979. Data summaries from this new tower for the time period April 1979 through March 1980 are presented in Appendix 2B.

a. Wind

Wind roses for the four seasons and 12 month period (November 1971-October 1972) of collected on-site data are provided in Figures 2.3-2 through 2.3-6, respectively. The data indicate that westerly through northwesterly winds predominate during most of the year. During the summer months, southwesterly through west-northwesterly, and east-southeasterly through south-southeasterly winds are prevalent. Wind direction persistence summaries for 22.5 and 45.0 degree sectors are presented in Appendix 2A.

Seasonal and 12 month period wind roses collected onsite from the new onsite meteorological tower (April 1979-March 1980) are provided in Appendix 2B. Wind direction persistence summaries for this same period are also provided in Appendix 2B.

b. Temperature

Tables 2.3-8 through 2.3-13 present long-term mean and extreme temperature values for a number of stations in the Seabrook area. Portsmouth data can be considered representative of long-term Seabrook temperatures. Monthly onsite mean and extreme temperature values for the time period April 1979 through March 1980 are presented in Appendix 2B.

Extremes of temperature are uncommon due to the proximity of the site to the Atlantic Ocean. During the winter, arctic air masses passing through New England can produce low minimum temperatures, but the frequency and persistence of such extreme values along the coast is less than for stations located farther inland. During the spring and summer a seabreeze usually moderates temperatures from reaching high extremes at the site.

Detailed analyses have determined that the highest hourly temperature recorded during the period 1957 through 1981 at Pease AFB (Portsmouth, NH) was 101°F on July 1, 1964 (hour 13). The hottest contiguous 24-hour period containing this temperature extended from June 30 (hour 15) through July 1 (hour 14). The hourly temperature progression for this period is provided in Table 2.3-13A. Hourly temperature data associated with the five hottest and five coldest 24-hour average temperatures recorded at Pease AFB in the period 1957 through 1981 are given in Table 2.3-13B. 53

An additional statistical analysis (Reference 27A) of extreme temperature data collected at nearby weather stations (Pease AFB), climatological stations (Rockport, MA, Sanford, ME, and Greenland, NH) and at the Seabrook site results in 100 year return period maximum and minimum hourly temperatures for the Seabrook site of 102°F and -21°F, respectively. (These values were computed following the methodology found in NUREG/CR-1390).

Since the design of certain equipment is dependent upon the maximum and minimum temperatures averaged over time periods greater than one-hour, 100-year return period extreme temperatures for 2, 4, 8, 12, and 24-hour averaging periods were also determined. These values are listed below:

	100 Year Return Period Temperature (°F)	
Averaging Period	Maximum	Minimum
2-Hour	102	-21
4-Hour	101	-21
8-Hour	99	-20
12-Hour	96	-19
24 Hour	89	-16

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c. Atmospheric Water Vapor

Long-term mean monthly relative humidity statistics at Pease AFB are provided in Table 2.3-14. Onsite dew point statistics for the period April 1979 through March 1980 are provided in Appendix 2B.

Joint frequency distributions of the on-site moisture deficit have been prepared for each stability category and wind direction.

Those data from April 1972 through March 1973 are presented in detail in Appendix 2A.

d. Precipitation

On the average, the Seabrook area has about 129 days per year with measurable (0.01 inch or more) precipitation, as indicated in Table 2.3-15. Table 2.3-16, which shows mean monthly and annual precipitation amounts indicates that monthly precipitation is equally distributed over the year, with mean monthly amounts generally between 2.7 to 4.6 inches. The site can expect an annual precipitation of about 43 inches.

Summer rainfall is caused primarily by thunderstorms and convective shower activity. Precipitation during the rest of the year generally results from the passage of low pressure systems. During the colder months of the year, intense coastal storms or northeasters move northeastward along the New England coast, usually affecting coastal locations with heavy rain or snow and on occasion, ice storm conditions. Occasionally during the summer or fall, a storm of tropical origin will cause substantial rainfall and high winds in the vicinity of the site.

Precipitation extremes for area stations are presented in Tables 2.3-17 through 2.3-20. Based on the Portsmouth data, a maximum monthly precipitation amount of about 14 inches and a maximum 24 hour precipitation amount of about 7 inches could be expected at the site.

While periods of prolonged drought are not common, dry spells do occasionally occur. March 1915 and October 1924 were particularly dry, as indicated in Table 2.3-20.

Snow falls in the site area as early as November and as late as April. Mean snowfall statistics for the area, Table 2.3-21, indicates that the site can expect an annual snowfall of about 72 inches. Maximum snowfall data are presented in Tables 2.3-22 and 2.3-23, which suggest a maximum 24 hour snowfall of about 22 inches and a maximum monthly snowfall of about 54 inches, based on Portsmouth data.

The ground is normally covered with snow from late December until well into March, although it may remain bare for several weeks during this period in a milder winter. A continuous snow cover of at least one inch lasts 30 to 45 days in a usual winter, but continued for 87 days in the snowy winter of 1955-1956. The average maximum snow depth is about 18-24 inches (Reference 23).

e. Fog

The proximity of the ocean is an important factor in fog occurrence at the site. During the spring and summer months, fog forms offshore as warm, moist air flows over the relatively cold ocean water. With any persistent eastern component in the wind direction, the fog that often lies just offshore during the warmer months can reach the Seabrook site. This situation is supported during the summer by local heating and a resulting seabreeze.

Table 2.3-24 provides information on the mean number of days with heavy fog at surrounding stations. Based on Pease AFB data, Table 2.3-25, all months of the year have a fairly consistent frequency of occurrence of fog. Although fog at Pease AFB occurs about 15% of the time, it is dense enough to restrict visibility to 1 mile or less only about 3.5% of the time (Reference 23). Table 2.3-26 lists the mean number of hours with visibility less than 0.5 miles.

Statistics on fog persistence at Portland are presented in Table 2.3-26a for the 10-year period (1968-1977). Table 2.3-26a indicates that durations of periods of fog lasting 48 hours or longer can occur several times a year. 44

f. Atmospheric Stability

Joint frequency distributions of Pasquill stability class by the temperature difference (delta-T) method are presented in Appendix 2A and Appendix 2B. Summaries of atmospheric stability persistence are also provided in both Appendices. The onsite data from the new meteorological tower indicate that from April 1979 through March 1980 unstable, neutral, and stable conditions occurred as follows:

Frequency of Stability Classes

Stability Classification	43'-150' Delta-T	43'-209' Delta-T
Unstable (A,B,C)	21.1%	12.7%
Neutral (D)	41.5%	43.3%
Stable (E,F,G)	37.3%	44.0%

2.3.2.2 Potential Influence of the Plant and Its Facilities On Local Meteorology

A map is presented in Figure 2.3-7 which shows the topography within a five-mile radius of the site. Maximum elevation with distance is plotted in Figure 2.3-8 for each of 16 sectors radiating from the plant site. The heights shown in these cross sections are for the highest representative terrain at that distance in the sector, and not necessarily the exact height at the precise bearing and distance shown.

The immediate site area is tidal marsh with short grass, reeds and tidal channels. Short trees begin at the edge of the marsh as the terrain becomes slightly irregular A few short ridges and hills occur within the first five miles from the site.

A map showing detailed topographic features within a 50 mile radius of the site is presented in Figure 2.3-1. The first hills and ridges of the White Mountains of New Hampshire occur 20-25 miles northwest, west and southwest of the site. Hilly terrain with peaks between 200 and 500 feet are found 25 to 40 miles from the site.

The plant is not expected to cause any significant influence on the local meteorology as cooling towers or spray ponds are not planned for normal operations.