2.1 GEOGRAPHY AND DEMOGRAPHY

2.1.1 Site Location and Description

2.1.1.1 Specification of Location

The site property consists of approximately 889 acres near the northern boundary of the town of Seabrook, Rockingham County, New Hampshire. The site is situated about 8 miles southeast of the county seat of Exeter; 5 miles northeast of Amesbury, Massachusetts; and 2 miles west of Hampton Harbor inlet. The site is bordered on the east by an extensive saltwater marsh and is located on a point of land called "The Rocks," between two small tidal estuaries, the Brown's River and the Hunt's Island Creek. The center of the Boston metropolitan area is approximately 40 miles south-southwest of the site. Figure 2.1-1 shows the site location in relation to principal cities and towns within a 50-mile radius.

Geographical coordinates of the reactor unit are as follows:

	Latitude and Longitude	Universal Transverse Mercator Coordinates
Unit No. 1	N 42° 53' 55.4" W 70° 50' 58.7"	4751005 m N (Zone 19) 348994 m E

2.1.1.2 Site Area

Figure 2.1-2 shows major transportation arteries and prominent natural features within 10 miles of the site. The details of the area within 5 miles of the site are shown on Figure 2.1-3. The site property plan, showing the site boundary and the location and orientation of principal structures within the site, is shown on Figure 2.1-4 and Figure 2.1-5. The site boundary will also be the exclusion area, as defined in 10 CFR Part 100. The minimum exclusion radius is 3000 feet measured from the center of the Containment Building to the nearest property line.

There are no industrial or recreational facilities located within the site boundary. There are no residential homes within the 3,000-foot exclusion radius measured from the center of the Unit I Containment Building. However, New Hampshire Yankee operates a public information center (Science and Nature Center) onsite approximately 1500 feet southwest of the reactor.

2.1.1.3 Boundaries for Establishing Effluent Release Limits

The boundary for establishing gaseous effluent release limits is the site boundary. The area within that boundary consists of:

a. Land and marsh surface area above the mean high water line

b. Two tidal streams, Brown's River and Hunt's Island Creek, which are public waterways of the State of New Hampshire.

The area referred to in a. above consists of real property with ownership as described in Updated FSAR Subsection 1.2.1.2. Public Service Company of New Hampshire has full legal right to control access to that area for all purposes. The area referred to in b. above consists of two tidal streams, both of which are virtually dry at low tide. While the public has the right to use these waters for boating and fishing, the actual occupancy rate is necessarily low and of short duration because of the small size and tidal nature of these streams which make them impassable at low tide. Numerous observations, as described in Subsection 2.1.3.3e.3, of boating activity on these streams during the summer boating season has shown no significant use with only an occasional boat passing through the 3000-foot exclusion area.

Access to the area within the site boundary is controlled by signs at normal access points, e.g., Rocks Road, the main access road, and Brown's River and Hunt's Island Creek, and by visual observation where practical. The presence of individuals within the site boundary who are using the public waterways would necessarily be of short duration because of the tidal nature of these waterways.

Figure 2.1-4 shows the location of the site with respect to adjacent bodies of water and the distance from the plant's gaseous effluent vent located on top of the Reactor Containment Building to the nearest point on the site boundary in all directions.

All liquid radwaste effluents are discharged from the station to the Atlantic Ocean via a submerged multiport diffuser beginning approximately 1.1 miles off Hampton Harbor inlet. The concentration of all radioactive liquid effluents at the point of discharge from the diffuser will be below the limits specified in the Offsite Dose Calculation Manual (ODCM). The dose objectives of Appendix I to 10 CFR Part 50 will be met at the edge of the initial mixing area where the effluents have undergone immediate mixing (prompt dilution) only.

The radioactive releases expected for normal operation of the station are given in Subsections 11.2.3 and 11.3.3.

2.1.2 Exclusion Area Authority and Control

2.1.2.1 Authority

As shown in Figure 2.1-4, the exclusion area for the Seabrook site is the site boundary. The area within the site boundary will provide a minimum distance from the Containment Building to the site boundary of 3000 feet. The exclusion boundary presently includes, in addition to lands owned by the Public Service Company of New Hampshire, the following:

a. A section of railroad track owned by the Boston and Maine Railroad

b. A section of power transmission line owned by the Exeter and Hampton Electric Company

c. Portions of the Brown's River and Hunt's Island Creek.

The Boston and Maine Railroad line, which approaches within about 2100 feet of the reactor containment, is not used for passenger service, and is used only infrequently for freight service. The line is currently terminated to the south by an inoperable bridge between Newburyport, Massachusetts and Salisbury, Massachusetts. Provisions have been made with the Boston and Maine Railroad to control traffic on the railroad right-of-way passing through the site in case of an emergency.

The power transmission line passing through the site is owned by the Exeter and Hampton Electric Company. The line is routed overhead outside of the protected area north of the site (Figure 2.1-4). Provisions have been made with the Exeter and Hampton Electric Company to control access to the right-of-way in case of an emergency.

The control of traffic in case of an emergency on those portions of the Brown's River and Hunt's Island Creek that fall within the exclusion area comes under the authority of the director of the New Hampshire Office of Emergency Management.

2.1.2.2 Control of Activities Unrelated to Plant Operation

Other than transit through the exclusion area by the Boston and Maine Railroad, and infrequent boat traffic along the Brown's River and Hunt's Island Creek, along with the access to Brown's River provided by Rocks Road the only activity on the site which is not directly related to plant operation is the Science and Nature Center located about 1500 feet southwest of the plant.

The Science and Nature Center is open specific hours and provides a focal point for the general public to become familiar with nuclear power and Seabrook Station. It is not expected that more than a few hundred people would normally be present at the Science and Nature Center at any one time.

Access to the center is via the main access road off of Route 1. It is expected that, upon notification, individuals in the Science and Nature Center could be moved to beyond the exclusion boundary in less than fifteen minutes.

2.1.2.3 Arrangements for Traffic Control

A letter agreement has been reached with the Seabrook Station Emergency Response Organization and the State of New Hampshire so that in case of an emergency, the State of New Hampshire will notify the Boston and Maine Railroad to prohibit rail traffic through the exclusion area.

2.1.2.4 Abandonment or Relocation of Roads

The existing Rocks Road will be abandoned approximately 1200 feet west of the Boston and Maine Railroad track. Relocated Rocks Road will be accessible from the north plant access road off of U.S. Route 1 at a point near the permanent Guardhouse. It will traverse parallel to the plant fence in an east and then southeast direction to the Rocks Road dock.

2.1.3 Population Distribution

Data from numerous sources were used in developing distributions and projections of permanent resident and transient populations within 50 miles of the Seabrook site. This area includes portions of New Hampshire, Massachusetts, and Maine. Each data source is identified in the applicable section. Census data from 1970 and more recent years, where available, have been used in this activity.

2.1.3.1 Permanent Population within 10 Miles

The area within 10 miles of the site includes portions of the states of New Hampshire and Massachusetts. Table 2.1-1 lists municipalities in each state which are located wholly or partly within 10 miles of the site. Also, shown on Table 2.1-1 are the 1970 resident population and estimated permanent resident populations for 1980 and 1983. Figure 2.1-2 is a map of the area within 10 miles of the site. Concentric circles have been drawn at radii of 1, 2, 3, 4, 5, and 10 miles, centered among plant structures approximately 250 feet southwest of the Containment Building. The circles have been divided into twenty-two sectors with each sector centered on one of the 16 cardinal compass points. The population distribution has been developed for each area formed by the series of concentric circles and radial lines.

Figure 2.1-6 and Figure 2.1-7 shows the projected resident population distribution within 10 miles of the site for the years 1983 and 2025, respectively. These times are the estimated year of Unit 1 startup and the approximate end of the life of the facility. Table 2.1-2 breaks down the resident population by segment for the two dates stated above and for the census decades between 1980 and 2020. This table also presents cumulative populations for annular rings and for radial distances. Those subdivisions of Figure 2.1-6 and Figure 2.1-7 and Table 2.1-2, which show a zero resident population, indicate an uninhabited area or water.

The distribution of the permanent resident population for 1983 within 5 miles of the site was determined using population projections and residential electric meter use data for 1978 and 1979, a mosaic of aerial photographs taken in July 1978, and the results of a field survey performed in December 1978. The procedures that were used are described below.

Within 1.25 miles of the site, the current resident population was estimated from an aerial photomosaic supplemented by a count of houses made during a field survey conducted in December 1978. An average household occupancy factor based on the 1970 U.S. Census of Housing data was applied. The rates used were 3.25 persons per household for Seabrook and 3.75 persons per household in Hampton Falls (Reference 1).

A second method was used to determine the population distribution within the 5-mile radius. A system of concentric circles and radial lines were superimposed on a map of electric meter reading routes (or pattern areas) within towns included within the 5-mile radius of Seabrook Station, excluding a small portion of North Hampton located between 4½ and 5 miles north of the site. For those communities within the 5-mile radius of the site, the residential electric meter data provided the basis for allocation of both the current and projected future resident populations to the defined sectors. First, portions of meter reading routes were assigned to the various sectors and counts of residential electric meters were made. Counts were made from electric use data collected over an extended record period (12 months) during 1978 and 1979. Table 2.1-3 provides a summary of the total residential living units based on counts of electric meters by town as well as estimates of those associated with seasonal and year-round residences. The proportion of year-round residential meters in a pattern to those included within an entire town was determined. These same proportions were used to distribute the permanent population estimates within the 5-mile radius for each of the above noted years. For that portion of North Hampton within the 5-mile radius, an equal area allocation approach was used to distribute the projected resident population since electric meter information was not available. Growth rates described below were used to project the population for 1983 and later years.

The distribution of population in the area between 5 and 10 miles from the site was made by area allocation in conjunction with review of local USGS maps. The fraction of a town's populated areas within each sector defined by the grid of concentric circles and radial lines was determined. The same fraction of each town's population was assigned to that segment.

The projected populations for towns in New Hampshire through the year 2000 were obtained from the report, "Interim Revisions - New Hampshire Population Projections for Towns and Cities to the Year 2000" (Reference 2). This document, dated August 1977, was prepared by the New Hampshire Office of Comprehensive Planning. The interim revisions were issued to account for observed trends that did not conform to the population projections made in 1975. Consequently, updated projections for southeastern New Hampshire, which includes the towns around the site, were included in the interim revisions. The projections were made by a three-step procedure. The steps include (1) statewide population forecasts by age and sex, (2) regional forecasts by age and sex, and (3) town and city total population forecasts.

The state and regional projections account for population changes over time resulting from births, deaths, and net migration. Fertility, survival, and net migration rates were developed from historic data and anticipated trends.

The population was allocated on the basis of a relative growth index. The index accounts for (1) the potential saturation population of the town, (2) its accessibility to nearby urban centers, and (3) its competitive advantage for attracting growth as compared to the region's other towns. Populations of towns for periods after the year 2000 were estimated by assuming the same rate of change in population projected to occur between 1990 and 2000.

The future populations of Massachusetts towns were taken from two sources. A town-by-town projection was prepared for 1980 and 1985 by the Massachusetts Office of State Health Planning (Reference 3). The methodology is similar to that described above for the New Hampshire projections with the exception that birth, death, and net migration rates were estimated on a town-by-town basis. Reference 4 describes the methodology in detail. For the years 1990 and 2000, the projected change in population is based on the estimates of the Bureau of Economic Analysis (Reference 5). These projections have been developed for individual states. For time periods beyond 2000, the projected growth rate from 1990 to 2000 was used.

2.1.3.2 Permanent Population between 10 and 50 Miles

The 50-mile radius around the site includes portions of New Hampshire, Massachusetts, and Maine. Concentric circles have been drawn with radii of 10, 20, 30, 40, and 50 miles centered on the site. The circles have been divided into twenty-two sectors with each sector centered on one of the 16 cardinal compass points. The population distribution has been developed for each area formed by the series of concentric circles and radial lines.

Figure 2.1-8 and Figure 2.1-9 shows the projected resident population distribution within 50 miles of the site for the years 1983 and 2025, respectively. Table 2.1-4 breaks down the resident population by sectors for the dates stated above and for census decades between 1980 and 2020. Those sectors on Figure 2.1-7 and Figure 2.1-8 and Table 2.1-4, which show a zero population, indicate uninhabited areas, primarily water.

The distribution of population in the area between 10 and 50 miles was made by equal area allocation.

The bases for projecting populations in cities and towns in Massachusetts and New Hampshire have been described in the previous section. For cities and towns in Maine, 1980 population estimates were obtained from Reference 6. These projections are provided for use by local, regional, and state agencies for planning purposes. The projections are based on population trends between 1970 and 1975 observed in the municipality itself, the surrounding cluster of municipalities, and the county in which the municipality is located. For 1990 and 2000 projections, the rates of change were taken from the Bureau of Economic Analysis for the State

of Maine (Reference 5) and applied to the cities and towns. The rate of change between 1990 and 2000 was used to project for later times.

2.1.3.3 Transient Population

a. Seasonal Resident Population (0 to 10 miles)

The seasonal resident population has been estimated from the number of seasonal dwelling units in the area. The number and distribution of seasonal homes were based on a review of several sources of data including (1) 1961 general highway maps for Rockingham County, New Hampshire, (2) 1970 U.S. Census of Housing data on vacant seasonal and migratory units for towns within the 10-mile area, (3) 1978-1979 electric meter use data for New Hampshire towns within 5 miles (excluding North Hampton), (4) 1978 weekday/weekend occupancy survey of beach area housing, (5) 1978 aerial photography, and (6) 1979 telephone survey of town assessors and building inspectors. These data indicate that seasonal residential units are concentrated in the beach area sectors.

Figure 2.1-10 provides a current estimate and distribution of seasonal dwelling units within 10 miles based on annual electric use distribution patterns within 5 miles and 1970 U.S. Census of Housing estimates for the areas between 5 and 10 miles. Total seasonal residential units within the 5-mile radius of Seabrook Station are estimated at 4,013. Approximately 71 percent (2,843) of these units are located in the Seabrook-Hampton Beach area, 19 percent (755) in the Salisbury Beach area, and 10 percent in nonbeach areas. A comparison of the 1961 county highway map data (New Hampshire), 1970 Census data, and 1978-1979 electric meter use data indicated an increase in New Hampshire total units of about 22 percent between 1961 and 1970 and a 22 percent decrease between 1970 and 1978-79. Thus, more recent growth of seasonal units is believed limited in the vicinity of the site with the decrease in seasonal units, probably due to conversion of seasonal homes to year-round use. A 1978 survey of beach area housing indicated weighted average weekday and weekend occupancies per seasonal residents of 5.4 and 7.6 persons, respectively. Figure 2.1-11 and Figure 2.1-12 provides estimates of the respective current seasonal resident populations for typical summer weekday and weekend conditions within a 10-mile radius. It is estimated that approximately 30,555 persons are associated with the seasonal homes on a weekday and about 43,012 on a weekend day within 10 miles.

A 1979 telephone survey of personnel in the building inspector and town assessor offices for communities within the 10-mile study area was undertaken. The limited survey indicated that only small numbers of new seasonal dwelling units have been constructed in either the beach area or inland areas in recent years. In both the towns of Seabrook and Salisbury, the total number of seasonal dwelling units has decreased from 1970 to 1979 by approximately 400 and 200 units, respectively. These decreases were largely attributed to conversions of seasonal units to permanent, year-round units. In the town of Hampton, there has been an estimated increase of several hundred seasonal dwelling units between 1970 and 1979. Most other town officials surveyed commented that the total stock of seasonal units has remained relatively constant in the last few years.

b. <u>Overnight Accommodations (0 to 10 miles)</u>

Survey work was undertaken to determine the locations and estimated capacities of major overnight accommodations within 10 miles of Seabrook Station. Such accommodations included hotels, motels, and a number of guest houses. Information for the 0- to 5-mile area was based on survey work undertaken during the summer of 1978. The 5-to 10-mile information was developed as part of survey work during the summer of 1979. Several hundred facilities were identified with an estimated capacity of 11,024 within the 10-mile radius.

The majority of facilities surveyed were concentrated in the "beach area" and within the 5-mile radius. A total of 210 facilities were identified in the 0- to 5-mile study area with an estimated capacity of 10,019 people as compared to only 20 such facilities identified in the larger 5- to 10-mile study area with an estimated capacity of 1,005. Thus, 91 percent of the total overnight accommodation capacity is within a 5-mile radius of the site with the remaining 9 percent being located within the 5- to 10-mile study area. Approximately 82 percent of the total capacity within the 5-mile radius is found in the beach area, primarily in Hampton Beach.

Table 2.1-5 is a summary listing of accommodations identified during both the 1978 and 1979 survey periods. Information including sector location and capacity is noted in this table for each facility. Information on facilities was obtained from a variety of sources, including local telephone directories, tourist information brochures, and limited telephone and field survey work. Estimated peak overnight populations associated with hotels, motels and guest houses have been summarized on Figure 2.1-13 for a 10-mile radius.

c. Campgrounds

An inventory of both public and private campgrounds was made for the area within 10 miles of Seabrook Station. Table 2.1-6 summarizes information collected on this subject. Information on location, number of campsites and estimated capacity of surveyed camping facilities is included in the table. Figure 2.1-14 summarizes the distribution of the estimated capacity of the camping population for the 10-mile study area. A total of 17 facilities with an estimated capacity of about 7,648 was identified as part of this inventory. Six of these facilities, with a total estimated capacity of approximately 3,160 campers, are located within a 5-mile radius.

Several sources were consulted to assemble campground information for the New Hampshire and Massachusetts portions of the 10-mile study area. References included local telephone directories, 1979 New Hampshire Camping Guide, 1977 New Hampshire Outdoor Recreation Plan, New Hampshire Campground Owner's Association Guide - 1979, Massachusetts Department of Environmental Management's Space Inventory - 1978, Camping in Massachusetts (Division of Tourism), Massachusetts Department of Commerce and Development, and Massachusetts Outdoors - 1978 Massachusetts Department of Environmental Management. Limited field observations (Exeter, Kingston, Hampton Falls, North Hampton, and Seabrook) and telephone communications (Rye and Exeter) with local town offices provided additional information on camping facilities.

d. Beach Area Daily Transient Population

1. Parking Lot Capacity Estimates

A substantial daily transient population during the summer period is associated with the beaches and other recreational facilities in the vicinity of Seabrook Station. The coastal beaches within 10 miles of Seabrook Station extend from the Plum Island Beach in Newbury, Massachusetts to Wallis Sands Beach in Rye, New Hampshire. The beaches are generally readily accessible to the public in this area. Estimates of available parking spaces in the beach area provided the basis for estimating this daily transient population category since the majority of daily transients are assumed to arrive by automobile. During the summers of 1978 and 1979, beach area parking lots were identified by field inspection. Capacity estimates were developed from interviews with parking lot operators and by review of current aerial photography of the beach area parking lots.

An average automobile occupancy factor was estimated at 3.2 persons per vehicle. This figure is based on a survey conducted in July 1978 at Hampton and Salisbury Beaches. Table 2.1-7 provides a summary of beach area parking facilities, capacity estimates, and the maximum number of vehicles observed as part of a 1979 summer survey program for these lots. Within the 10-mile radius, it is estimated that 13,336 parking lot spaces (including metered street parking spaces, but excluding leased spaces) exist in the beach area. The maximum observed number of vehicles in the fee and free parking lots commonly used by daily transients occurred on July 22, 1979 during the summer survey period. Figure 2.1-15 shows the distribution of vehicles for this date.

Figure 2.1-16 is a capacity-type estimate of the peak population associated with surveyed parking lot spaces.

Some parking spaces in the beach area are leased during the summer months by seasonal residents and by motels for their lodgers; and, therefore, have not been included in the above capacity estimate. Leased spaces identified were located in five municipal parking lots: one in Salisbury and four in Hampton. A total of 559 leased parking spaces were identified in the beach area within 10 miles of the site.

2. Parking Lot Aerial Survey Data

To more accurately estimate the total numbers of daily transients entering the beach area and temporal variations in the daily transient population, data were collected and analyzed from June through September 1979. Aerial photographs (color slides) were taken from a light aircraft flying over the beach area on selected days throughout the summer. Vehicles parked in the major lots available to the public were counted from these slides. In addition, vehicles parked on the streets in the beach area were counted. However, many vehicles parked on the street are associated with other population categories (i.e., seasonal and year-round residents as opposed to daily transients). No distinction between vehicles was made in the counting process for on-street vehicles. Aerial photographs were taken and analyzed for a total of 64 days during the summer of 1979: 42 weekdays and 22 weekend days. This includes the 4th of July and Labor Day holidays.

3. Analysis of Parking Lot Data - Summer 1979

Beach area parking facilities available to the public are concentrated within a 6-mile radius of the site. The total capacity of available beach parking lot facilities in the Salisbury/Seabrook/Hampton Beach area is estimated at 11,434 parking spaces (includes Salisbury Beach State Park estimated at 1,921 spaces. Available capacity excludes leased parking spaces). This estimate was based on a survey of lots during the summer of 1979 and represents about 86 percent of the total parking lot spaces within the larger 10-mile radius of the site. During the summer of 1979, beach area lots were observed for 22 weekend and holiday periods and 42 weekday dates. Table 2.1-8 and Table 2.1-9 provides a summary of these survey dates. Observations were made primarily between noon and 3:00 p.m. when greatest use by daily transients can be noted. Figure 2.1-16 illustrates the distribution by time of day of vehicles in beach parking lots for several survey dates for which multiple observations were made.

The maximum number of vehicles observed in the major parking lots in the beach areas of Salisbury, Seabrook and Hampton, for all survey dates, occurred on a fair weather Sunday, July 22, 1979, between 1:00 and 2:00 p.m. At this time, a total of 9,077 vehicles were observed in the various beach area lots, representing 79 percent of the total capacity within approximately 6 miles of the site. For this peak observation during the survey period, beach area lots can be characterized as being either at or near capacity with the exception of several of the larger parking facilities in the Salisbury Beach area. For example, the Salisbury Beach State Park parking lot only reached 59 percent of its estimated 1,921-vehicle capacity on one of the 22 weekend and holiday survey periods in 1979. It was common to observe this facility at only 20-25 percent capacity during fair weather weekend beach days. Likewise, the observed use of this lot was lower for weekday periods than for weekend periods.

For lots within the 6-mile radius, the average number of vehicles observed for the 22 weekend periods was 4,945. This represents about 43 percent of the total available capacity of beach area lots in this radius. The level of observed weekday use was somewhat lower for these same facilities. The average number of vehicles observed for the 42 weekday survey dates was 3,073 or 26 percent of the total available capacity. The maximum number of vehicles in the available parking lots within a 6-mile area of the site for all weekday periods was 5,099 or 45 percent of capacity.

The total capacity of beach area parking lot facilities within the 6- to 10-mile radius is estimated at 1,902 spaces. The maximum number of vehicles observed also occurred on July 22, 1979. Approximately 1,444 vehicles representing about 76 percent of the available lot parking were observed.

The summer survey period extended from the second week in June through the third week in September. Figure 2.1-18 further illustrates the variation in total numbers of vehicles associated with surveyed parking facilities in the coastal area extending for approximately 28 miles along the New Hampshire-Massachusetts shore. Figure 2.1-18 also shows the variation in daily transients between weekend and weekday survey dates.

4. <u>On-Street Parking</u>

(a) <u>Review of Aerial Photography</u>

Survey work was also undertaken to determine the daily transient population using on-street parking in the beach area during the summer by estimating the total capacity of on-street parking spaces available to daily transients.

The number of daily transients in the beach area was estimated by comparing color high resolution aerial photography taken of the beach area at 8:00 a.m. and 1:00 p.m. on a high-use beach day (i.e., a clear and sunny Sunday, July 8, 1979). The scale of this aerial photography is approximately 1:2000.

The beach area was divided into sectors to record the number of vehicles observed parked on local streets. Similar sectors were used for both the on-street parking survey work and the beach area parking lot survey work previously described. These sector boundaries were delineated on the aerial photography and a review of vehicles observed and the number of available on-street parking spaces undertaken.

On-street parking was defined as the number of available parking spaces which are in the right-of-way of a road or within approximately ten feet of the edge of the traffic lane. It was also assumed that vehicles observed parked on-street in the 1:00 p.m. aerial photographs and not found in the same location or in nearby driveways in the 8:00 a.m. aerial photographs belonged to daily transients (e.g., persons making day trips to the beaches). Conversely, it was assumed that vehicles observed in both the 8:00 a.m. and 1:00 p.m. photos belonged to the "seasonal or permanent residents" or "overnight" beach area populations and thus were not associated with the daily transient population.

The number of daily transients may have been conservatively estimated in this manner. For example, some overnight, permanent, or seasonal residents may have moved their vehicles from off-street locations to on-street parking places or may have moved to another on-street parking place some distance away between the 8:00 a.m. and 1:00 p.m. periods. Such vehicles were counted as daily transients. However, most of the vehicles observed parked on-street in the 8:00 a.m. photographs were present, in the same place, in the 1:00 p.m. series.

The extent of illegal parking in the beach area was also considered as part of this survey. Parking ordinances were obtained from town police departments and reviewed. "No Parking" zones were outlined on local street maps from field observations of existing signs. By comparing on-street parking in the above noted 1:00 p.m. aerial photographs against the parking maps, a tabulation of illegally parked vehicles in the beach areas was made for a high beach use day. The amount of illegal parking was determined to be approximately 10 percent of the total number of vehicles observed parked on-street in the 1:00 p.m., July 8, 1979 aerial photography. Most of the "illegally parked" vehicles were observed in a small number of locations in the towns of Seabrook and Hampton.

(b) Estimate of On-Street Parking

Estimating the total capacity of on-street parking involved an examination of the 1:00 p.m., July 8, 1979 aerial photography. Spaces occupied by vehicles as well as empty spaces observed on the streets were recorded. The estimate of "on-street parking" required judgment regarding the distance daily transients would park from the beach. Thus, in all areas, except Hampton Beach, a maximum distance of approximately 600 feet from the beach was assumed as the boundary of "on-street parking" used by daily transients. All streets in Hampton Beach were assessed for their on-street parking capacity since it was observed that more parking at greater distances was common in this area.

From a detailed study of vertical aerial photographs for the beach area, a total of 4,574 vehicles was observed parked on-street at 1:00 p.m., July 8, 1979 within the beach area and within the 5-mile radius. This is 87 percent of the total on-street parking capacity (5,262). Of this total, 2,514 or 48 percent were defined as daily transients since these vehicles were not observed in the 8:00 a.m. photo series. Approximately 10 percent of the total number of vehicles parked on-street were parked illegally. Most areas where on-street parking occurred were at or near capacity for the observed date. Half of the empty on-street parking spaces were located north of the more popular Hampton Beach area (in sectors NE 3-4 miles and NE 4-5 miles). The total on-street parking capacity (including legal and illegal parking) for daily transients was estimated to be about 3,202 vehicles within 5 miles. The daily transient population associated with this parking is estimated at 10,246 persons (assuming 3.2 persons per vehicle).

Figure 2.1-19 shows the distribution of on-street parking estimated to be available to daily transients within the 10-mile radius. A beach area on-street parking capacity population estimate is included as Figure 2.1-20.

5. Origin/Destination Survey

An analysis was performed to determine if significant "double- counting" of the "permanent population" within capacity estimates for "daily transients" in the beach area occurred.

Survey work was directed at estimating the percentage of permanent residents residing within the 0- to 5-mile and 5- to 10-mile radii of the site and typically traveling to the Hampton/Seabrook/Salisbury beaches during the summer season for the day. A survey was designed and conducted during the summer of 1979 of individuals arriving by car at major parking lots in this beach area. Information on origins of trips for both weekdays and weekends was collected for selected lot locations. A summary of the survey results is included on Table 2.1-10.

A total of 3,000 questionnaires was completed over a 19-day period during the summer of 1979.

The results of the survey show that for all locations, averaged over all days of the week, about 5 percent of the people surveyed came from within 5 miles of the plant to the beach area, and 10 percent came from within 10 miles of the plant. On weekends, 3 percent of all beach area users came from within the 5-mile radius and 7 percent from within the 10-mile radius. On weekdays, the results are 6 percent from within 5 miles and 14 percent from within 10 miles of the site.

The survey results indicate that the daily beach population is made up primarily of "daily transients" with only a relatively small percentage of the area permanent and seasonal populations using the beach area parking lots. Since the percentage of permanent residents using the beach area parking lots is small, the total capacity of lots was attributed to the daily transient population category.

e. Other Activities

1. Seabrook Greyhound Park

A major commercial dog race track, Seabrook Greyhound Park, is located 2¼ miles west of the site. The facility operates year-round according to the following schedule (as of October 1979):

Evening Activity	Races scheduled nightly, except Sundays, from 7:45 to 11:00 p.m.
Daytime Activity	Races scheduled on Tuesdays and Thursdays between 1:15 and 4:00 p.m. and on Saturday between 12:00 noon and 4:00 p.m.

Track attendance data from January 1977 to September 1979 was reviewed. Highest recorded attendance during this 33-month period was on September 1, 1979, with an evening attendance of 7,027 persons. Observation of the facility on this day indicated that the track's parking lot with approximately 3,100 spaces was nearly full. Table 2.1-11 provides a summary of peak monthly attendance at this facility. The peak capacity of the track is estimated at 7,500 persons.

2. Route 1

Route 1 is a major north-south artery located in the 0- to 10-mile study area. A variety of commercial uses exist along Route 1 including shopping centers, gas stations, restaurants and fast food chains, motels, automobile dealers and repair shops, taverns, gift shops, and building supply stores. Shopping centers found along this route have the greatest concentrations of vehicles. Six shopping centers were identified along Route 1 within the 10-mile radius. These major shopping facilities include:

Vehicles parked at these facilities were recorded for ten days during the summer of 1979. Observations were made between 1:00 and 5:00 p.m. on both weekday and weekend periods. The maximum number of vehicles observed, as noted above, was less than the lot capacity estimates.

Shopping Center	Distance/ Direction	Lot Vehicle Capacity Estimate	Max Observed
Seabrook Plaza	W/0-1 mi	710	265
Seabrook Southgate	SW/1-2 mi	730	460
Convenience Shopping Center	2/3-4 mi	50	22
Hampton Court (lacks major tenant)	N/4-5 mi	750	67
North Hampton Village Shopping Center	N/5-6 mi	140	66
Southgate Plaza	NNE/9-10 mi	550	286

3. Recreational Boating

Recreational boating is prevalent in the summer months in the Hampton Harbor vicinity. Observations of occupied boats (moving and stationary) within the 3,000-foot station exclusion area (Brown's River and Hunts's Island Creek), within a 2-mile radius (Hampton and Blackwater Rivers), and an approximate 5- to 10-mile radius in the Atlantic Ocean were made. Fifty-two observations were made during the summer of 1979 between 1:00 and 4:00 p.m. on both weekdays and weekends of the waters within the 5-mile radius. These observations are summarized on Table 2.1-12.

Only three boats were observed on three dates during the summer in Brown's River within the 3,000-foot exclusion zone of Seabrook Station. No occupied boats were observed on Hunt's Island Creek, the Boston and Maine Railroad Landing, Farm Dock Landing, and Walton Landing.

Boating activity on the Hampton and Blackwater Rivers within a 2-mile radius of Seabrook Station was concentrated within their lower stretches in the Hampton Harbor area. Many of the moving boats observed in Hampton Harbor were either departing for or returning from the Atlantic Ocean. The average weekend observation was 5 occupied boats on the Hampton River and one occupied boat on the Blackwater River. With the exception of the larger, charter deep-sea fishing vessels, the boats observed were small or medium-sized power boats. Few sailboats and no water skiers were observed in this area.

Boating activity in the Atlantic Ocean was largely concentrated within 2 or 3 miles of Hampton Harbor inlet. It is highly probable that many of the sailboats, which accounted for roughly half of all boats observed in the Atlantic, originated at points either north (Portsmouth) or south (Ipswich, Gloucester) of Hampton Harbor. No sailboats were observed in Hampton Harbor.

Boating activity was greatest on warm, sunny weekends and holidays. The largest number of boats observed within the 5-mile radius in the Atlantic Ocean was estimated to be 300. The average weekend observation during the summer in the Atlantic Ocean within 5 miles of Seabrook Station was 95 boats. Weekday boating activity was substantially less than weekend activity.

Boating activity in the 5- to 10-mile area is concentrated on the Merrimack River, approximately 6 to 7 miles south from Seabrook Station, and in Rye Harbor about 9 miles northeast of Seabrook Station.

4. Major Manufacturing

An inventory of major employers was undertaken for the 10-mile study area. Inventory work undertaken relates to populations associated with major manufacturing and industrial facilities. Four primary sources of data were used: (1) Directory of Massachusetts Manufacturers: 1981-82 Edition, George D. Hall Company, 1981, (2) Directory of New England Manufacturers: 1980, New England Council, 1980, (3) MacRae's New Hampshire State Industrial Directory: 1982, MacRae's Blue Book, Inc., 1981, and (4) "Exeter, N.H. Industrial & Manufacturer's Guide and Exeter Grown Products," Exeter Area Chamber of Commerce, 1981. Local telephone directories and limited telephone contacts were made to locate major employers. Major employers were defined as facilities listed in the manufacturers' guides.

Table 2.1-13 is a listing of the "major employers" with their associated reported employment levels. Figure 2.1-21 shows the distribution of this total major employer population within the 10-mile study area. Employment related to small manufacturing, commercial retail, and service-type business is not in this estimate.

Within the 0- to 5-mile radius, there are an estimated 3,547 employees associated with major industrial or manufacturing firms. The number of employees in the 5- to 10-mile radius is estimated to be 6,707. Therefore, in the 0- to 10-mile radius, there are an estimated 10,254 employees. Over 50 percent of these employees are located in a 3-mile ring (between the 4- and 7-mile radii) in the following sectors: WSW, SW, SSW, and S. This area includes the towns of Newburyport, Amesbury, and Salisbury. A total of about 18 percent of the estimated number of employees work in Seabrook, NH in a 2-mile ring (between the 1- and 3-mile radii) in the W, WSW, SW, and S sectors.

5. Educational Facilities

Information on the location of schools was developed for the 10-mile study area. An estimate of population for each facility was developed based on current levels of staffing and enrollment. Table 2.1-14 summarizes this information, while Figure 2.1-22 indicates the distribution of the total school population within 10 miles of the site. It indicates a total school population of 6,020 at 18 facilities within 0 to 5 miles of the site and an additional population of 15,469 at 53 facilities within the 5- to 10-mile radius.

Information on schools was obtained from directories prepared by New Hampshire's and Massachusetts' Departments of Education (i.e., Education Directory, Student Enrollment, 1977 School Population by Massachusetts Department of Education and Education Directory 1978-79 and Park II 1978 Student Enrollment by the New Hampshire Department of Education). Their directories provided enrollment figures for both public and approved nonpublic facilities. Local telephone directories were also used to identify other preschool and special schools. Telephone surveying of most school district offices and a number of schools directly was also undertaken.

6. Medical-Related Facilities

Information on the location and capacities of major medical- related facilities, including hospitals and nursing homes, was collected for the area within 10 miles of Seabrook Station. Table 2.1-15 provides a summary of the medical-related facilities including the estimated bed capacities and staffing at these facilities. The distribution of this estimated medical-related population is shown on Figure 2.1-22. The majority of the medical-related population within the 10-mile radius is found within the 5- and 10-mile radii. Approximately 10 percent (or 329 persons) of the total estimated medical-related population is located within a 5-mile area and 90 percent (or 3,146 persons) within 5 to 10 miles. Hospital staff were included in the estimates of this medical-related population estimate. However, estimates of visitors and other personnel were not included in the total estimate. Sources of information included the United States Health Systems Agency in Concord, New Hampshire, health planning services directories, and communication with many other facilities.

f. Seasonal Transients (10 to 50 miles)

For the area between 10 and 50 miles from the site, transient population elements have been investigated. Data at a level of detail similar to the information presented for the area within 10 miles are not readily available. This section describes the information on transient populations by state. For each of the three states - Maine, New Hampshire and Massachusetts - seasonal transient population data were investigated. Seasonal transient population data were examined for three components: beach users, campers and occupants of seasonal dwellings. Daily employment movements were assumed to correspond to commutation of the work force from residential locations to places of employment. Emphasis is placed on the seasonal transient element due to the recreational use of much of the study area.

1. Seasonal Transients (Maine)

(a) Swimming or Beach Use

The portion of Maine within 50 miles of the site comprises about 75 percent of York County's land area. A report entitled Maine Comprehensive Outdoor Recreation Plan (1978) describes recreational activities in various parts of the state. York County and a southern portion of Oxford County comprise what is referred to in this report as the Southern Maine District (Southern Maine Regional Planning Commission Area). Approximately 53 percent of the Southern Maine District is within the 50-mile study area. The report indicates that 57,862 feet of municipal and 8,975 feet of private beach exist in the planning district. Much of the summer beach activity occurs along the coast of York County where several of Maine's major beaches are located. Major York County beach areas include Old Orchard Beach, Ogunquit, Kennebunk, Kennebunkport, and Biddeford. A beach-capacity estimate was made by applying a standard of two feet of beach shoreline per person or 33,418 persons.

(b) Camping

The Maine Comprehensive Outdoor Recreation Plan also indicates that approximately 4,808 campsites exist in the York County-Southern Oxford County area. This estimate excludes summer camps. Applying a standard of four persons per campsite results in an estimated camping population of 19,232 persons in the entire southern Maine planning district. About half of the southern district's land area is included within the 50-mile study area. Thus, for estimating purposes 53 percent or 10,195 persons are located within the York County sectors within the 50-mile radius. The Maine Comprehensive Outdoor Recreation Plan estimates "peak day camping demand" at less than capacity with 6,717 persons for 1980 and 7,464 persons for 1990.

(c) Seasonal Residents

An estimate of the seasonal resident population was developed based on the 1970 U.S. Census of Housing data. An estimate of the seasonal resident population was developed by applying an average occupancy factor of 7.6 persons per "vacant-seasonal and migratory" dwelling unit. This is the weekend occupancy factor which was determined from a 1978 survey conducted in the Hampton, Seabrook, and Salisbury beach area. It was estimated that 7,030 of the 9,373 "seasonal units" reported were within the portion of Maine included within the 50-mile radius. This estimate was based on an equal area allocation approach. The estimated seasonal resident population is 53,428 persons within this same area. Table 2.1-16 presents 1970 U.S. Census of Housing data on vacant-seasonal and migratory units for counties in Maine, New Hampshire, Massachusetts, and Vermont. All or portions of these counties are included within the 50-mile radius. Figure 2.1-24 shows the estimated size and distribution of this seasonal resident population.

(d) General Employment Patterns

Daily transient population movements related to the work force also occur in this area. It is assumed that the primary movements of work force populations are to urban centers. The most densely developed areas within the 50-mile radius in York County include Biddeford, Sanford, Kittery, Berwick and South Berwick, Kennebunk, and Kennebunkport. A 1972 report entitled Future Land Use Plans, prepared by the Southeastern New Hampshire Regional Planning Commission (SNHRPC), indicates that a large part of the Southeastern New Hampshire region labor force[1] works in Maine, particularly at the Portsmouth Naval Shipyard, which is in Kittery.

Table 2.1-17 is a summary of employment statistics by place of residence for the counties within the 50-mile radius. Figure 2.1-25 shows the distribution of 1970 employment by place of residence based on equal area allocation. Total employment estimated in this manner for the 50-mile radius is 1,328,320 workers. Total employment in York County, Maine increased from 31,191 in 1940 to 44,780 in 1970.

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[1] Towns included in the region are Epping, Fremont, Brentwood, Newfields, Exeter, East Hampton, South Hampton, Kensington, Hampton Falls, Seabrook, Stratham, Greenland, Newington, Portsmouth, Rye and North Hampton.

2. Seasonal Transients (New Hampshire)

(a) Swimming or Beach Use

A detailed estimate of the seasonal and daily transient populations within 10 miles of the site was presented above. Major transient populations in this area were associated with the beach areas of Seabrook and Hampton, New Hampshire and Salisbury, Massachusetts. The remainder of the New Hampshire coast is also subject to seasonal shifts in the population. For example, the "swimming" or beach area population for the remainder of the coastal area from Wallis Sands State Beach in Rye to New Castle is estimated at 4,873 to 14,058 persons in a report entitled Public Shorefront Access Planning Process for the State of New Hampshire (June 1978) by the Strafford Rockingham Regional Council.

(b) Camping

The 1977 New Hampshire Outdoor Recreation Plan indicates that approximately 6,180 campsites exist in Planning Regions 2, 5, and 6 which are contained in the area within 50 miles of the site (Reference 8). It is estimated by equal area allocation that approximately 2,441 campsites exist within 10 to 50 miles of the site. Applying a standard average occupancy factor of four persons per campsite results in an estimated camping population of 9,764 persons within the 10- to 50-mile radius.

(c) Seasonal Residents

It is estimated by equal area allocation that about 41 percent or 10,013 of the 24,251 vacant-seasonal and migratory units reported in the 1970 U.S. Census of Housing for Carroll, Belknap, Merrimack, Hillsborough, Strafford and Rockingham counties were in the 10- to 50-mile portion of New Hampshire. An occupancy factor of 7.6 was applied to the seasonal units in the 10- to 50-mile study area to estimate the size and distribution of the seasonal resident population. Thus, the seasonal resident population for this area of New Hampshire is estimated at 76,099 persons.

(d) General Employment Patterns

Daily work force population shifts also occur in New Hampshire. Major employment centers in the 10- to 50-mile portion of New Hampshire include Manchester, Nashua, Concord, Salem, Derry, Goffstown, Milford, Wilton, Suncook, and Penacook. Some employment shifts from New Hampshire to Massachusetts and southern Maine likely exist. No detailed information of the types of daily work force employment shifts was available. Table 2.1-17 indicates that total employment in Belknap, Carroll, Hillsborough, Merrimack, Rockingham and Strafford counties increased from 125,224 in 1940 to 232,131 workers in 1970.

3. Seasonal Transients (Massachusetts)

(a) Swimming or Beach Use

The seasonal transient population within Massachusetts and the 10- to 50-mile radius of the site is significantly influenced by the permanent population within this same area. For example, the permanent population of the Boston Metropolitan Area and Lawrence, Haverhill, and Lowell, as well as persons in other less densely settled communities may use the nearby coastal beaches.

(b) Camping

A 1978 report entitled Massachusetts Outdoors provided the basis for estimating the camping population within the 50-mile radius. All or portions of four "recreation demand study regions" are within the 50-mile radius (e.g., regions 3, 4, 5, and 6). Based on equal area allocation, an estimated 5,887 campsites exist in this area. Applying four persons per campsite results in an estimate of 23,548 campers in the region.

(c) Seasonal Residents

It is believed that a large shift in the summer seasonal and seasonal resident populations occurs in the coastal communities from Newburyport (5 miles) to the Rockport-Gloucester area (12 miles). It is estimated that 5,140 of the 19,229 "vacant-seasonal and migratory units" reported in the 1970 U.S. Census of Housing for Essex, Middlesex, Suffolk, Norfolk, Plymouth, and Worcester Counties were within the 10- to 50-mile radius of the site. About 67 percent or 3,419 of these estimated units are in Essex County. A large concentration of seasonal residences exists in the Plum Island beach community in Newburyport. It is believed that the majority of seasonal units in Essex County exist along the coast between Plum Island and the Rockport- Gloucester area. The total seasonal resident population for the 10- to 50-mile area of Massachusetts is estimated at 39,064 persons.

(d) General Employment Patterns

Shifts in the daily work force population occur in this same area. The major shifts are believed related to workers commuting to the major urban areas noted above. The largest shift would be related to work force population commuting into the Boston-Route 128 area. Total employment in Essex, Middlesex, Norfolk, Plymouth, Suffolk, and Worcester counties was 1,175,766 in 1940 and 1,803,919 workers in 1970.

g. Estimate of Peak Population

Table 2.1-18 presents a summary of the total peak summer transient population within 10 miles of the site. As indicated in Table 2.1-18, the peak summer weekend day transient population, including seasonal residents, overnight visitors, and daily transients, is estimated at about 84,366 for the 5-mile radius and approximately 32,622 for the 5- to 10-mile area. Figure 2.1-25 shows the distribution of this estimated summer peak weekend transient population. Figure 2.1-26 is a similar figure showing an estimate and distribution of the summer weekday transient population. This estimate assumes that both lot and street-type beach area parking would be at 43 percent capacity as estimated for the weekend condition including the estimate of the manufacturing work force (based on the maximum number of vehicles observed in lots within the 5-mile radius on a weekday on 7/20/79). The estimate reflects highest weekday count of 46 weekdays between June and September for which data was included. The summer weekday transient population is estimated at 57,553 for the 0- to 5-mile area and 81,041 within 10 miles.

A number of other facilities exist in the vicinity of the site. Table 2.1-13, Table 2.1-14, and Table 2.1-15 provide information including estimated populations for medical-related facilities (e.g., hospitals and nursing homes), schools, and other facilities. Estimated peak populations associated with such facilities were not included in the peak summer population estimate indicated in Table 2.1-18 and Figure 2.1-26 and Figure 2.1-27 since it is assumed that these people are included in other categories (e.g., permanent population) or the facilities (e.g., schools) are not operating during summer weekends.

2.1.3.4 Low Population Zone (LPZ)

The low population zone for the Seabrook Station site is defined as a circle with a radius of 1.25 miles. The center of the circle is located among site structures, approximately 250 feet southwest of the reactor containment.

Three considerations apply in the selection of the LPZ in accordance with 10 CFR Part 100. The first is that the low population zone " ...contains residents, the total number and density of which are such that there is a reasonable probability that appropriate protective measures could be taken on their behalf in the event of a serious accident." This requirement is satisfied by the specified LPZ. The second consideration of 10 CFR Part 100 requires that the specified whole body and thyroid dose limits be met. This requirement is also satisfied by the specified low population zone. The third consideration is that the population center distance must be at least one and one-third times the distance from the reactor to the outer boundary of the LPZ. It is this consideration which sets the size of the low population zone at a radius of 1.25 miles since the closest distance to an assumed population center, namely the Hampton Beach area, is 1.67 miles (see Subsection 2.1.3.5).

Figure 2.1-28 is a map which shows the low population zone. The major roadway which traverses the low population zone is U.S. Route 1 which is a north-south road to the west of the site. Portions of several feeder roadways to U.S. Route 1 are also included in the low population zone. There are no roadways which permit traveling through the low population zone in an east-west direction.

There is one railway which traverses the low population zone in a north-south direction. This is a spur owned by the Boston and Maine Railroad. The line terminates 6 miles to the south and is used infrequently.

There is one school within the low population zone boundary, the Seabrook Elementary School, located on Walton Road south of the site near the outer edge of the LPZ. The 1978 enrollment of this school was approximately 740. A list of all schools within a distance of 10 miles from the site is shown on Table 2.1-14. There are no other institutions, such as hospitals or prisons, within 5 miles of the site. The closest hospital to the site is the Amesbury Hospital, located about 5½ miles to the southwest.

The Bailey Division of USM Corporation is inside the low population zone at about 1 mile west-southwest of the site. About 1,000 people are employed there. Several commercial establishments, such as shops, retail stores, and restaurants, are located along the section of U.S. Route 1 which passes through the low population zone. Two shopping centers are located within the low population zone along Route 1. One is about 1 mile to the west, and the other is ¼ mile to the southwest.

The major beaches in the area are outside the low population zone. They are located east of Route 1A in Salisbury, Massachusetts and Seabrook and Hampton, New Hampshire. The seasonal homes and lodging facilities are also primarily located along the coast outside the LPZ. A portion of Hampton Harbor and sections of several tidal brooks and rivers are located within the LPZ. None of these is a major shipping route. However, these waters are used for recreation, principally during the summer. Population estimates for the beach areas are discussed in Subsection 2.1.3.3.

The other major recreational facility in the area is the greyhound racing track in Seabrook. This facility is outside the low population zone 2 miles west of the site.

Table 2.1-19 presents permanent population estimates for the years 1983 and 2025 and for 10-year periods from 1980 through 2020 for the low population zone. Figure 2.1-29 and Figure 2.1-30 show the projected resident population within the low population zone for the years 1983 and 2025, respectively. Transient population data for the low population zone are presented in Table 2.1-20. These population estimates for the permanent population were derived in the same manner as discussed in Subsection 2.1.3.1.

2.1.3.5 Population Center

The closest municipality with a current population of 25,000 or more people is Portsmouth, New Hampshire. This city is located approximately 12 miles north-northeast of the site. Available projections (Reference 2) for this city indicate that the population will increase at a relatively slow rate.

Amesbury, Massachusetts, 4 miles south-southwest of the site, had a 1970 population of about 11,000. The estimated 1985 population for Amesbury is 19,000 (Reference 3). Continued growth of Amesbury could result in that municipality becoming a population center during the life of the station. Newburyport, Massachusetts with a 1970 population of about 16,000 is located about 6 miles south-southwest of the site. Its growth is projected to be less than that of Amesbury with an estimated population of about 17,000 in 1985 (Reference 3).

The transient population in the vicinity of the site is sufficiently large that the Atomic Licensing Appeal Board, in the course of construction permit proceedings, directed that the beach area to the east of the site be considered the population center (Reference 7). The Board ruled that Route 1A to the east of the site serves as the real boundary of the populated areas. The area between the site and Route 1A to the east is largely marshland and provides a buffer between the site and the roadway. It is concluded that the population center should continue to be bounded by Route 1A and the population center distance should remain at 1.67 miles.

2.1.3.6 Population Density

Subsections 2.1.3.1 and 2.1.3.2 describe the methods used for estimating population distribution within 50 miles of the site. Figure 2.1-31 is a plot of the cumulative resident population to a distance of 50 miles for 1983, the projected year of plant startup. For comparison purposes, the population resulting from a uniform density of 500 persons per square mile is also shown on Figure 2.1-31. Table 2.1-21 indicates the cumulative population density out to 50 miles from the site for the permanent resident population. The maximum population density for 1983 is 532 persons per square mile.

Figure 2.1-32 shows the projected resident population to a distance of 50 miles from the site for the year 2025, the approximate end of the useful life of the facility. These values are compared with the population resulting from a uniform distribution of 1,000 persons per square mile. The maximum cumulative density of year 2025 is projected to be 1,155 persons per square mile as shown in Table 2.1-21.

2.1.4 References

1. U.S. Census Bureau, Census Bureau Display Program for the Fifth Count Summary Tapes of the 1970 Census (for towns within 5 miles of the site).

2. New Hampshire Office of Comprehensive Planning, "Interim RevisionsNew Hampshire Population Projections for Towns and Cities to the Year 2000," August 1977.

3. Massachusetts Department of Public Health-Office of State Health Planning, "Population Projections Massachusetts, City and Town Age-Sex Data, 1980 and 1985," August 1978.

4. Massachusetts Department of Public Health-Office of State Health Planning, "Population Projections Methodology and Handbook for Users," August 30, 1978.

5. Bureau of Economic Analysis, Regional Economic Analysis Division, U.S. Department of Commerce, "Population, Personal Income and Earnings By State; Projections to 2000," October 1977.

6. SPO Statistical Reports, Population Projection Series PPS-2, Maine Municipal Population Projections 1977, 1980, 1982, August 1977.

7. Atomic Licensing Appeal Board, ALAB-422, July 26, 1977.

8. 1977 New Hampshire Outdoor Recreation Plan. N.H. Department of Resources and Economic Development, Office of Comprehensive Planning.

1.2 GENERAL PLANT DESCRIPTION

1.2.1 Site Characteristics

1.2.1.1 Location

Seabrook Station is located on the western shore of Hampton Harbor in Rockingham County, in the township of Seabrook, New Hampshire. It is approximately 11 air miles south of Portsmouth, New Hampshire and 2 miles west of the Atlantic Ocean. The site coordinates are 70 degrees, 51 minutes, 05 seconds west longitude, and 42 degrees, 53 minutes, 53 seconds north latitude. The Universal Transverse Mercator Coordinates of the site are 348,970 meters east and 4,751,090 meters north. Figure 2.1-4 shows the plant arrangement and its surroundings.

1.2.1.2 Size and Ownership

Seabrook Station is owned by a group of utilities that are signatories to the Joint Ownership Agreement and that are hereafter referred to collectively as the Joint Owners. Public Service Company of New Hampshire (PSNH) was formerly the principal owner of Seabrook Station and, through its New Hampshire Yankee Division, was responsible for the managing agent functions in accordance with the Operating License. However, pursuant to a plan of reorganization for PSNH approved by the United States Bankruptcy Court, PSNH became a wholly-owned subsidiary of Northeast Utilities (NU) on June 5, 1992. On that same date, PSNH's ownership share of Seabrook Station was transferred to another subsidiary of NU, the North Atlantic Energy Corporation (NAEC). As part of that plan of reorganization, and in accordance with the approval granted by the NRC in Amendment 10 to the Operating License, PSNH's managing agent responsibilities were transferred to the North Atlantic Energy Service Corporation (North Atlantic), another wholly-owned subsidiary of NU, on June 29, 1992.

In 1996, the New Hampshire Legislature adopted the Electric Utility Restructuring Act (“EURA”), RSA 374-F with the overall public policy goal of developing a more efficient industry structure and regulatory framework. In accordance with EURA, the New Hampshire Public Utilities Commission (“NHPUC”) required NAEC to sell its ownership shares in Seabrook Station through a public auction. Seven other Joint Owners joined NAEC in the auction process. Through the auction process, the Selling Owners transferred their respective operating and ownership shares to FPL Energy Seabrook, LLC (“FPLE Seabrook”). As part of the transfer of ownership, and in accordance with the approval granted by the NRC in Amendment 86 to the Operating License, North Atlantic’s managing agent responsibilities were transferred to FPLE Seabrook on November 1, 2002.

The Seabrook Station site includes as a minimum the land within a 3000-foot radius of the two reactor building centerlines. The site, for purposes of ownership, is described as two lots. Lot 1 includes the land for the station buildings of Units 1 and 2 and the North Access Road. It corresponds closely with the controlled area boundary except for the access road. Lot 1 is owned by the Joint Owners in proportion to their ownership shares in the project as a whole.

The remainder of the site, Lot 2, is owned by FPLE Seabrook. Certain station structures and facilities are located on Lot 2. Easements for access, construction, operation and maintenance of the station facilities on Lot 2 are granted to the Joint Owners by FPLE Seabrook. Covenants and easements, including all rights and authority to determine activities as necessary to qualify the site as an "exclusion area" as defined in 10 CFR 100, have been assigned by NAEC and North Atlantic to FPLE Seabrook. Figure 1.2-1, Sheet 2 shows the ownership boundaries for lots 1 and 2.

1.2.1.3 Access

The site is bounded on the north, east and south by marshland. The only access to the site is from the west via two roads, both entering from U.S. Route 1. A railroad spur enters the site from the Boston and Maine Railroad track, located west of the station (see Figure 1.2-1, Sheet 1). All access to the site is under the control of FPLE Seabrook.

1.2.1.4 Geology

The site area is characterized by broad open areas of level tidal marsh, dissected by numerous tidal creeks and man-made linear drainage ditches, interrupted locally by wooded "islands" or peninsulas which rise to elevations of 20 to 30 feet above sea level.

The station buildings are placed on or in a gneissoid phase of the Newburyport quartz diorite intrusive. Newburyport is a hard, strong crystalline igneous rock consisting of a medium-to-course-grained quartz diorite matrix intimately enclosing inclusions of dark gray, fine-grained diorite.

A detailed discussion is presented in Section 2.5.

1.2.1.5 Seismology

The most severe earthquakes effects experienced by the site were Intensity VI (MM), as estimated by isoseismal lines from two offshore earthquakes in 1727 and 1755. The ground acceleration associated with the Safe Shutdown Earthquake was selected as 0.25 g.

A detailed discussion is presented in Section 2.5.

1.2.1.6 Meteorology

The site is located about two miles from the open Atlantic Ocean resulting in a definite maritime influence on the general climate. Winter temperature extremes are tempered by the relatively warmer water, and summer temperatures are moderated by a sea breeze. Precipitation amounts are uniform throughout the year, with an occasional heavy rainfall during a northeast storm. The site is not usually subjected to the full strength of east coast hurricanes. Such storms usually move either offshore or inland before they reach the Seabrook latitude.

A detailed discussion is presented in Section 2.3.

1.2.1.7 Hydrology

The site is located on the western side of the Hampton Harbor estuary on a peninsula of land which is bordered on the north by the Browns River and on the south by Hunts Island Creek. Surface drainage of natural precipitation from the peninsula is into these two tidal streams. The mean tidal range of Hampton Harbor is about 8.6 feet, varying from 4 feet below to 4.6 feet above mean sea level. The critical flood elevations at the site result from the probable maximum hurricane occurring simultaneously with the standard project storm. All safety-related systems and components are protected by structures which surround them, or by being located above the maximum stillwater level on the plant grade. Structures and components subject to wave runup are adequately protected to maintain the integrity of their functions.

A detailed discussion is presented in Section 2.4.

1.2.2 Facility Arrangement

1.2.2.1 General Arrangement

The arrangement of the major structures on the site is shown on Figure 1.2-1. The general arrangements of the individual structures shown in Figures 1.2-2 through 1.2-59 are provided for historical purposes only.

The major structures associated with Seabrook Station are the containment structure, containment enclosure, Primary Auxiliary Building, Fuel Storage Building, Waste Processing Building, Control Building, Diesel Generator Building, Turbine Building, Circulating Water Pumphouse, Service Water Pumphouse, Administration and Service Building, Emergency Feedwater Pump Building, cooling water tunnels, ocean intake structures, ocean discharge nozzles, Ultimate Heat Sink Cooling Tower, Chlorination Building, Fire Pumphouse, and Steam Generator Blowdown Recovery Building.

1.2.2.2 Containment Structure

The containment structure, Figure 1.2-2, Figure 1.2-3, Figure 1.2-4, Figure 1.2-5, Figure 1.2-6, completely encloses a Reactor Coolant System, and is a seismic Category I reinforced concrete structure in the form of a right vertical cylinder with a hemispherical dome and flat foundation mat founded on bedrock. The inside face is lined with a welded carbon steel plate, providing a high degree of leak tightness. A protective 4-ft thick concrete mat that forms the floor of the Containment protects the liner over the foundation mat. The containment structure provides biological shielding for normal and accident conditions. The approximate dimensions of the Containment are:

Inside diameter	140 ft
Inside height	219 ft
Vertical wall thickness	4 ft 6 in. and 4 ft 7 ½ in.
Dome thickness	3 ft 6 1/8 in.
Foundation mat thickness	10 ft

Containment penetrations are provided in the lower portion of the structure, and consist of a personnel lock and an equipment hatch/personnel lock, a fuel transfer tube and piping, electrical, instrumentation, and ventilation penetrations.

The Containment is designed to withstand all credible conditions of loading, including normal loads, construction loads, test loads, severe environmental loads and extreme environmental and abnormal loads. The maximum design pressure is 52 psig. The maximum liner temperature associated with the design pressure response is 271°F.

Detailed discussions are presented in Subsections 3.8.1, 3.8.2 and 6.2.1.

1.2.2.3 Containment Enclosure

The containment enclosure, Figure 1.2-2 Figure 1.2-3, Figure 1.2-4, Figure 1.2-5, Figure 1.2-6, surrounds the containment structure and is designed in a similar configuration as a vertical right cylindrical seismic Category I, reinforced concrete structure with dome and ring base. The approximate dimensions of the structure are: inside diameter, 158 ft; vertical wall thickness, varies from 1 ft, 3 in. to 3 ft; and dome thickness, 1 ft, 3 in.

The containment enclosure is designed to entrap, filter and then discharge any leakage from the containment structure. To accomplish this, the space between the containment enclosure and the containment structure, as well as the penetration and safety-related pump areas, are maintained at a negative pressure following a loss-of-coolant accident by fans which take suction from the containment enclosure and exhaust to atmosphere through charcoal filters. To ensure air tightness for the negative pressure, leakage through all joints and penetrations has been minimized.

Additional information is presented in Subsections 3.8.4 and 6.2.3.

1.2.2.4 Primary Auxiliary Building

The Primary Auxiliary Building, Figure 1.2-7, Figure 1.2-8, Figure 1.2-9, Figure 1.2-10, Figure 1.2-11, Figure 1.2-12, Figure 1.2-13, Figure 1.2-14, is a seismic Category I, reinforced concrete structure which is located adjacent to the containment structure, and contains most of the auxiliary systems for the Reactor Coolant System. Those systems whose major components are in the Primary Auxiliary Building include the Chemical and Volume Control, Primary Component Cooling, Sample, Low Pressure Safety Injection, Residual Heat Removal and Containment Spray Systems.

The residual heat removal and containment spray pumps and their associated heat exchangers are located in water tight compartments in the northern part of the Primary Auxiliary Building. The compartments are isolated from the rest of the Primary Auxiliary Building by concrete walls to preclude flooding the pumps due to a rupture anywhere else in the building. The containment spray pumps are located below grade to satisfy net positive suction head requirements.

Additional information is presented in Subsection 3.8.4.

1.2.2.5 Fuel Storage Building

The Fuel Storage Building, Figure 1.2-15 and Figure 1.2-21, is a seismic Category I reinforced concrete structure which houses a new fuel vault and a spent fuel pool. The new or unused fuel is stored in the new fuel vault prior to its use in the core. It is transported into the Containment by an underwater conveyor system. The spent fuel is transferred back from the Containment in the same manner, and is stored in the spent fuel pool where the pool water provides cooling and shielding.

Additional information is presented in Subsection 3.8.4.

1.2.2.6 Waste Processing Building

The Waste Processing Building, Figure 1.2-22, Figure 1.2-23, Figure 1.2-24, Figure 1.2-25, Figure 1.2-26, Figure 1.2-27, Figure 1.2-28, Figure 1.2-29 and Figure 1.2-30, is seismic Category I, reinforced concrete and structural steel. It houses the Liquid and Gas Waste Processing, Boron Recovery and Solid Waste Systems.

The building contains systems to process radioactive gases, liquids and solids. The gases are processed through charcoal delay beds to provide for iodine removal and radioactive decay of the noble gases. Liquids are processed in demineralizer skids, and can be recycled back into the plant or released if low enough in activity. Evaporators, installed as plant design, are available as an alternate method of processing liquids. Solids are normally stored in various containers and stored on site prior to shipment offsite for burial. The plant contains equipment designed to solidify waste which may be used to process solid waste prior to shipment off site.

Additional information is presented is Subsection 3.8.4.

1.2.2.7 Control Building

The Control Building, Figure 1.2-31, Figure 1.2-32 and Figure 1.2-33, is a seismic Category I, reinforced concrete structure which includes an electrical equipment room which houses the switchgear, batteries, rod drive controls, and rod drive M-G sets, a cable spreading room and a control room.

Additional information is presented in Subsection 3.8.4.

1.2.2.8 Diesel Generator Building

The Diesel Generator Building, Figure 1.2-34, Figure 1.2-35 and Figure 1.2-36, is a seismic Category I, reinforced concrete structure which houses two diesel generators together with their auxiliary equipment and two diesel generator fuel oil storage tanks.

Additional information is presented in Subsection 3.8.4.

1.2.2.9 Turbine Building

The Turbine Building, Figure 1.2-37, Figure 1.2-38, Figure 1.2-39, Figure 1.2-40, Figure 1.2-41, Figure 1.2-42, Figure 1.2-43, Figure 1.2-44, and Figure 1.2-45, is a nonseismic Category I structure which houses a turbine generator and associated condensers, pumps and feedwater heaters. The lube oil, secondary component cooling and service and instrument air systems are also located in the Turbine Building.

1.2.2.10 Circulating Water Pumphouse

The Circulating Water Pumphouse, Figure 1.2-46, Figure 1.2-47 and Figure 1.2-48, is a non-seismic Category I structure located approximately 160 feet east of the containment structure. It is composed of a forebay and three bays with a circulating water pump in each. Each pump bay also has one traveling screen. The three pumps supply cooling water to the condensers.

Additional information is presented in Subsection 10.4.5.

1.2.2.11 Service Water Pumphouse

The Service Water Pumphouse, Figure 1.2-46, Figure 1.2-47, and Figure 1.2-48, is a seismic Category I structure which is adjacent to the Circulating Water Pumphouse. It contains the four service water pumps which are available for normal operation and for post-accident cooldown.

Additional information is presented in Subsection 3.8.4.

1.2.2.12 Administration and Service Building

The Administration and Service Building, Figure 1.2-49 and Figure 1.2-50, is a non-seismic Category I structure which is located adjacent to the Turbine Building. It houses the administrative offices, store room, water treatment plant, auxiliary boilers, health physics checkpoint, chemistry laboratories, locker rooms, machine shops and other service areas. The access to the radiologically controlled area (RCA) is made through the health physics checkpoint.

1.2.2.13 Emergency Feedwater Pump Building

The Emergency Feedwater Pump Building, Figure 1.2-51, is a seismic Category I structure which is located adjacent to the containment structure, and contains the emergency feedwater pumps and emergency feedwater control valves.

Additional information is presented in Subsection 3.8.4.

1.2.2.14 Cooling Water Tunnels

The Heat Dissipation System uses once-through ocean water cooling, and is designed to provide all heat removal requirements. The cooling water is obtained from the Atlantic Ocean and is carried to the power plant through a 17,000 - foot long intake tunnel in the underlying bedrock, and is returned to the ocean through a similar discharge tunnel, approximately 16,500 feet long. The tunnels, which are nonseismic Category I, are lined with a permanent lining of cast-in-place concrete to a 19'-0" finished inside diameter. Figure 1.2-52 and Figure 1.2-53 show the plan and profile of the circulating water tunnels.

Additional information is presented in Subsections 9.2.5 and 10.4.5.

1.2.2.15 Ocean Intake Structures

The intake tunnel is connected to the ocean by means of three, nonseismic Category I, 9'-10½" finished inside diameter shafts, spaced between 103 and 110 feet apart. These shafts are located approximately 7000 feet off the Hampton Beach shoreline in 60 feet of water. A submerged 30'-6" diameter 19' high reinforced concrete structure ("velocity cap"), Figure 1.2-54, is mounted on top of each structure.

Additional information is presented in Subsection 10.4.5.

1.2.2.16 Ocean Discharge Nozzles

The discharge tunnel is connected to the ocean by means of eleven, non-seismic Category I, 5'-1" finished inside diameter shafts, spaced approximately 100 feet apart, located approximately 5000 feet off the Seabrook Beach shoreline in water up to 70 feet deep. A double discharge nozzle, Figure 1.2-55, is attached to the top of each shaft to increase the discharge velocity and diffuse the heated water.

Additional information is presented in Subsection 10.4.5.

1.2.2.17 Ultimate Heat Sink Cooling Tower

The cooling tower, Figure 1.2-56, is a seismic Category I structure that is composed of a concrete basin, pump rooms, electrical switchgear rooms and mechanical equipment rooms. The pump rooms house vertical centrifugal pumps.

Additional information is presented in Subsection 9.2-5.

1.2.2.18 Chlorination Building

The Chlorination Building, Figure 1.2-57 and Figure 1.2-58, is a nonseismic Category I structure which houses sodium hypochlorite storage tanks, storage tanks and related equipment for chlorination of circulating water piping, cooling tower and condensers. It is located south of the discharge transition structure. Part of the building on the west end houses electrical substations, and the east side of the building also houses a maintenance machine shop.

1.2.2.19 Fire Pumphouse

The Fire Pumphouse is a nonseismic Category I structure which houses electric and diesel-driven fire pumps and associated controls for use in extinguishing any fire that may occur on the site.

1.2.2.20 Steam Generator Blowdown Recovery Building

The Steam Generator Blowdown Recovery Building, Figure 1.2-59, is located on the south side of the Waste Processing Building and tank farm area, and houses the Steam Generator Blowdown Recovery System.

1.2.2.21 SEPS Equipment Enclosures

The Supplemental Emergency Power System (SEPS) equipment enclosures, Figure 1.2-1, are located on the south side of the Cooling Tower. These enclosures house the SEPS diesel generators and paralleling switchgear.

1.2.3 Reactor Systems

A detailed discussion of the various reactor systems is presented in Chapter 4.

1.2.3.1 Reactor Core

The reactor core is a multi-region cycled core. The fuel rods are slightly cold worked Zircaloy-4 or Zirlo™ tubes containing slightly enriched uranium dioxide fuel. The fuel rods are supported by spring clip grids in a 17x17 array to form fuel assemblies. There are 193 fuel assemblies in the core.

1.2.3.2 Reactor Vessel Internals

The reactor internals are comprised of a lower core support structure (including the entire core barrel and neutron shield pad assembly), the upper core support structure, and the core instrumentation support structure. The reactor internals support the core, maintain fuel alignment, limit fuel assembly movement, maintain alignment between fuel assemblies and control rods, direct coolant flow to the pressure vessel head, provide gamma and neutron shielding and guide the incore instrumentation.

A detailed discussion is presented in Subsection 3.9.5.

1.2.3.3 Reactivity Control Systems

Full-length control rod assemblies and burnable neutron absorber rods are inserted into guide thimbles of fuel assemblies for neutron control. The absorber sections of the control rods are composed of silver-indium-cadmium cylinders encapsulated in 304 stainless steel cladding. Within the cladding, the silver alloy rods are stacked to provide an absorber column of 142 inches. The absorber material in the fixed burnable neutron absorber rods is in the form of borosilicate glass sealed in stainless steel tubes. Boric acid in solution in the coolant is also used for neutron control during slow transients.

The control rod drive mechanisms are equipped with magnetic latches, which are controlled by three magnetic coils. The latches are designed so that upon a loss of power to the coils, the Rod Cluster Control Assembly is released and falls by gravity into the core to shut down the reactor.

Additional information is presented in Chapter 4.

1.2.3.4 Nuclear Instrumentation

The reactor is provided with two types of monitoring systems: a system of fixed ion chambers located symmetrically around the core outside of the reactor pressure vessel, a system of fixed-moveable incore instrumentation and a system of safety grade excore fixed fission chambers located symmetrically around the reactor vessel. The incore detection devices consist of fixed self-powered platinum detectors and moveable neutron detectors. The fixed self-powered detectors are distributed along the part of each detector assembly in the active length of the fuel assembly. Their continuous signals, when processed, provide an ongoing flux map. The moveable flux detectors can traverse the entire length of the instrumented fuel assemblies to provide data from which a finely defined three-dimensional map of the neutron flux distribution can be determined.

The Safety Grade Excore Neutron Flux Monitoring System measures thermal neutron flux and boron dilution of the reactor vessel during operation and during and after remote safe shutdown. This meets requirements of RG 1.97 and NUREG-0737.

Additional information is presented in Section 7.7 and Subsection 4.4.6.

1.2.4 Reactor Coolant System and Connected Systems

1.2.4.1 Reactor Coolant System

The Reactor Coolant System is composed of four steam generators, four reactor coolant pumps, a pressurizer, reactor vessel, and pressurizer relief tank. The system is designed to transfer a maximum thermal output of 3678 MWt (including pump heat) from the core to the steam generators where the heat is transferred to the Secondary Steam System that drives the turbine generator.

The Reactor Coolant System is arranged in four parallel loops, each consisting of a single steam generator and reactor coolant pump. Water is pumped under pressure through the reactor vessel where it picks up the thermal output of the core and to the steam generator where it gives up the core heat. It is then recirculated by the pumps back into the reactor vessel. The pressurizer is used to pressurize the water to 2250 psia to inhibit any boiling in the core. The core cooling water also acts as a neutron moderator, a reflector and a solvent for a chemical neutron absorber.

A detailed discussion on this system is presented in Chapter 5.

1.2.4.2 Reactor Vessel

The reactor vessel is a cylindrical structure with a hemispherical bottom head and a flanged and gasketed removable upper head, which houses the core, core support structures, control rod clusters, thermal shield and other parts associated with the core. The outlet and inlet nozzles which provide the exit of the heated coolant and its return to the vessel interior for recirculation through the core, are located at an elevation between the head flange and the core.

A detailed discussion is presented in Section 5.3.

1.2.4.3 Residual Heat Removal System

The Residual Heat Removal System is used to reduce the temperature of the reactor coolant at a controlled rate from 350°F to 125°F, within 20 hours after shutdown (with all equipment operating), and to maintain the proper reactor coolant temperature during refueling. The residual heat removal pumps circulate reactor coolant through two residual heat removal heat exchangers, and return it to the Reactor Coolant System through the low-pressure safety injection header.

A detailed discussion on this system is presented in Subsection 5.4.7.

1.2.5 Engineered Safety Features

The Engineered Safety Features serve to limit the potential radiation exposure to the public and to plant personnel following an accidental release of radioactive fission products from the Reactor Coolant System, particularly as the result of a loss-of-coolant accident (LOCA). These safety features function to localize, control, mitigate and terminate such accidents, ensuring that 10 CFR 100 limits are not exceeded. The safety features consist of the following:

a. Containment Systems

    1. Containment structure (including compartments)

    2. Containment enclosure

    3. Containment Heat Removal System (Containment Spray System)

    4. Containment Isolation System

    5. Combustible Gas Control System

b. Emergency Core Cooling System

c. Control room habitability systems

d. Fission Product Removal and Control Systems (Containment Enclosure and Fuel Storage Building ESF filter systems)

e. Emergency Feedwater System.

The above systems include those portions of the Instrumentation and Protection System and electrical power distribution system necessary for operation.

1.2.5.1 Containment Structure

The containment structure is described in Subsection 1.2.2.2.

1.2.5.2 Containment Enclosure

The containment enclosure is described in Subsection 1.2.2.3.

1.2.5.3 Containment Heat Removal System

A Containment Spray System is utilized for post-accident containment heat removal. The Containment Spray System is designed to spray water containing boron and sodium hydroxide into the Containment atmosphere after a LOCA to cool it and remove iodine. The pumps initially take suction from the refueling water storage tank and pump its contents into the Containment atmosphere through the spray headers located in the Containment dome. After a prescribed amount of water is removed from the tank, the pump suction is transferred to the Containment sump, and cooling is continued by recirculating sump water through the spray heat exchangers and back through the spray headers.

The spray is actuated by a Containment spray actuation signal that is generated at a designated containment pressure. The system is completely redundant and can withstand any single failure.

A detailed discussion on this system is presented in Subsection 6.2.2.

1.2.5.4 Containment Isolation System

The Containment Isolation System establishes and/or maintains isolation of the containment from the outside environment in order to prevent the release of fission products. Containment isolation signals actuate the appropriate valves to a closed position whenever automatic safety injection occurs or high containment pressure is experienced. Double barrier protection is provided for all lines that penetrate the Containment boundary.

A detailed discussion on this system is presented in Subsection 6.2.4.

1.2.5.5 Combustible Gas Control System

Thermal electric hydrogen recombiners reduce the concentration of hydrogen in the post-LOCA Containment atmosphere. A purge feature is also provided for backup control of hydrogen.

A detailed discussion of this system is presented in Subsection 6.2.5.

1.2.5.6 Emergency Core Cooling System

The Emergency Core Cooling System (ECCS) injects borated water into the Reactor Coolant System following a LOCA to limit core damage, metal-water reactions and fission product release, and to assure adequate shutdown margin. The ECCS also provides continuous long-term post-accident cooling of the core, by recirculating borated water between the containment sump and the reactor core.

The system consists of two centrifugal charging pumps, two low pressure safety injection pumps, two residual heat removal pumps and heat exchangers, and four safety injection accumulators. The system is completely redundant, and will assure flow to the core in the event of any single failure.

A detailed discussion on this system is presented in Section 6.3.

1.2.5.7 Control Room Habitability Systems

The Control Building contains the building services necessary for continuous occupancy of the control room complex by operating personnel during all operating conditions. These building services include: HVAC services, air purification and iodine removal, fresh air intakes, fire protection, emergency breathing apparatus, communications and meteorological equipment, lighting, and housekeeping facilities.

A detailed discussion on this system is presented in Section 6.4.

1.2.5.8 Engineered Safety Features (ESF) Filter Systems

ESF filter systems required to perform a safety-related function following a design basis accident are discussed below:

a. The Containment Enclosure Exhaust Filter System collects, filters and discharges most airborne containment leakage (excluding noble gases). The system is not normally in operation, but in the event of a LOCA, it is placed in operation and keeps the containment enclosure (as defined in Subsection 6.2.3.2a) at negative pressure to ensure most airborne leakage (excluding noble gases) from the containment structure is collected and filtered before discharge to the plant vent.

b. One of two redundant charcoal filter exhaust trains is placed in operation in the Fuel Storage Building whenever irradiation fuel not in a cask is being handled. These filter units together with dampers and controls will maintain the building at a negative pressure.

Detailed discussions on these systems are presented in Subsection 6.5.1.

1.2.5.9 Emergency Feedwater System

The Emergency Feedwater System supplies demineralized water from the condensate water storage tank to the four steam generators upon loss of normal feedwater flow to remove heat from the Reactor Coolant System. Operation of the system will continue until the reactor coolant system pressure is reduced to a value below which the Residual Heat Removal System can be operated. The combination of one turbine-driven and one motor-driven emergency feedwater pump provides a diversity of power sources to assure delivery of condensate under emergency conditions.

A detailed discussion of the system is presented in Section 6.8.

1.2.6 Instrumentation and Controls

1.2.6.1 Reactor Trip System

The Reactor Trip System automatically initiates a reactor trip when any monitored variable or combination of variables approaches pre-established limits. Sufficient redundancy is provided to permit periodic testing while maintaining capability to meet single failure criteria. The Reactor Protection System acts to shut down the reactor, close isolation valves, and initiate operation of the Engineered Safety Features should any or all of these actions be required.

A detailed discussion on this system is presented in Section 7.2.

1.2.6.2 Engineered Safety Features Systems

This system provides the instrumentation and controls required to sense accident situations and initiate the operation of necessary Engineered Safety Features. The system is designed to ensure adequate redundancy and separation to provide reliable system initiation and meets single failure criteria.

A detailed discussion on this system is presented in Section 7.3.

1.2.6.3 Other Safety Significant Systems

Instrumentation and controls are provided to actuate, control and monitor systems required for safe shutdown. The instrumentation and controls are designed to ensure reliable operation and meet single failure criteria.

The accident monitoring instrumentation (AMI) displays provide the information necessary for the operators to monitor plant variables and systems during and following postulated accidents. The AMI provides the operators the information necessary to assist in evaluating the nature of the accident, the functioning of engineered safety features actuation systems, the plant response to safety measures in operation and the need for additional manual action.

Detailed discussions on these systems are presented in Sections 7.4 and 7.5.

1.2.7 Electric Power

The facility is interconnected to offsite power via three 345 kilovolt lines of the transmission system for the New England states. The normal preferred source of power for the unit is its own main turbine generator. The redundant safety feature buses of the unit are powered by two unit auxiliary transformers. A highly reliable generator breaker is provided to isolate the generator from the unit auxiliary transformers in the event of a generator trip, thereby obviating the need for a bus transfer upon loss of turbine generator power. In the event that the unit auxiliary transformers are not available, the redundant safety feature buses of the unit are powered by two reserve auxiliary transformers. Upon loss of offsite power, the unit is supplied with adequate power by either of two fast-starting, diesel-engine generators. Either diesel-engine generator and its associated safety feature bus is capable of providing adequate power for a safe shutdown under accident conditions with a concurrent loss of offsite power. A non-safety related supplemental emergency power system (SEPS) is available as a backup power source to either safety feature bus when the emergency diesel generators fail to start and load. SEPS is capable of providing adequate power for a safe shutdown under loss of offsite power condition. A constant supply of power to vital instruments and controls of each unit is assured through the redundant 125 volt direct current buses and their associated battery banks, battery chargers and inverters.

A detailed discussion on this system is presented in Chapter 8.

1.2.8 Auxiliary Systems

1.2.8.1 Fuel Storage and Handling

The reactor is refueled with equipment designed to handle spent fuel under water from the time it leaves the reactor vessel until it is transferred into the spent fuel pool for storage. Transfer of spent fuel under water enables the use of an optically transparent radiation shield, and provides a reliable source of coolant for removal of residual heat. The system includes a manipulator crane located inside the Containment above the refueling cavity, fuel transfer carriage, upending devices, fuel transfer tube, spent fuel pool crane in the spent fuel pool area, and various devices used for handling new fuel assemblies.

New fuel is taken from the new fuel storage vault and transferred to the Containment using the upending devices and transfer carriage. It is then put into the core using the manipulator crane. Spent fuel is taken out in the same manner and transferred back into the spent fuel pool for storage.

The new fuel is stored dry on 21-inch centers in the new fuel vault. The new fuel vault is designed to assure a $k_{eff} \leq 0.98$ even if optimum neutron moderation is assumed. The spent fuel racks are designed for high density fuel storage and contain neutron absorbing material to assure a $k_{eff} \leq 0.95$, even if no credit is taken for the soluble boron present in the water where the spent fuel is immersed.

Detailed discussion on these systems are presented in Subsections 9.1.1, 9.1.2 and 9.1.4.

1.2.8.2 Station Service Water System

The Service Water System consists of two completely independent and redundant parallel flow trains, each supplying cooling water to a primary component cooling water heat exchanger, a diesel generator water jacket water cooler, the secondary component cooling water heat exchangers and the condenser water box priming pump seal water heat exchangers. Under normal conditions, flow is supplied by pumps taking suction from a common bay of the Service Water Pumphouse; when transfer to the Ultimate Heat Sink Cooling Tower occurs, service water is obtained from the cooling tower basin using the cooling tower pumps.

A detailed discussion of this system is presented in Subsection 9.2.1.

1.2.8.3 Cooling System for Reactor Auxiliaries

The Primary Component Cooling Water System consists of two independent trains of pumps and heat exchangers to remove heat from the various auxiliary systems. During normal operation, the system circulates corrosion-inhibited demineralized water through all the heat loads associated with primary systems. Some of these loads are the letdown heat exchanger, sample heat exchangers, spent fuel pool heat exchanger, boric acid and waste evaporators. For a LOCA, the system automatically isolates nonsafety-related loads and provides cooling for the residual heat exchangers, the containment spray heat exchangers, and other safety-related loads.

A detailed discussion of this system is presented in Subsection 9.2.2.

1.2.8.4 Makeup Water System

Makeup water is processed in the water treatment plant located in the Administration and Service Building. The water treatment plant can process water at a design flow of 150 gpm for use in both the primary and secondary systems.

A detailed discussion of this system is presented in Subsection 9.2.3.

1.2.8.5 Compressed Air System

The Compressed Air System consists of two separate subsystems: plant compressed air system and containment compressed air system.

The Plant Compressed Air System consists of three compressors, intake filters, aftercooler/moisture separators, four air receivers, two instrument air dryers, associated instruments/controls, piping and valves. The above equipment is located in the south end of the Turbine Building.

The Containment Compressed Air System consists of two package compressor units (including intake filter, after cooler/moisture-separator and receiver) that discharge compressed air either to a service air header or to an independent air dryer.

A detailed discussion on this system is presented in Subsection 9.3.1.

1.2.8.6 Ultimate Heat Sink

The ultimate heat sink is normally the Atlantic Ocean. Ocean water is supplied to the Service Water System during normal operating and accident conditions through one of two tunnels. The heated water is then returned to the ocean through the other tunnel.

In the unlikely event that the tunnels are unavailable, the ultimate heat sink is transferred to a mechanical draft cooling tower. The cooling water is supplied by cooling tower pumps to the primary component cooling water and diesel generator heat exchangers.

A detailed discussion of this system is presented of Subsection 9.2.5.

1.2.8.7 Chemical and Volume Control System

The Chemical and Volume Control System functions to control reactivity in the core by boron addition or dilution; purify the reactor coolant by filtering, demineralizing and injecting clean water; add chemicals for corrosion control of the reactor coolant, and supply purified water to the reactor coolant pump seals.

The purity level in the Reactor Coolant System is controlled by continuous purification of a letdown stream of reactor coolant. Water letdown from the Reactor Coolant System is first cooled in two heat exchangers. It is then filtered, demineralized and degassed to remove corrosion and fission products and is sprayed into the volume control tank.

The Chemical and Volume Control System automatically adjusts the amount of reactor coolant to compensate for changes in specific volume due to coolant temperature changes and reactor coolant pump shaft seal leakage in order to maintain a constant level in the pressurizer.

A detailed discussion on this system is presented in Subsection 9.3.4.

1.2.8.8 Boron Recovery System

The Boron Recovery System stores and processes reactor coolant effluent and reactor coolant grade drainage for reuse in the reactor plant or for disposal offsite. The system maximizes recycling of effluent back to the reactor plant and minimizes the release of radioactive material to the environment by proper cleanup and volume reduction methods. The system process is a combination of degassification, demineralization, filtration and evaporation.

A detailed discussion on this system is presented in Subsection 9.3.5.

1.2.8.9 Air Conditioning, Heating, Cooling and Ventilating Systems

The Ventilation and Air Conditioning Systems for Engineered Safety Features and other essential equipment rooms provide an adequate supply of tempered air to safety-related and emergency equipment areas during accident and post-accident conditions. These Ventilation and Air Conditioning Systems are redundant and seismically designed. The Ventilation and Air Conditioning

Systems also provide clean ventilating air, heated or cooled when required, to all plant areas during normal operating conditions.

Flow patterns have been established so that air in areas of low potential radioactive contamination progress toward areas of higher potential radioactive contamination.

A Containment Recirculating Filter System provides atmospheric mixing following a LOCA, to prevent excessive hydrogen concentrations in the dome portion of the Containment which also provides for containment cleanup during normal plant operation. A Containment Purge System permits purging of the Containment prior to personnel entry, after reactor shutdown, and during refueling. An Online Purge System permits purging of the Containment periodically during normal plant operation.

Detailed discussions on these systems are presented in Section 9.4.

1.2.8.10 Plant Fire Protection System

The Fire Protection System contains two diesel-driven and one electric motor-driven fire pumps which supply the various hydrants, hose stations and sprinkler and spray systems. The pumps take suction from two 500,000-gallon storage tanks. Three hundred thousand gallons of water from each tank is dedicated for fire protection; the remainder is available for other plant use. Standpipes and hose stations in areas containing safe shutdown equipment are also capable of being fed from the Service Water System.

Fire detection is provided at locations determined by the fire hazard analysis as having significant fire hazards resulting from the presence of combustible liquids, solids or other flammable materials. Detection is also provided in other areas on a case basis.

Portable hand-held extinguishers, primarily dry chemical, CO_2, Halon 1211 and water, are provided at strategic locations throughout the various plant buildings.

A detailed discussion on this system is presented in Subsection 9.5.1.

1.2.8.11 Lighting Systems

The lighting systems provide the illumination required for plant operation and maintenance, and for personnel safety and convenience. Upon loss of offsite power, AC emergency lighting is powered by the diesel generators to provide continued onsite lighting. Upon loss of all AC power, DC lighting is provided for immediate short-term illumination.

A detailed discussion on these systems is presented in Subsection 9.5.3.

1.2.8.12 Communication System

The communications system provides for intraplant and offsite communications. The system consists of telephone, public address, sound-powered telephone, plant radio system and microwave link. The five subsystems are totally independent of each other so that a failure in one does not affect the others.

A detailed discussion on this system in Subsection 9.5.2.

1.2.8.13 Radiation Data Management System

The Radiation Data Management System consists of three subsystems: process and effluent radiation monitoring system, area radiation monitoring system, airborne and particulate radioactivity monitoring system.

A detailed discussion on this system is presented in Sections 11.5 and 12.3.

1.2.9 Steam and Power Conversion System

1.2.9.1 Main Steam Supply System

Steam is supplied from the outlet of four steam generators, taking heat from the Pressurized Water Reactor Coolant System to drive the turbine. Each steam line includes a flow restrictor, power-operated atmospheric relief valve, safety valves and isolation valve. The Main Steam System also provides primary steam to the reheaters, steam generator feed pumps and the seal system.

A detailed discussion on this system is presented in Section 10.3.

1.2.9.2 Turbine Generator

The turbine generator nameplate output is 1,304,003 kW at rated conditions. The turbines are six flow tandem compound 1800 rpm machines with 43-inch last stage buckets. The throttle steam conditions are 960 psig, 1192H with one stage of reheat. The unit has six stages of feedwater heating fed by extraction steam from the turbines. Steam from the moisture separator/reheaters is used to supply two turbine-driven steam generator feed pumps during normal operation. The rating of the generator output is 1,373,100 kVA at 1800 rpm, 3-phase 60 Hz, 0.94 power factor, 0.52 short circuit ratio and a rated hydrogen pressure of 75 psig.

A detailed discussion is presented in Section 10.2.

1.2.9.3 Main Condensers/Condenser Evacuation System

The condenser system consists of three deaerating, double-pass, single pressure, radial flow-type surface condensers, having titanium tubes. A condenser air evacuation system removes noncondensible gases from the main condensers of the unit and delivers these gases to the atmosphere after monitoring for radioactivity.

A detailed discussion on this system is presented in Subsections 10.4.1 and 10.4.2.

1.2.9.4 Condensate and Feedwater System

The Condensate and Feedwater System takes suction from the main condenser hotwell and heater drain tank and delivers feedwater to the steam generators at increased temperature and pressure. A startup feedwater pump is provided to deliver the required flow of water to the steam generators during startup, hot standby and shutdown.

A detailed discussion on this system is presented in Section 10.4.

1.2.9.5 Secondary Component Cooling Water System

The Secondary Component Cooling Water System removes heat from the turbine accessories and auxiliary equipment and transfers the heat to the Service Water System.

A detailed discussion on this system is presented in Subsection 10.4.10.

1.2.9.6 Steam Generator Blowdown System

The Steam Generator Blowdown System receives, processes and recycles water from the secondary side of the steam generators. The blowdown from each of the four steam generators is routed to a flash tank where the flashed steam is removed and routed to the main condenser. Residual liquid from the flash tank may be further processed through the Waste Liquid System if found to be radioactive; otherwise, it is recycled back to the plant for storage and/or use, or discharged to the Circulating Water System.

A detailed discussion on this system is presented in Subsection 10.4.8.

1.2.9.7 Circulating Water System

Cooling of the Main Condenser System is via water taken from the Atlantic Ocean through one 19-foot diameter tunnel which is pumped through the three condenser shells. The heated water is returned to the ocean through one 19-foot diameter tunnel with diffusers.

A detailed discussion is presented in Subsections 9.2.5 and 10.4.5.

1.2.10 Radioactive Waste Management

1.2.10.1 Liquid Waste Management System

The Liquid Waste System stores and processes nonrecoverable radioactive liquid waste from various sources throughout the plant. The system normally uses a combination of filtration and demineralization to convert the waste into a liquid acceptable for discharge to the environment and a concentrate suitable for solidification. Permanently installed evaporators may be used as an alternate method for processing liquids.

A detailed discussion on this system is presented in Section 11.2.

1.2.10.2 Gaseous Waste Management System

The Radioactive Gaseous Waste System is designed to collect and process fission product gases from the reactor coolant letdown stream and from the liquids collected in the reactor coolant drain tank and primary drain tank. This system is also used to recycle hydrogen as well as introduce makeup hydrogen from the storage system.

A detailed discussion on this system is presented in Section 11.3.

1.2.10.3 Solid Waste Management System

The Solid Waste Management System consists of the following subsystems: spent resin sluicing, Dry Active Waste (DAW) volume reduction, alternate solidification, and volume reduction and solidification in asphalt. Volume reduction and solidification is further broken down to waste concentrates handling, spent resin handling, liquid waste volume reduction, and material handling.

A detailed discussion on the Solid Waste Management System is presented in Section 11.4.

1.3 COMPARISON TABLES

Comparison Table 1.3-1 and Table 1.3-2 are provided in the Updated FSAR for continuity with the original FSAR. These tables have not been revised for the Updated FSAR.

1.3.1 Comparisons with Similar Facility Designs

Table 1.3-1 provides a summary of principal design similarities and differences between Seabrook Station and other nuclear power plants using the same NSSS supplier. The comparison covers the reactor design, the engineered safety features, containment concept, the instrumentation and electrical systems, the Radioactive Waste Management System, and other principal systems. The plants selected for the comparison were W. B. McGuire Nuclear Station (Duke Power Company), Comanche Peak Steam Electric Station (Texas Utilities Generating Company), and Byron/Braidwood Station (Commonwealth Edison Company).

A detailed comparison of principal nuclear, thermal-hydraulic, and mechanical design parameters between the Seabrook and W. B. McGuire reactors is presented in Table 4.1-1.

1.3.2 Comparison of Final and Preliminary Information

Table 1.3-2 outlines the significant design changes that have been made since the submittal of the Preliminary Safety Analysis Report (PSAR).

1.4 IDENTIFICATION OF AGENTS AND CONTRACTORS

1.4.1 Applicants

Public Service Company of New Hampshire (PSNH), the former principal owner, was responsible for the design, construction, and startup of Seabrook Station. FPLE Seabrook is currently responsible for the operation of Seabrook Station. The following contractors and service organizations were engaged to perform engineering, design, procurement, construction and technical support services for the construction and operation of Seabrook Station.

1.4.2 Yankee Atomic Electric Company

PSNH contracted with Yankee Atomic Electric Company (YAEC) for the services of certain personnel involved in project engineering, licensing, and fuel supply. In addition, PSNH contracted with YAEC for establishing and implementing the Quality Assurance Program for design and construction.

1.4.3 Westinghouse Electric Corporation

Westinghouse Electric Corporation was contracted to design, fabricate and deliver the Nuclear Steam Supply System (NSSS) and nuclear fuel for the plant. Westinghouse also provided technical assistance for installation and startup of their supplied equipment. NSSS equipment is listed in Table 3.2-2.

1.4.4 United Engineers & Constructors Inc.

United Engineers & Constructors (Philadelphia, Pennsylvania) provided engineering, design and procurement services for the balance of plant. As Construction Managers, UE&C directed construction of the plant by the various subcontractors and also provided technical assistance in the startup program when requested. In July 1984 various subcontractors were terminated and UE&C assumed responsibility for direction of the majority of the construction labor forces. Balance-of-plant equipment supplied through UE&C is listed in Table 3.2-2.

1.4.5 General Electric Company

The turbine generators for Seabrook Station were supplied by General Electric Company.

1.4.6 Major Construction Contractors

Other major construction contractors or subcontractors that provided construction services are listed below:

Organization	Construction Service
Daniel O'Connell's Sons, Inc.	Site preparation (excavation)
Phillips, Getschow Co.	Yard and fire pumphouse piping
Pittsburgh Test Laboratory	Field testing laboratory services
Perini Corporation	General concrete
Pittsburgh-DesMoines Steel Co.	Containment liner and field fabricated tanks.
Pullman Inc./J.C. Higgins Co., Inc.	Piping and mechanical equipment installation
Fischbach and Moore Inc. E.S. Boulos Div.	Electrical installation
Manzi Electrical Corp.	Electrical installation
Morrison Knudsen	Tunneling and marine work
Johnson Controls Inc.	Instrument installation
Grinnel Fire Protection Systems	Fire protection systems
Bisco	Penetration fire seals

1.4.7 Service Organizations

The services of various technical support organizations were used during the design and construction of Seabrook Station. A list of the major consultants include the following:

Organization	Consultation Service
Weston Geophysical Research Jack Rand	Geology & seismology
American Drilling & Boring Warren George	Core Drilling
Geotechnical Engineering	Geotechnical & soils
TRC	Meteorology

Organization	Consultation Service
Dames & Moore	Hydrometeorology
Alden Research Laboratories	Hydraulic & model testing
Environmental Research & Technology	Demography
Wilbur Smith	Traffic Study
Marc Analysis Research	Computer program analysis (containment)
Wiss, Janney, Elstner & Assoc.	Containment liner anchor load test
Erlin-Himes Assoc.	Concrete test evaluation
Construction Engineering Consultants	Concrete mix design
Teledyne Engineering Services	Piping analysis
NUCON	Gaseous waste system design
Applied Research Assoc., Inc.	Tornado missile evaluations
Pickard, Lowe & Garrick	Probabilistic risk assessment
Sheridan Associates	Detailed control room design review
Impell	Environmental qualification review
Cynga	Piping analysis
Bechtel	Cable tray analysis
Ebasco	General consulting services

1.5 REQUIREMENTS FOR FURTHER TECHNICAL INFORMATION

Reference 1 presents descriptions of the safety-related research and development programs that have been carried out for, or by, or in conjunction with Westinghouse Nuclear Energy Systems, and which are applicable to Westinghouse pressurized water reactors.

The technical information generated by these research and development programs is used either to demonstrate the safety of the design and more sharply define margins of conservatism, or leads to design improvements.

Included in the overall research and development effort is the program described below that is applicable to this plant, but is not required for issuance of an Operating License.

1.5.1 Blowdown Heat Transfer Testing

1.5.1.1 Introduction

The NRC acceptance criteria for emergency core cooling systems (ECCSs) for light-water power reactors was issued in Section 50.46 of 10 CFR 50 on December 28, 1973. It defines the basis and conservative assumptions to be used in the evaluation of the performance of ECCSs. Westinghouse believes that some of the conservatism of the criteria is associated with the manner in which transient critical heat flux (CHF) phenomena are treated in the evaluation models. Transient critical heat flux data presented at the 1972 specialists meeting of the Committee on Reactor Safety Technology (CREST) indicated that the time to CHF can be delayed under transient conditions. To demonstrate the conservatism of the ECCS evaluation models, Westinghouse initiated a program to experimentally simulate the blowdown phase of a loss-of-coolant accident (LOCA). This testing was part of the Electric Power Research Institute (EPRI) sponsored Blowdown Heat Transfer Program, that was started in early 1976. Testing was completed in 1979. A CHF correlation will be developed by Westinghouse from these test results for use in the ECCS analyses.

1.5.1.2 Objective

The objective of the Blowdown Heat Transfer Test was to determine the time that CHF occurs under LOCA conditions. This information will be used to confirm the existing, or develop a new Westinghouse transient correlation. The steady-state CHF data obtained from 15x15 and 17x17 assembly test programs can be used to assure that the geometrical differences between the two fuel arrays can be correctly treated in the transient correlations.

1.5.1.3 Program

The program was divided into two phases. Phase I tests were initiated from steady-state conditions, with sufficient power to maintain nucleate boiling throughout the bundle. Controlled ramps of decreasing test section pressure or flow initiated CHF. By applying a series of controlled conditions, investigation of the CHF is studied over a range of qualities and flows, and at pressures relevant to a pressurized water reactor blowdown. Phase I provided separate-effects data for heat transfer correlation development. Typical parameters used for Phase I testing are shown on Table 1.5-1.

Phase II simulates pressurized water reactor behavior during a LOCA to permit definition of the time delay associated with onset of CHF. Tests in this phase covered the large double-ended guillotine cold leg break. The test in Phase II was also started after establishment of typical steady-state operating conditions. The fluid transient was then initiated, and the rod power decay programmed to simulate the actual heat input of fuel rods. The test was terminated when the heater rod temperatures reached a predetermined limit. Typical parameters used for Phase II testing are shown on Table 1.5-2.

1.5.1.4 Test Description

The experimental program was conducted in the J-Loop at the Westinghouse Forest Hills Facility with a full length 5x5 rod bundle simulating a section of a 15x15 assembly to determine CHF occurrence under LOCA conditions.

The heater rod bundle used in this program consists of internally heated rods, capable of a maximum power of 18.8 kW/ft, with a total power of 135 kW (for extended periods) over the 12-foot heated length of the rod. Heat was generated internally by means of a varying cross-sectional resistor which approximates a chopped cosine power distribution. Each rod was adequately instrumented with a total of 12 clad thermocouples.

1.5.1.5 Results

The experiments in the J-Loop facility resulted in cladding temperature and fluid properties measured as a function of time throughout the blowdown range from 0 to 20 seconds.

Facility modifications and installation of the initial test bundle have been completed. A series of shakedown tests in the J-Loop have been performed. These tests provided data for instrumentation calibration and check-out, and provided information regarding facility control and performance. Initial program tests were performed during the first half of 1975. Under the sponsorship of EPRI, testing was reinitiated during 1976 on the same test bundle. The testing was terminated in November of 1976 and further testing with a new test bundle was conducted

during 1978-79. A CHF correlation will be developed from these test results for use in the Westinghouse ECCS analyses.

1.5.2 References

1. Eggleston, F.T., "Safety-Related Research and Development for Westinghouse Pressurized Water Reactors, Program Summaries," WCAP-8768, Revision 2, October, 1978.

1.6 MATERIAL INCORPORATED BY REFERENCE

Table 1.6-1 lists topical reports with information additional to that provided in the UFSAR which have been filed separately with the Nuclear Regulatory Commission (NRC) in support of this and similar applications.

1.7 DRAWINGS AND OTHER DETAILED INFORMATION

FPLE Seabrook maintains configuration control under which selected design drawings are regularly updated to reflect changes in the facility implemented under the FPLE Seabrook and previous contractor Design Control Programs. Design drawings include the following examples:

DISCIPLINE: SYSTEMS

DESCRIPTION

Piping and Instrumentation Diagram, (B series)

Data sheets for motor- and air-operated valves and dampers 1-NHY-250000

Engineering Safety Features Flow Diagram 1-NHY-804979

DISCIPLINE: INSTRUMENT AND CONTROL DIAGRAMS

Logic diagrams

Loop diagrams

Westinghouse block diagrams

Safeguard information

DISCIPLINE: ELECTRICAL

NHY schematics

Foreign prints

Control wiring diagrams (CWDs)

NHY Drawings

1) Single line diagrams

2) Substation drawings

Appendix "R" emergency lighting

Bus failure analysis

Design drawing current revision status is reflected on the Document Distribution System (DDS) Report.

The original FSAR contained tables in this section which listed all design drawing numbers, drawing titles, revision numbers and dates. This listing was voluminous and the regular updating of drawings resulted in much of the listing being out of date.

The Updated FSAR does not contain a complete list of design drawings. A cross-reference list for those figures included in the Updated FSAR is provided in Table 1.1-1.

1.8 CONFORMANCE TO NRC REGULATORY GUIDES

This section addresses the degree of conformance to each of the applicable NRC Division I regulatory guides.

Where strict conformance to the requirements or guidelines of Regulatory Guides or Standards would conflict with reasonable compliance to the ALARA guidelines of Regulatory Guide 8.8, the degree of such conformance will be determined by appropriate levels of management.

Regulatory Guide 1.1

(Rev. 0, 11/70) Net Positive Suction Head for Emergency Core Cooling and Containment Heat Removal System Pumps

The BOP design complies fully with Regulatory Guide 1.1.

The NSSS is designed to an acceptable alternative method rather than Regulatory Guide 1.1.

This subject is further discussed in Subsection 6.3.2.2.

Regulatory Guide 1.2

(Rev. 0, 11/70) Thermal Shock to Reactor Pressure Vessels

All the recommendations of Regulatory Guide 1.2 have been followed. For further discussion, refer to Section 5.3.

Regulatory Guide 1.3

(Rev. 2, 6/74) Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Boiling Water Reactors

This regulatory guide is not applicable to Seabrook Station.

Regulatory Guide 1.4

(Rev. 2, 6/74) Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss-of-Coolant Accident for Pressurized Water Reactors

The requirements of Regulatory Guide 1.4, Rev. 2, have been met with the following exceptions:

Section c.2.d

The iodine dose conversion factors given in ICRP Publication 2, Report of Committee II, "Permissible Dose for Internal Radiation," 1959, have not been used. Instead, the iodine dose conversion factors presented in Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," USNRC (October 1977), have been used.

Section c.2.e

The equations presented for beta dose rates and gamma dose rates from an infinite cloud have not been used. Instead, external whole body gamma doses and beta plus gamma skin doses are evaluated using a semi-infinite cloud model for atmospheric dispersion and the gamma and beta dose conversion factors presented in Regulatory Guide 1.109.

A discussion of dose methodology used is presented in Appendix 15A to Chapter 15.

Section c.2.g

The atmospheric diffusion model presented has not been used. Instead, the atmospheric dispersion model presented in Regulatory Guide 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants" USNRC, August 1979, has been used.

A discussion of the short-term (accident) diffusion estimates is presented in Subsection 2.3.4 and Appendix 15B to Chapter 15.

Regulatory Guide 1.5

(Rev. 0, 3/71) Assumptions Used for Evaluating the Potential Radiological Consequences of a Steam Line Break Accident for Boiling Water Reactors

This regulatory guide is not applicable to Seabrook Station.

Regulatory Guide 1.6

(Rev. 0, 3/71) Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems

The design totally conforms with the recommendations of this regulatory guide.

The subject matter of this guide is discussed in Subsections 8.1.5.3.a, 8.3.1.1, 8.3.1.2 and 8.3.2.2.

Regulatory Guide 1.7

(Rev. 2, 11/78) Control of Combustible Gas Concentrations in Containment Following a Loss-of-Coolant Accident

Seabrook Station employs a large dry containment for containing fission gases and aerosols following an accident, in accordance with GDC 50. Any hydrogen generated during an accident is controlled per GDC 5, 41, 42, 43 and 10 CFR 50.44.

Regulatory Guide 1.7, Rev. 3 details an acceptable method of showing compliance with the GDC. The design of the Seabrook plant, considering the Westinghouse scope of supply, was analyzed against GDC 41 and 50, using assumptions specified in Rev. 3 of this guide.

The BOP design complies fully with Regulatory Guide 1.7, Rev. 3 and provides the capability to continuously measure the concentration of hydrogen in the containment atmosphere following a beyond-design-basis accident for accident management, including emergency planning.

Refer to Subsection 6.2.5 for further discussion of this subject.

Regulatory Guide 1.8

(Rev. 3, 5/00) Qualification and Training of Personnel for Nuclear Power Plants

Endorses ANSI/ANS-3.1-1993 for experience requirement sections 4.4.1, “Operations Shift Supervisor,” 4.4.2, “Senior Operator,” 4.5.1, “Reactor Operator,” and 4.6.2, “Shift Technical Advisor” with the exceptions as noted in Regulatory Guide 1.8, Revision 3.

(Rev. 2, 4/87) Qualification and Training of Personnel for Nuclear Power Plants

Endorses ANS 3.1/ANSI N18.1-1971 - and Section 4.4.4, "Radiation Protection" of ANSI/ANS 3.1-1981.

The personnel selection and training program meets the requirements of Regulatory Guide 1.8 (1987 edition), except that ANSI/ANS 3.1-1978 will be used as the standard rather than ANS 3.1/ANSI N18.1-1971 except as discussed in the UFSAR Sections noted below.

The Nuclear Oversight Manager will meet the requirements for "Professional Technical" positions in ANSI N18.1-1971 as endorsed by Regulatory Guide 1.8, Revision 2.

With regard to Section 4 of ANS 3.1-1978, individuals other than the Nuclear Oversight Manager, who do not possess the formal requirements specified in this section shall not be automatically eliminated where other factors provide sufficient demonstrations of their abilities. The requirement in Section 4.2.2 for the Operations Manager to hold a senior reactor operator's license is modified to require this individual to hold or have held a senior reactor operator's license at Seabrook Station prior to assuming the Operations Manager position, which is consistent with ANS 3.1-1987. A retraining and replacement licensed training program for the Station Staff shall be maintained under the direction of the Training Manager in accordance with the Seabrook Station Institute of Nuclear Power Operations (INPO) Accredited Programs.

For further clarification and alternatives, see discussion in Sections 13.1, 13.2, and in Regulatory Guide 1.58 appearing later in this section.

Regulatory Guide 1.9

(Rev. 2, 12/79) Selection of Diesel Generator Set Capacity Standby Power Supplies

The diesel generator design is in general conformance with the recommendations of Regulatory Guide 1.9.

Position C.14 requires that the engine run at full load for 22 hours, following 2 hours at short-time rated load. For Seabrook, a "Load Capability Qualification" test was performed per IEEE 387-1977. The engine was run at full load for 22 hours after reaching equilibrium temperature, followed by 2 hours at the short-time rated load.

The subject matter of this guide is discussed in Subsections 8.1.5.3.b and 8.3.1.

Regulatory Guide 1.10

(Rev. 1, 1/73) — Mechanical (Cadweld) Splices in Reinforcing Bars of Category I Concrete Structures

The requirements for crew qualification, inspection, testing and sampling of mechanical splices in reinforcing bars of concrete structures comply with the regulatory positions outlined in Regulatory Guide 1.10, Rev. 1, except that retesting due to the failure of production and sister mechanical splices is in accordance with ASME Section III, Division 2, 1975 edition and Article CC-4333.4.5(b) of the Winter 1979 Addenda in lieu of the corresponding article in the 1975 code. For further discussion on this subject, refer to Subsection 3.8.1.6.

This regulatory guide was withdrawn on July 8, 1981, and superseded by Regulatory Guide 1.136, Rev. 2, 6/81.

Regulatory Guide 1.11

(Rev. 0, 3/71) — Instrument Lines Penetrating Primary Reactor Containment

The design of instrument lines penetrating primary containment conforms with the intent of Regulatory Guide 1.11, except where modified by Regulatory Guide 1.141.

Additional discussion relative to containment isolation systems is provided in Subsections 6.2.4.1.d, 6.2.4.2m, 7.1.2.2a, and 7.3.1.1b.

Regulatory Guide 1.12

(Rev. 1, 4/74) — Instrumentation for Earthquakes

Seismic instrumentation has been selected to provide a basis for comparing recorded response to that used as a design basis. This instrumentation is in compliance with the seismic instrumentation program described in Regulatory Guide 1.12, Rev. 1, and as applicable, ANSI 2.2, "Earthquake Instrumentation Criteria for Nuclear Power Plants." For further discussion and exceptions to Regulatory Guide 1.12, Rev. 1, see Subsections 3.7(B).4.1 and 3.7(B).4.2.

Regulatory Guide 1.13

(Rev. 1, 12/75) Spent Fuel Storage Facility Design Basis

The design complies with the intent of Regulatory Guide 1.13, Rev. 1. No loss of water from the spent fuel storage area can occur as a result of cask drop [Historical Event] and liner failure, since the spent fuel storage area is isolated by a gate during cask handling operations. See Subsection 9.1.2 for a discussion on the detailed design.

Regulatory Guide 1.14

(Rev. 1, 8/75) Reactor Coolant Pump Flywheel Integrity

The NSSS design follows the recommendations of Regulatory Guide 1.14, Rev. 1, except for the following:

a. Post-Spin Inspection

Westinghouse has shown in Reference 1 that the flywheel would not fail at 290 percent of normal speed for a flywheel flaw of 1.15 inches or less in length. Results for a double-ended guillotine break at the pump discharge, with full separation of pipe ends assumed, showed the maximum overspeed to be less than 110 percent of normal speed. The maximum overspeed was calculated in Reference 1 to be about 280 percent of normal speed for the same postulated break, and an assumed instantaneous loss of power to the reactor coolant pump. In comparison with the overspeed presented above, the flywheel is tested at 125 percent of normal speed. Thus, the flywheel could withstand a speed up to 2.3 times greater than the flywheel spin test speed of 125 percent provided that no flaws greater than 1.15 inches are present. If the maximum speed were 125 percent of normal speed or less, the critical flaw size for failure would exceed 6 inches in length. Nondestructive tests and critical dimension examinations are all performed before the spin tests. The inspection methods employed (described in Reference 1) provide assurance that flaws significantly smaller than the critical flaw size of 1.15 inches for 290 percent of normal speed would be detected. Flaws in the flywheel will be recorded in the pre-spin inspection program (see Reference 1). Flaw growth attributable to the spin tests (i.e., from a single reversal of stress, up to speed and back), under the most adverse conditions, is about three orders of magnitude smaller than that which nondestructive inspection techniques are capable of detecting. For these reasons, Westinghouse performs no post-spin inspections and believes that pre-spin test inspections are adequate.

b. Interference-Fit Stresses and Excessive Deformation

Much of Revision 1 to Regulatory Guide 1.14 deals with stresses in the flywheel resulting from the interference fit between the flywheel and the shaft. Because the NSSS design specifies a light interference fit between the flywheel and the shaft, at zero speed the hoop stresses and radial stresses at the flywheel bore are negligible. Centering of the flywheel relative to the shaft is accomplished by means of keys and/or centering devices attached to the shaft, and at normal speed, the flywheel is not in contact with the shaft in the sense intended by Revision 1 of Regulatory Guide 1.14. Hence, the definition of "Excessive Deformation," as defined in Revision 1 of Regulatory Guide 1.14, is not applicable to this design since the enlargement of the bore and subsequent partial separation of the flywheel from the shaft does not cause unbalance of the flywheel. Extensive Westinghouse experience with reactor coolant pump flywheels installed in this fashion has verified the adequacy of the design.

The combined primary stress levels, as defined in Revision 1 of Regulatory Guide 1.14 (Regulatory Positions C.2.a and C.2.c) are both conservative and proven, and no changes to these stress levels are necessary. The flywheels are designed to these stress limits and, thus, do not have permanent distortion of the flywheel bore at normal or spin test conditions.

c. Discussion B, Cross-Rolling Ratio of 1 to 3

Specification of a cross-rolling ratio is considered unnecessary since past evaluations have shown that ASME SA-533, Grade B, Class 1 materials produced without this requirement have suitable toughness for typical flywheel applications.

Proper material selection and specification of minimum material properties in the transverse direction adequately ensure flywheel integrity. An attempt to gain isotropy in the flywheel material by means of cross-rolling is unnecessary since adequate margins of safety are provided by both flywheel material selection (ASME SA-533, Grade B, Class 1) and by specifying minimum yield and tensile levels and toughness test values taken in the direction perpendicular to the maximum working direction of the material.

Regulatory Guide 1.15

(Rev. 1, 12/18/72) Testing of Reinforcing Bars for Category I Concrete Structures

The requirements for testing and inspection of reinforcing bars for all seismic Category I concrete structures comply fully with Regulatory Guide 1.15, Rev. 1. Containment reinforcing bar testing is discussed further in Subsection 3.8.1.6.

This Regulatory Guide was withdrawn on July 8, 1981, and superseded by Regulatory Guide 1.136, Rev. 2, 6/81.

Regulatory Guide 1.16

(Rev.. 4, 8/75) Reporting of Operating Information -Appendix A, Technical Specifications

The reporting of Operating Information, as required by the Technical Specifications, meets the requirements of Regulatory Guide 1.16, Rev. 4.

Regulatory Guide 1.17

(Rev. 1, 6/73) Protection of Nuclear Power Plants Against Industrial Sabotage

A security plan has been developed and implemented for the Seabrook project which meets the intent of Regulatory Guide 1.17, Rev. 1. The plan has been submitted to the NRC in a separate topical report as a proprietary document.

Regulatory Guide 1.18

(Rev. 1, 12/28/72) Structural Acceptance Test for Concrete Primary Reactor Containments

This Regulatory Guide to be used for information only. Refer to Subsection 3.8.1.7a for detailed discussion.

This regulatory guide was withdrawn on July 8, 1981, and superseded by Regulatory Guide 1.136, Rev. 2, 6/81.

Regulatory Guide 1.19

(Rev. 1, 8/72) Nondestructive Examination of Primary Containment Liner Welds

The codes and methods presented in Regulatory Guide 1.19 for nondestructive examination of primary containment welds were utilized. Inspections were performed in accordance with Article CC-5000 of Division 2 of ASME III. Refer to Subsection 3.8.1.6.

This Regulatory Guide was withdrawn on July 8, 1981, and superseded by Regulatory Guide 1.136, Rev. 2, 6/81.

Regulatory Guide 1.20

(Rev. 2, 5/76) Comprehensive Vibration Assessment Program for Reactor Internals During Preoperational and Initial Startup Testing

The recommendations of Regulatory Guide 1.20, Rev. 2, were met by conducting the confirmatory preoperational testing examination. Instrument tests are not considered necessary. For further discussion on this subject, refer to Subsection 3.9(N).2.4.

Regulatory Guide 1.21

(Rev. 1, 6/74) Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants

The design guidance of Regulatory Guide 1.21 for the selection of locations and type of effluent measurements to cover all major or potentially significant pathways of release of radioactive materials during normal reactor operation, including anticipated operational occurrences, is incorporated into the station design and the requirements of the Technical Specifications and the Offsite Dose Calculation Manual (ODCM).

UFSAR Section 11.5 describes in detail, the process and effluent monitoring system and sampling system. Technical Specifications and the Offsite Dose Calculation Manual (ODCM) delineate the radioactive liquid and gaseous waste sampling and analysis program requirements. The requirements for solid waste handling are also addressed.

The instrument calibration program for instrumentation that supports the requirements of Regulatory Guide 1.21 is described in the ODCM.

The calibration of additional instrumentation described as part of the effluent monitoring systems in UFSAR Section 11.5 will be in accordance with written station procedures.

The reporting of radioactivity in solid, liquid, and gaseous waste released from site, including the estimation impact on man, will be in accordance with station Technical Specifications and the ODCM which reference the use of Regulatory Guide 1.21 for reporting format.

Regulatory Guide 1.22

<u>(Rev. 0, 2/72)</u> <u>Periodic Testing of Protection System Actuation Functions</u>

NSSS systems meet the recommendations of Regulatory Guide 1.22, as discussed in Subsections 7.1.2.5, 8.1.5.3 and 8.3.1.

The BOP protection system design is in conformance with IEEE Standard 279-1971. All safety actuation circuitry is provided with a capability for testing with the reactor at power. The protection system, including the engineered safety features test cabinet design, complies with Regulatory Guide 1.22. Periodic testing of protection systems associated with the diesel generators is in accordance with Regulatory Guide 1.22, as supplemented by Regulatory Guide 1.108, Rev. 1.

Regulatory Guide 1.23

(Rev. 0, 2/72) <u>Onsite Meteorological Programs</u>

The Operational Primary Meteorological Monitoring System described in Subsection 2.3.3 conforms to Regulatory Guide 1.23 with the following exceptions:

- Since the base of the Primary Meteorological Tower is located approximately 10 feet (3 meters) below plant grade, the lower level sensors are placed 43 feet (13 meters) above ground level in order to be located 33 feet (10 meters) above plant grade.

- The Primary Meteorological Monitoring System performance requirements for wind speed, wind direction, and delta-temperature are those specified in Regulatory Guide 1.97 (Rev. 3). Compliance with these requirements is discussed in Subsection 2.3.3.

Regulatory Guide 1.24

(Rev. 0, 3/72) Assumptions Used for Evaluating the Potential Radiological Consequences of a Pressurized Water Reactor Radioactive Gas Storage Tank Failure

The design and operational bases of the Radioactive Gaseous Waste Disposal System (RGWS) preclude the unilateral assumption that the entire noble gas inventory of the Reactor Coolant System following a cold shutdown near the end of an equilibrium core is stored in one gas decay tank. The maximum activity that could be released as a result of a gas decay tank failure is the activity stored in one gas decay tank plus associated piping during the period immediately before the tank has been isolated from the RGWS. The activity is such that the offsite dose resulting from a tank failure will be well below 10 CFR 100 guidelines. The design of the RGWS prohibits the transfer of all the gaseous radioactivity in the primary coolant immediately following a cold shutdown at the end of an equilibrium core cycle to one gas decay tank. Thus, Section C.1.a of Regulatory Guide 1.24 is not valid for the analysis of the radiological consequences of a gas decay tank failure for this plant design. For additional discussion, see Subsection 15.7.1.

Regulatory Guide 1.25

(Rev. 0, 3/72) Assumptions Used for Evaluating the Potential Radiological Consequences of a Fuel Handling Accident in the Fuel Handling and Storage Facility for Boiling and Pressurized Water Reactors

The assumptions in Regulatory Guide 1.25 related to the release of radioactive material from the fuel and fuel storage facility as a result of a fuel handling accident are utilized in the accident analysis described in Subsection 15.7.4, except for the iodine removal efficiencies of the Engineered Safeguard Filter System. The iodine removal efficiencies for this system are assumed to be 95 percent for inorganic iodine and 90 percent for the organic form (see Appendix 15B), based on the design of this system as described in Subsection 6.5.1.

Site specific meteorological data are used to calculate the atmospheric dispersion concentrations in conjunction with the methods described in Section 2.3 in place of the default meteorology represented in Figure 1 of Regulatory Guide 1.25.

Regulatory Guide 1.26

(Rev. 3, 2/76) Quality Group, Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants

The component classification system defined in ANSI N18.2-1973 "Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants" and ANSI N18.2a - 1975 "Revision and Addendum to Nuclear Safety Criteria for the Design of Stationary Pressurized Water Reactor Plants" has been employed as an alternate method for meeting the intent of Regulatory Guide 1.26, Rev. 3.

Refer to Section 3.2 for further discussion of this subject.

Regulatory Guide 1.27

(Rev. 2, 1/76) Ultimate Heat Sink for Nuclear Power Plants

The design is committed to the availability of sufficient cooling tower makeup water in the tower basin for seven days of operation during accident conditions in the event that cooling tower water is unavailable from the main circulating water tunnels. (Regulatory Guide 1.27 requires 30 days.) During this time period, provisions can be made to transport additional makeup water to the site. If necessary, salt water can be pumped into the tower basin from the nearby Brown's River or Hampton Harbor. A portable, self priming, diesel-driven pump is stored onsite along with sufficient lengths of hose for this pump. For additional discussion, refer to Subsection 9.2.5.

Regulatory Guide 1.28

(Rev. 2, 2/79) Quality Assurance Program Requirements (Design and Construction) Endorses ANSI N45.2-1977

The quality assurance program for the BOP during design and construction for safety-related equipment, described in Subsections 17.1.1 and 17.1.2, complied with the requirements of ANSI N45.2 and satisfied Regulatory Guide 1.28, Rev. 2.

The quality assurance program implemented for the NSSS was discussed in Subsection 17.1.3.

This guide and the standard it endorses have been superseded for operations activities by Regulatory Guide 1.33 and ANSI N18.7-1976 which it endorses.

The operational phase complies with ASME NQA-1, 1994 and commitment to Regulatory Guide 1.28 (Safety Guide 28) is per the FPL Quality Assurance Topical Report section A.7.

Regulatory Guide 1.29

(Rev. 3, 9/78) Seismic Design Classification

The BOP design complies fully relative to Regulatory Guide 1.29, Rev. 3.

The NSSS design classifies each component important to safety as Safety Class 1, 2 or 3. These classes are qualified to remain functional in the event of the safe shutdown earthquake (SSE), except where exempted by meeting all of the below requirements. Portions of systems required to perform the same safety function as required of a safety Class component which is part of that system shall be likewise qualified or granted exemption. Conditions to be met for exemption are:

a. Failure would not directly cause a Condition III or IV event (as defined in ANSI N18.2-1973).

b. There is no safety function to mitigate, nor could failure prevent mitigation of, the consequences of a Condition III or IV event.

c. Failure during or following any Condition II event would result in consequences no more severe than allowed for a Condition III event.

d. Routine post-seismic procedures would disclose loss of the safety function.

For further discussion, refer to Section 3.2 and Subsection 10.4.7.

Regulatory Guide 1.31

(Rev. 3, 4/78) Control of Ferrite Content in Stainless Steel Weld Metal

The BOP design complies with the intent of Regulatory Guide 1.31, Rev. 3. Refer to Subsection 6.1.1.

The control of delta ferrite in stainless steel welding for NSSS equipment is discussed in Subsection 5.2.3.

Regulatory Guide 1.32

(Rev. 2, 2/77) Criteria for Safety-Related Electric Power Systems for Nuclear Power Plants

The safety-related electric power systems design conforms with the recommendations of Regulatory Guide 1.32, Rev. 2, with the following exceptions:

The response to Regulatory Guide 1.75 in this UFSAR Subsection addresses conformance to Regulatory Guide 1.75 which is referenced in Regulatory Guide 1.32 Positions C.1.d and C.1.e.

Regulatory Guide 1.32 states in Position C.1.c that "That battery service test described in IEEE Std 450-1975 should be performed in addition to the battery performance discharge test." The Technical Specifications require service tests at least once per 18 months and performance discharge tests at least once per 60 months. However, the Technical Specifications allow the performance discharge test to be performed in lieu of (not in addition to) the service test once per 60 month interval.

Regulatory Guide 1.32 states in Position C.1.c that "The battery service test should be performed during refueling operations or at some other outage, with the intervals between tests not to exceed 18 months."

The Technical Specifications permit the battery service test to be performed during non-outage periods. The Seabrook Station design incorporates two 100% capacity battery banks per train. Removing one of these battery banks from service for surveillance testing does not reduce the system capabilities. The Regulatory Guide assumes only one 100% capacity battery bank per train.

The subject matter of Regulatory Guide 1.32 is further discussed in Subsections 8.1.5.3, 8.3.1 and 8.3.2.

Regulatory Guide 1.33

(Rev. 2, 2/78) Quality Assurance Program Requirements (Operation)

See FPL Quality Assurance Topical Report

Regulatory Guide 1.34

(Rev. 0, 12/72) Control of Electroslag Weld Properties

Where electroslag welding is used in fabricating components, vendors are required to follow the recommendations of Regulatory Guide 1.34.

Regulatory Guide 1.35

(Rev. 2, 1/76 — Inservice Surveillance of Ungrouted Tendons in Prestressed Concrete Containment Structures

This guide is not applicable, since a steel reinforced concrete containment structure is used.

Regulatory Guide 1.36

(Rev. 0, 2/73) — Nonmetallic Thermal Insulation for Austenitic Stainless Steel

The design complies with the recommendations of this guide.

For further discussion, refer to Subsection 6.1.1.

Regulatory Guide 1.40

(Rev. 0, 3/73) — Qualification Tests of Continuous-Duty Motors Installed Inside the Containment of Water-Cooled Nuclear Power Plants

The qualification test recommendations of Regulatory Guide 1.40 have been followed. Details of the qualification of specific motors are contained in Reference 15. Refer to Section 3.11 for additional discussion of environmental qualification.

Regulatory Guide 1.41

(Rev. 0, 3/73) — Preoperational Testing of Redundant Onsite Electrical Power Systems to Verify Proper Load Group Assignments

Testing will conform with the recommendations of Regulatory Guide 1.41.

The subject matter of this guide is further discussed in Subsections 14.2.7* and 14.2.12.

Regulatory Guide 1.42

(Rev. 1, 3/74) — Interim Licensing Policy on As Low As Practicable for Gaseous Radioiodine Releases from Light-Water-Cooled Nuclear Power Reactors

This regulatory guide was withdrawn by the NRC on March 18, 1976.

Regulatory Guide 1.43

(Rev. 0, 5/73) Control of Stainless Steel Weld Cladding of Low-Alloy Steel Components

For the NSSS, the same purpose of Regulatory Guide 1.43 is achieved by requiring qualification of any high heat input process, such as the submerged-arc wide-strip welding process and the submerged-arc 6-wire process used on ASME SA-508, Class 2, material, with a performance test as described in Regulatory Position 2 of the guide. No qualifications are required by the regulatory guide for ASME SA-533 material and equivalent chemistry for forging grade ASME SA-508, Class 3, material.

The fabricator monitors and records the weld parameters to verify agreement with the parameters established by the procedure qualification as stated in Regulatory Position C.3.

Production weld cladding for safety-related BOP components complies with the fabrication requirements specified in Sections III and IX of the ASME Boiler and Pressure Vessel Code. The supplementary criteria identified in Regulatory Guide 1.43 were also implemented to give reasonable assurance that underclad cracking was avoided in production weld cladding.

Regulatory Guide 1.44

(Rev. 0, 5/73) Control of the Use of Sensitized Stainless Steel

Compliance with the regulatory positions of Regulatory Guide 1.44 relative to the NSSS is discussed in part in Subsection 5.2.3.4. Compliance with the regulatory positions of this document is as follows:

a. The use of processing, packaging and shipping controls, and preoperational cleaning to preclude adverse effects of exposure to contaminants on all stainless steel materials are in accordance with Regulatory Position C.1.

b. Austenitic stainless steel materials are utilized in the final heat-treated conditions required by the respective ASME Code, Section II, material specifications for the particular type or grade of alloy in accordance with Regulatory Position C.2.

c. The position concerning material inspection programs and Regulatory Position C.3 is discussed in Subsection 5.2.3.4.

d. The intent of Regulatory Position C.4 is met as discussed in detail in Subsection 5.2.3.4. Exception (b) to Regulatory Position C.4 is covered in the discussion of delta ferrite in Subsection 5.2.3.4.

e. Conformance with Regulatory Position C.5 is as discussed in Subsection 5.2.3.4. Exception (a) to Regulatory Position C.5 is covered in the discussion of delta ferrite in Subsection 5.2.3.4.

f. Conformance with Regulatory Position C.6 is in the manner discussed in Subsection 5.2.3.4.

Conformance to Regulatory Guide 1.44 relative to the BOP is achieved by imposing detailed requirements on subcontractors and their material suppliers covering processing, welding, heat treatment, cleaning and packaging. Procedures covering these activities during fabrication and erection require engineering review. Although weld procedure qualification test assemblies will not be corrosion-tested as recommended by the guide, sensitization during welding is minimized by prohibiting post-weld stress relief, and by controlling weld heat input. Welding procedures include restrictions governing voltage, amperage, interpass temperature, weaving, and travel speed for automatic process. For applications involving aggressive environments, low carbon stainless steel is specified.

Regulatory Guide 1.45

<u>(Rev. 0, 5/73)</u> <u>Reactor Coolant Pressure Boundary Leakage Detection System</u>

The design of the Reactor Coolant Pressure Boundary Leakage Detection System complies with Regulatory Guide 1.45. The regulatory position taken in the guide has been incorporated into the design of the Leakage Detection System.

For additional discussion on this subject, see Subsection 5.2.5.

Regulatory Guide 1.46

<u>(Rev. 0, 5/73)</u> <u>Protection Against Pipe Whip Inside Containment</u>

This Regulatory Guide was withdrawn by the NRC on 3/11/85. It has been "superseded" by NUREG-0800, Section 3.6 requirements.

The design against pipe whip is discussed in Section 3.6.

Regulatory Guide 1.47

<u>(Rev. 0, 5/73)</u> <u>Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems</u>

Provisions have been made in the design of the Plant Safety Systems to meet the intent of Regulatory Guide 1.47.

Automatic indication, at the system level, of bypassed and inoperable status of safety systems has been provided in the control room. Once activated, the system-level indication will remain on until the activating condition is cleared. Manual system level indication is also provided in the control room for those systems whose complexity increases the possibility of having frequent inoperable conditions that are not monitored by the automatic system.

Additional discussion on this subject is presented in Section 7.1 and Subsection 8.1.5.3b.

Regulatory Guide 1.48

<u>(Rev. 0, 5.73)</u> <u>Design Limits and Loading Combinations for Seismic Category I Fluid System Components</u>

NSSS components are designed using the stress limits and loading combinations presented in Section 5.2 and Subsection 3.9(N).1 for ASME Code Class 1 components and in Subsection 3.9(N).3 for ASME Code Class 2 and 3 components. The conservatism in these limits and the associated ASME design requirements precludes any component structural failure.

The operability of active ASME Code Class 1, 2 and 3 valves and active ASME Code Class 2 and 3 pumps (there are no active Class 1 pumps) will be verified by methods detailed in Section 5.2 and Subsection 3.9(N).1 for ASME Code Class 1 components and in Subsection 3.9(N).3 for ASME Code Class 2 and 3 components.

The use of the above-stated methods provides an acceptable alternate method to meeting the guidance of this regulatory guide.

The design stress limits and loading combinations for BOP seismic Category I fluid system components are presented in Subsection 3.9(B).3.1 for the various plant operating conditions, as defined by the subject regulatory guide. The structural integrity of the fluid system components is ensured by the conservatism in these stress limits which are in accordance with industry practice and ASME Section III design requirements.

The assurance of operability of active ASME Code Class 2 and 3 pumps and ASME Code Class 1, 2 and 3 valves are qualified by the approaches delineated in Subsection 3.9(B).3.2.

The methods cited above provide an acceptable program to satisfy the intent of the subject regulatory guide.

Regulatory Guide 1.49

<u>(Rev. 1, 12/73)</u> <u>Power Levels of Nuclear Power Plants</u>

The design complies with the recommendations of Regulatory Guide 1.49, Rev. 1, since the projected initial power level is less than 3800 megawatts thermal (MWt), and analyses and evaluation consider operation at 102 percent rated core power level, which is less than the level in this regulatory guide.

For further discussion, refer to Section 1.1.

Regulatory Guide 1.50

<u>(Rev. 0, 5/73)</u> <u>Control of Preheat Temperature for Welding of Low-Alloy Steel</u>

Relative to the NSSS, this regulatory guide is considered as applicable to ASME Code, Section III, Class 1 components.

The practice for NSSS Class 1 components is in agreement with the recommendations of Regulatory Guide 1.50, except for Regulatory Positions C.1.b and C.2. For Class 2 and 3 NSSS components, the recommendations of Regulatory Guide 1.50 are not considered applicable. In the case of Regulatory Position C.1.b, the welding procedures are qualified within the preheat temperature ranges required by Section IX of the ASME Code. NSSS experience has shown excellent quality of welds using the ASME qualification procedures.

In the case of Regulatory Position C.2, the NSSS position documented in Reference 6 has been found acceptable by the NRC.

Weld fabrication of low alloy steel components for the BOP complies with the fabrication requirements specified in Sections III and IX of the ASME Boiler and Pressure Vessel Code.

Regulatory Guide 1.51

<u>Inservice Inspection of ASME Code Class 2 and 3 Nuclear Power Plant Components</u>

This guide was withdrawn on July 21, 1975.

Regulatory Guide 1.52

(Rev. 2, 3/78) — Design, Testing and Maintenance Criteria for Post-Accident Engineered Safety Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants

The design complies with this guide, with Regulatory Guide 1.140 and/or with the exceptions discussed in Subsection 6.5.1 and Table 6.5-1, Table 6.5-2 and Table 6.5-3.

Regulatory Guide 1.53

(Rev. 0, 6/73) — Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems

NSSS systems meet the recommendations of Regulatory Guide 1.53, in accordance with the discussion provided in Subsection 7.1.2.7.

The BOP design complies with the guidance provided in Regulatory Guide 1.53. Refer to Subsection 7.1.2.7 for the discussion on Regulatory Guide 1.53 and to Chapter 7 for the definition of BOP systems and for reference to sections where pertinent discussions can be found.

Regulatory Guide 1.54

(Rev. 0, 6/73) — Quality Assurance Requirements for Protective Coatings Applied to Water-Cooled Nuclear Power Plants

Endorses ANSI N101.4-1972

NSSS equipment located in the Containment Building is separated into four categories to identify the applicability of this regulatory guide to various types of equipment. These categories of equipment are as follows:

Category 1 - Large equipment

Category 2 - Intermediate equipment

Category 3 - Small equipment

Category 4 - Insulated/stainless steel equipment.

A discussion of each equipment category follows:

a. Category 1 - Large Equipment

The Category 1 equipment consist of the following:

Reactor Coolant System supports

Reactor coolant pumps (motor and motor stand)

Accumulator tanks

Manipulator crane.

Since this equipment has a large surface area and is procured from only a few vendors, it is possible to implement tight controls over these items.

Stringent requirements have been specified for protective coatings on the NSSS equipment through the use of a painting specification in procurement documents. This specification defines requirements for:

1. Preparation of vendor procedures
2. Use of coating systems which are qualified to ANSI N101.2
3. Surface preparation
4. Application of the coating systems in accordance with the paint manufacturer's instructions
5. Inspections and nondestructive examinations
6. Exclusion of certain materials
7. Identification of all nonconformances
8. Certifications of compliance.

The vendor's procedures are subject to review by NSSS engineering personnel, and the vendor's implementation of the specification requirements is monitored during the Westinghouse quality assurance surveillance activities relative to the NSSS.

This system of controls provides assurance that the protective coatings will properly adhere to the base metal during prolonged exposure to a post-accident environment present within the Containment Building.

b. Category 2 - Intermediate Equipment

The Category 2 equipment consists of the following:

Seismic platform and tie rods
Reactor internals lifting rig
Head lifting rig
Electrical cabinets.

Since these items are procured from a large number of vendors, and individually have very small surface areas, it is not practical to enforce the complete set of stringent requirements which are applied to Category 1 items. However, another specification has been implemented in the NSSS procurement documents. This specification defines to the vendors the requirements for:

1. Use of specific coating systems which are qualified to ANSI N101.2

2. Surface preparation

3. Application of the coating systems in accordance with the paint manufacturer's instructions.

The vendor's compliance with the requirements is also checked during the NSSS quality assurance surveillance activities in the vendor's plant. These measures of control provide a high degree of assurance that the protective coatings will adhere properly to the base metal and withstand the postulated accident environment within the Containment Building.

c. Category 3 - Small Equipment

Category 3 equipment consists of the following:

Transmitters
Alarm horns
Small instruments
Valves
Heat exchanger supports.

These items are procured from several different vendors and are painted by the vendor in accordance with conventional industry practices. Because the total exposed surface area is very small, no further requirements are specified.

d. Category 4 - Insulated or Stainless Steel Equipment

Category 4 equipment consists of the following:

Steam generators - covered with blanket insulation
Pressurizer - covered with blanket insulation
Reactor pressure vessel - covered with rigid reflective insulation
Reactor cooling piping - stainless steel
Reactor coolant pump casings - stainless steel.

Since Category 4 equipment is insulated or is stainless steel, no painted surface areas are exposed within the containment.

Therefore, this regulatory guide is not applicable for Category 4 equipment.

Protective coatings provided for the BOP, except for acceptably limited and inventoried coatings on non-NSSS equipment, piping and structures, are in accordance with ANSI N101.4 "Quality Assurance for Protective Coatings Applied to Nuclear Facilities," used in conjunction with ANSI N45.2 "Quality Assurance Program Requirements for Nuclear Power Plants," and therefore meet Regulatory Guide 1.54.

During the operations phase, compliance with the regulatory guide also includes the following clarification:

a. When the requirements of ANSI N101.4 apply, specific requirements, such as documented site meetings, field demonstrations, substrate priming, applicator reporting, inspection reporting and report forms will be considered on a job-by-job basis and invoked only where found to provide a meaningful QA contribution to that task.

b. When 10 percent or less of the surface of the item requires coating, it is considered to be touch-up work and only a general conformance to these requirements will be necessary.

Regulatory Guide 1.55

(Rev. 0, 6/73) Concrete Placement in Category I Structures

The placement of concrete for seismic Category I structures complies with Regulatory Guide 1.55, Rev. 0, except that the documents referenced in the appendix to the guide were used for guidance only, as appropriate. Use of the Maturity Method (correlating strength to integrated temperature-time history) is permitted for monitoring curing of concrete placements (except containment). When this method is implemented to determine in-place strength, curing temperatures can be reduced to 40°F, as permitted by Paragraph 3.2.3 of ACI 308. Temperature control is maintained at least until the placement attains 70 percent of the design strength, in accordance with Paragraph 12.2.3 of ACI 301. The subject is further discussed in Subsections 3.8.1.6 and 3.8.3.6.

This regulatory guide was withdrawn on July 8, 1981 and superseded by Regulatory Guides 1.136 Rev. 2, 6/81 and 1.142.

Regulatory Guide 1.56

Rev. 1, 7/78) Maintenance of Water Purity in Boiling Water Reactors

This regulatory guide is not applicable to Seabrook Station.

Regulatory Guide 1.57

(Rev. 0, 6/73) Design Limits and Loading Combinations for Metal Primary Reactor Containment System Components

The design complies with Regulatory Guide 1.57, Rev. 0, requirements for the personnel lock, the equipment hatch, and the piping and electrical penetrations inside and outside the containment which are not backed by concrete.

This guide is not considered applicable to other portions of the containment system.

The subject is further discussed in Subsection 3.8.2.

Regulatory Guide 1.59
(Rev. 2, 8/77; Errata 7/80) Design Basis Floods for Nuclear Power Plants

The recommendations of Regulatory Guide 1.59, Rev. 2, have been followed relative to design basis flooding. The Probable Maximum Precipitation analysis indicates that the site may develop ponding, but that all safety-related structures are not adversely affected. A protective revetment has been designed and constructed to safeguard the site and safety-related facilities from the predicted Probable Maximum Surge level.

For further discussion, refer to Section 2.4.

Regulatory Guide 1.60
(Rev. 1, 12/73) Design Response Spectra for Seismic Design of Nuclear Power Plants

The recommendations of Regulatory Guide 1.60, Rev. 1, have been followed for the BOP design with the following comments and/or exceptions:

a. The vibratory ground motions represented by the design response spectra are assumed as free-field surface motions because the design response spectra were derived from analysis of historic ground motions recorded at or near ground surface.

b. Because the vertical design response spectra are presented as scaled to lg horizontal ground acceleration, it is implicitly, but inadvertently, required that the vertical peak ground acceleration equal the horizontal peak ground acceleration. The assumption of the peak vertical acceleration being two-thirds of the peak horizontal acceleration has been acceptable to the NRC. Therefore, to follow the intent of the regulatory guide appropriately, the vertical design response spectra are modified for frequencies greater than 33 Hz, as shown in the Figure 1.8-1. For further discussion, refer to Subsections 2.5.2.6 and 3.7(B).1.1.

The design response spectra of Regulatory Guide 1.60 are acceptable for the NSSS, with the damping values recommended and approved by the NRC in Reference 7 for use in dynamic analysis of NSSS equipment. For further discussion, refer to Subsection 3.7(N).1.1.

Regulatory Guide 1.61

(Rev. 0, 10.73) Damping Values for Seismic Design of Nuclear Power Plants

The damping values of Regulatory Guide 1.61 have, in general, been fully complied with in the BOP design. For further discussion, refer to Subsection 3.7(B).1.3.

Relative to the NSSS, the damping values listed in Regulatory Guide 1.61 are considered acceptable with the single exception of the large piping systems faulted condition value of 3 percent critical. Higher damping values, when justified by documented test data, have been provided for the Regulatory Position C.2. A conservative value of 4 percent critical has therefore been justified by testing for the NSSS reactor coolant loop configuration in Reference 7, and has been approved by the NRC.

For pipe stress verification and for pipe support optimization, the damping values of ASME B&PV Code, Code Case N-411, may be used in lieu of the values listed in Regulatory Guide 1.61.

For further discussion, refer to Subsection 3.7(N).1.3.

Regulatory Guide 1.62

(Rev. 0, 10/73) Manual Initiation of Protective Actions

The NSSS protection system meets the recommendations of this regulatory guide, in accordance with the comments of Subsection 7.3.2.2.

The BOP portion of the protection system was designed, built and tested in accordance with IEEE Standard 279-1971, and complies with Regulatory Guide 1.22 and 1.62. The design of the protection system includes the following:

a. Manual initiation of each protective action is provided at the system level, in addition to the means to initiate protective action at the component level.

b. Manual initiation of the protective actions at the system level perform all functions carried out by the automatic initiation signal to the actuating devices, and provide the required action, such as sequencing functions and interlocks.

c. The switches for manual initiation of protective actions at the system level are located in the main control room.

d. The amount of equipment common to both manual and automatic initiation has been minimized. The single failure criterion has been satisfied.

For further discussion, refer to Section 7.3.

Regulatory Guide 1.63

(Rev. 2, 7/78) Electric Penetration Assemblies in Containment Structures for Light-Water-Cooled Nuclear Power Plants

The design conforms to the recommendations of Regulatory Guide 1.63, Rev. 2, with certain clarifications which are discussed further in Subsections 3.8.2, 8.1.5, 8.3.1.1 and 8.3.1.2.

Regulatory Guide 1.65

(Rev. 0, 10/73) Materials and Inspections for Reactor Vessel Closure Studs

Westinghouse is in agreement with Regulatory Guide 1.65 except for material and tensile strength guidelines.

Westinghouse has specified both 45 ft-lb and 25 mils lateral expansion for control of fracture toughness determined by Charpy-V testing, required by the ASME Boiler and Pressure Vessel Code, Section III, Summer 1973 Addenda and 10 CFR Part 50, Appendix G (July 17, 1973, Paragraph IV.A.4). These toughness requirements assure optimization of the stud bolt material tempering operation with the accompanying reduction of the tensile level when compared with previous ASME Boiler and Pressure Vessel Code requirements.

The specification of both impact and maximum tensile strength as stated in the guide results in unnecessary hardship in procurement of material without any additional improvement in quality.

The closure stud bolting material is procured to a minimum yield strength of 130,000 psi and a minimum tensile strength of 145,000 psi. This strength level is compatible with the fracture toughness requirements of 10 CFR Part 50, Appendix G (July, 1973, Paragraph 1.C), although higher strength level bolting materials are permitted by the code. Stress corrosion has not been observed in reactor vessel closure stud bolting manufactured from material of this strength level. Accelerated stress corrosion test data do exist for materials of 170,000 psi minimum yield strength exposed to marine water environments stressed to 75 percent of the yield strength (given in Reference 2 of the guide). These data are not considered applicable to Westinghouse reactor vessel closure stud bolting because of the specified yield strength differences and a less severe environment; this has been demonstrated by years of satisfactory service experience.

The ASME Boiler and Pressure Vessel Code requirement for toughness for reactor vessel bolting has precluded the guide's additional recommendation for tensile strength limitation, since to obtain the required toughness levels, the tensile strength levels are reduced. Prior to 1972, the Code required a 35 ft-lb toughness level which provided maximum tensile strength levels ranging from approximately 155 to 178 kpsi (Westinghouse review of limited data – 25 heats). After publication of the Summer 1973 Addenda to the Code and 10 CFR Part 50, Appendix G, wherein the toughness requirements were modified to 45 ft-lb with 25 mils lateral expansion, all bolt material data reviewed on Westinghouse plants showed tensile strengths of less than 170 kpsi.

The in-service inspection program described in Subsection 5.2.4 provides an acceptable alternate method to following the guidance of this regulatory guide.

Regulatory Guide 1.66

(Rev. 0, 10.73) Nondestructive Examination of Tubular Products

This regulatory guide was withdrawn by the NRC on September 28, 1977.

Regulatory Guide 1.67

(Rev. 0, 10/73) Installation of Overpressure Protection Devices

The design criteria for safety valve stations fully conform to the requirements of Regulatory Guide 1.67. For further discussion, refer to Subsection 3.9(B).3.3.

Regulatory Guide 1.68

(Rev. 2, 8/78) Initial Test Programs for Water-Cooled Reactor Power Plants

The initial test program was conducted in accordance with the intent of Regulatory Guide 1.68, with the exceptions discussed in Subsection 14.2.7.

Regulatory Guide 1.68.1

(Rev. 1, 1/77) Preoperational and Initial Startup Testing of Feedwater and Condensate Systems for Boiling Water Reactor Power Plants

This regulatory guide is not applicable to Seabrook Station.

Regulatory Guide 1.68.2

(Rev. 1, 7/78) Initial Startup Test Program to Demonstrate Remote Shutdown Capability for Water-Cooled Nuclear Power Plants

The remote shutdown capability was demonstrated in accordance with the intent of Regulatory Guide 1.68.2, Rev. 1. For discussion, refer to Subsection 14.2.6.

Regulatory Guide 1.69

(Rev. 0, 12/73) Concrete Radiation Shields for Nuclear Power Plants

The design of the concrete radiation shields fully complies with Regulatory Guide 1.69, Rev. 0. The applicable documents, design loads and design approach presented in ANSI N101.6-1972 were used in the design.

For further discussion, refer to Subsections 3.8.3.1, 3.8.3.2 and 3.8.3.4.

Regulatory Guide 1.70

(Rev. 3, 11/78) Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants-LWR Edition

The FSAR and Updated FSAR were prepared using the recommended format and content of Regulatory Guide 1.70, Rev. 3, with the exception of a listing of any unusually hazardous materials to be used on site that could present unexpected fire hazards or complicate firefighting activities. Regulatory Guide 1.70, Rev. 3, was issued prior to the issuance of 10 CFR 50 - Appendix R "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979." As such, the unexpected fire hazards, fire brigade training and the storage and/or use of combustible materials concerns that were addressed in Regulatory Guide 1.70 have been addressed in expanded detail in 10 CFR 50 - Appendix R. 10 CFR 50 - Appendix R, by reference, is part of the UFSAR.

Regulatory Guide 1.71

(Rev. 0, 12/73) Welder Qualification for Areas of Limited Accessibility

NSSS practice does not require qualification or requalification of welders for areas of limited accessibility as described by Regulatory Guide 1.71. Experience shows that the current NSSS shop practice produces high quality welds. In addition, the performance of required nondestructive evaluations provides further assurance of acceptable weld quality.

Limited accessibility qualification or requalification in excess of ASME Code, Section III or IX requirements is considered an unduly restrictive requirement for NSSS component fabrication, where the welders' physical position relative to the welds is controlled and does not present any significant problems. In addition, shop welds of limited accessibility are repetitive due to multiple production of similar components, and such welding is closely supervised.

For field application, the type of qualification should be considered on a case-by-case basis due to the great variety of circumstances encountered.

This guide was also not followed for the BOP for the following reasons: "Limited Accessibility" welds, which we define as welds inaccessible from at least 12 inches in any direction, will be identified by contractors and would require us to provide extensive surveillance and field supervision of the affected areas.

Contract specifications require that contractors, regardless of the code requirement, consider the necessity of special inspection techniques.

Qualification alone does not ensure the integrity of welds in limited areas, nor does a continual audit of the welder for the correct application of procedure parameters and welder technique ensure the integrity of production welds. The integrity of welds has been assured by nondestructive examination or special inspection techniques during fabrication and baseline inspections.

For Operational Phase activities under the scope of the Operational QA Program, PSNH welder qualification will comply with the requirements of this regulatory guide, with the following clarifications:

a. With regard to Section C.1 of the regulatory guide, selected welders may, in addition to the normal qualifications, be trained and qualified for limited access conditions.

b. With regard to Section C.2.a of the regulatory guide, when a limited access weld must be performed, the judgment of experienced supervisory personnel will be used to determine whether the above noted additional qualification is satisfactory for the given task, or whether additional training and qualifications for the specific configuration is required.

Regulatory Guide 1.72

<u>(Rev. 2, 11/78)</u> <u>Spray Pond Piping Made From Fiberglass-Reinforced Thermosetting Resin</u>

This guide is not applicable to Seabrook Station.

Regulatory Guide 1.73

(Rev. 0, 1/74) Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants

This regulatory guide endorses IEEE 382-1972, and provides some additional clarification in the area of accessories, such as solenoid valves and limit switches. Qualification of valve appurtenances, such as motor operators, solenoid valves and limit switches, is in accordance with this Regulatory Guide. Details of the qualification of specific motor operators, solenoid valves and limit switches are contained in Reference 15.

For NSSS safety-related motor-operated valves located inside containment, environmental qualification is performed in accordance with IEEE Standards 382-1972 and 323-1974. The qualification program for valve-related equipment is described in Reference 9. Refer to Section 3.11 for additional discussion of environmental qualification.

Regulatory Guide 1.75

(Rev. 2, 9/78) Physical Independence of Electric Systems

The design is consistent with the criteria for physical independence of electrical systems established in "Attachment C" of AEC letter dated December 14, 1973 (see Updated FSAR Appendix 8A) and is in general conformance with Regulatory Guide 1.75, Rev. 2, except as follows:

Battery Room Ventilation. Although the four Class 1E batteries are housed in separate safety Class structures, they represent only two redundant load groups (see Subsection 8.3.2). Each load group is served by a separate safety-related ventilation system. There is a cross-tie between the two ventilation systems to allow one system to serve both load groups in case the other system is inoperable. Fire dampers are provided to isolate each battery room.

The subject of this regulatory guide is further discussed in Subsections 8.1.5.3 and 8.3.1.2.

The NSSS and BOP furnished systems comply with the recommendations of Regulatory Guide 1.75, Rev. 2, as discussed in Subsection 7.1.2.2.

The requirements of position C4, as it relates to cables for the associated circuits is clarified as follows:

Instrumentation, control and power cables used for the associated circuits will not be covered by the Operational Quality Assurance Program (OQAP). However, pragmatic controls will be applied to these items. The actual implementation of these controls will be defined by the programs manuals used to control specific activities at Seabrook Station. Implementation of these programmatic will be verified by Quality Assurance personnel to the extent necessary to insure proper application. For further details on provisions and considerations for the associated circuits, see Updated FSAR Chapter 8, Subsection 8.3.1.4b.1(d).*

The Seabrook cable and raceway separation criteria (see Updated FSAR Subsection 8.3.1.4) is a combination of the standard criteria given in Attachment C of AEC Letter dated December 14, 1973 (see Updated FSAR Appendix 8A) and IEEE 384-1974 and criteria established by analysis and testing as permitted by Attachment C and IEEE 384-1974.

Regulatory Guide 1.76

<u>(Rev. 0, 4/74)</u> <u>Design Basis Tornado for Nuclear Power Plants</u>

The structural designs for withstanding the design basis tornado fully comply with the recommendations of Regulatory Guide 1.76, Rev. 0. For further discussion, refer to Section 3.5 and Subsections 3.3.2, 3.8.1 and 3.8.4.

Regulatory Guide 1.77

<u>(Rev. 0, 5.74)</u> <u>Assumptions Used for Evaluating a Control Rod Ejection Accident for Pressurized Water Reactors</u>

Methods and criteria are documented in Reference 3 and 8, which has been reviewed and accepted by the NRC.

The results of analyses show agreement with Regulatory Positions C.1 and C.3. However, exception has been taken to Regulatory Position C.2 which implies that the rod ejection accident should be considered as an emergency condition. This is considered a faulted condition as stated in ANSI N18.2. Faulted condition stress limits are applied for this accident. This is an acceptable alternate method to following the guidance of this regulatory guide. For further discussion, refer to Subsection 15.4.8.

Regulatory Guide 1.78

(Rev. 0, 6/74) Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release

As explained in Section 2.2, there are no significant manufacturing plants, chemical plants, refineries, storage facilities, mining, and quarrying operations, oil pipelines, wells or storage facilities identified within a five-mile radius of the site. Local natural gas pipelines within the five-mile radius of the site have been evaluated for potential impact to plant operation. The evaluation has concluded that there is no impact from accidental release of natural gas.

Section 2.2 also provides information regarding transportation facilities and available data regarding the use of these transportation facilities. Also, there is no toxic or hazardous chemical (in excess of 100 lb. limit) stored on the site.

Based on available information, it is concluded that the requirements of Regulatory Guide 1.78 are met.

Regulatory Guide 1.79

(Rev. 1, 9/75) Preoperational Testing of Emergency Core Cooling Systems for Pressurized Water Reactors

The initial preoperational test program will be conducted in accordance with the intent of Regulatory Guide 1.79, with the exceptions discussed in Subsection 14.2.7.

For further discussion, refer to Section 14.2.

Regulatory Guide 1.80

(Rev. 0, 6/74) Preoperational Testing of Instrument Air Systems

The initial test program has been conducted in accordance with the intent of Regulatory Guide 1.80, with the exceptions discussed in Subsection 14.2.7.

For further discussion, refer to Section 14.2.

Regulatory Guide 1.81

(Rev. 1, 1/75) Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants

The power system design is in conformance with the recommendations of Regulatory Guide 1.81, Rev. 1. Seabrook Station is a single unit plant; therefore no portion of the power system is shared.

Regulatory Guide 1.82

(Rev. 0, 6/74) Sumps for Emergency Core Cooling and Containment Spray Systems

The sump design meets the intent of the positions of Regulatory Guide 1.82. For further discussion, refer to Subsection 6.2.2.2.

Regulatory Guide 1.83

(Rev. 1, 7/75) Inservice Inspection of Pressurized Water Reactor Steam Generator Tubes

The steam generators are designed to permit access to tubes for inspection and/or plugging. The in-service inspection program is discussed in Subsection 5.4.2.5 and in the Technical Specifications.

Regulatory Guide 1.84

(all revisions) Design and Fabrication Code Case Acceptability - ASME Section III Division I

This regulatory guide is used for the BOP design where applicable. The ASME Code Case interpretations were used for design and fabrication after they had been reviewed to assure that their use would not compromise the component design or reliability. Table 1.8-2 lists specific Code Cases, not included in this Regulatory Guide, for which authorization to use was requested of, and granted by, the NRC.

The NSSS suppliers have:

a. Limited the use of Code Cases to those listed in Regulatory Position C.1 of Regulatory Guides 1.84 and 1.85, except as allowed below.

b. Identified and requested permission for use of any Code Cases not listed in Regulatory Position C.1 of Regulatory Guides 1.84 and 1.85 where use of such Code Cases is needed by the supplier.

c. Permitted continued use of a Code Case considered acceptable at the time of equipment order, where such Code Case was subsequently annulled or amended.

NRC permission has been requested for the use of Class 1 Code Cases needed by NSSS suppliers and not then endorsed in Regulatory Position C.1 of Regulatory Guides 1.84 and 1.85, and permits supplier use only if NRC permission is obtained or is otherwise assured (e.g.; a later version of the regulatory guide includes endorsement).

Regulatory Guide 1.85

(all revisions) Materials Code Case Acceptability - ASME Section III Division I

Refer to the discussion of Regulatory Guide 1.84.

Regulatory Guide 1.85 requires that components and supports be identified that use Code Case N242-1. The code case is applied to safety relief valves, thermowells, and generically to supports. The use of the code case is documented in the data reports.

Regulatory Guide 1.86

(Rev. 0, 6/74) Termination of Operating Licenses for Nuclear Reactors

Applicability of this guide is considered premature.

Regulatory Guide 1.87

(Rev. 1, 6/75) Guidance for Construction of Class 1 Components in Elevated Temperature Reactors (Supplement to ASME Section III Code Cases 1592, 1593, 1594, 1595 and 1596)

This regulatory guide is not applicable to Seabrook Station.

Regulatory Guide 1.89

(Rev. 1, 6/84) Qualification of Class 1E Equipment for Nuclear Power Plants

The guidance provided by Regulatory Guide 1.89, which endorses IEEE 323-1974 with certain exceptions, i.e., source terms and the use of IEEE 344-1971, has been followed for the BOP equipment except for those instances discussed below:

a. Qualification of Class 1E electrical, instrumentation and control equipment meets the requirements of IEEE 323-1974, with exceptions. Further discussion regarding qualification is provided in Sections 3.10, 3.11 and Reference 15.

   Exceptions: Turbine trip-related inputs to the Reactor Trip System consist of the following:

   1. Turbine stop valve position

   2. Turbine Electro-Hydraulic System fluid pressure

3. Turbine impulse chamber pressure.

This equipment was tested in accordance with the guidelines of IEEE Standard 323-1974.

b. The total integrated radiation doses to be used in qualification of the Class 1E equipment will be a combination of normal operating environment and post-accident environment, with credit taken for locations, shielding and the time for which the equipment is required to perform its function.

Values of integrated doses to be used in the qualification of Class 1E equipment are given in Reference 15.

For the safety-related equipment located inside the containment and required after a LOCA, the sources used in establishing the integrated dose are consistent with Regulatory Guide 1.89, Rev. 0. Both instantaneous gamma and beta doses have been considered in establishing the integrated doses.

The seismic qualification of electrical, instrumentation and control equipment meets the requirements of IEEE 344-1975.

Conformance of NSSS Class 1E equipment with IEEE Standard 323-1974 (including IEEE Standard 323A-1975 position statement of July 23, 1975) and Regulatory Guide 1.89 is being demonstrated by an appropriate combination of any or all of the following: type testing, operating experience, qualification by analysis and on-going qualification programs. This commitment is being satisfied by implementation of Reference 9.

Regulatory Guide 1.90

<u>(Rev. 1, 8/77)</u> <u>Inservice Inspection of Prestressed Concrete Containment Structures with Grouted Tendons</u>

This guide is not applicable to Seabrook Station since grouted tendons are not employed.

Regulatory Guide 1.91

<u>(Rev. 1, 2/78)</u> <u>Evaluation of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants</u>

The guidance provided by Regulatory Guide 1.91, Rev. 1, has been followed. For further discussion, refer to Section 2.2.

Regulatory Guide 1.92

(Rev. 1, 2/76) Modes and Spatial Components in Seismic Response Analyses

The procedure for combining modal responses for NSSS equipment is presented in Subsection 3.7(N).3.2. This procedure is considered as an alternate acceptable solution that provides a basis for findings requisite to issuance or continuance of a permit or license by the NRC.

The procedure used for BOP equipment design fully conforms with the guidance of Regulatory Guide 1.92, Rev. 1, relative to seismic system analysis. The requirements for the combination of modes and spatial components in seismic subsystem analyses also complies with this guide, except that closely spaced modes for seismic analyses of components by the normal mode approach are combined in accordance with the two methods indicated in Subsection 3.7(B).3.6.

Regulatory Guide 1.92 presents three other means of combining closely spaced modes. Justification for nonconformance is that the methods prescribed in the guide are not here applicable since the construction permit application docket date is before the date of issue of the guide. In addition, the method used is deemed more conservative. For further discussion, refer to Section 3.7(B) and Subsection 3.7(B).3.7.

Regulatory Guide 1.93

(Rev. 0, 12/74) Availability of Electric Power Sources

The Technical Specification (T/S) ac and dc power sources allowable out-of-service times (action statements) are based on RG 1.93. Where differences exist between the T/S and RG 1.93, the T/S are the governing document.

RG 1.93 does not allow out-of-service times to be used for preventative maintenance that incapacitates a power source. These activities are to be scheduled for refueling or shutdown periods. This is interpreted to also apply to surveillance activities. Preventative maintenance and surveillance activities are performed on-line when permitted by the T/S and with appropriate consideration of the effects on safety, reliability, and availability.

Regulatory Guide 1.95

(Rev. 1, 2/77) Protection of Nuclear Power Plant Control Room Operators Against Accidental Chlorine Release

The relevant portions of Regulatory Guide 1.95 are complied with based on the findings that the plant design does not include the storage of chlorine within 100 meters of the control room, excluding small laboratory quantities, nor is there chlorine stored in excess of the maximum allowable chlorine inventory, as given as a function of distance in Regulatory Guide 1.95 for Type I control rooms (refer to Subsection 2.2.3.1).

Regulatory Guide 1.96

(Rev. 1, 6/76) Design of Main Steam Isolation Valve Leakage Control Systems for Boiling Water Reactor Nuclear Power Plants

This regulatory guide is not applicable to Seabrook Station.

Regulatory Guide 1.97

(Rev. 3, 5/83) Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident

Regulatory Guide 1.97, Revision 3 endorses ANSI/ANS-4.5-1980, "Criteria for Accident Monitoring Functions in Light-Water-Cooled Reactors." With minor exceptions, the above guidance has been followed in providing Accident Monitoring Instrumentation (AMI). These exceptions are specified in Subsection 7.5.4.

A complete description of the Seabrook AMI is provided in Section 7.5.

Regulatory Guide 1.98

(Rev. 0, 3/76) Assumptions Used for Evaluating the Potential Radiological Consequences of a Radioactive Offgas System Failure in a Boiling Water Reactor

This regulatory guide is not applicable to Seabrook Station.

Regulatory Guide 1.99

(Rev. 2, 5/88) Effects of Residual Elements on Predicted

The reactor vessel material meets the end-of-life reference criterion of Regulatory Guide 1.99, Rev. 2.

Regulatory Guide 1.100

(Rev. 1, 8/77) Seismic Qualification of Electric Equipment for Nuclear Power Plants

The program for seismic qualification of NSSS safety-related electric equipment is delineated in Reference 9.

BOP electric equipment has been seismically qualified in accordance with the intent of the guidance provided in Regulatory Guide 1.100, Rev. 1.

For further discussion, refer to Section 3.10(B).

Regulatory Guide 1.101

(Rev. 2, 10/81) Emergency Planning for Nuclear Power Plants

The Seabrook Station Radiological Emergency Plan was developed based on the requirements of Appendix E to 10 CFR 50 and Revision 1 of NUREG-0654/FEMA-REP 1; therefore, the recommendations of this regulatory guide have been followed with the exceptions noted below:

- The acceptance criteria for the meteorological monitoring system meet the intent of Regulatory Guide 1.23 (Rev. 0) and Regulatory Guide 1.97 (Rev. 3). Exceptions are discussed in Section 1.8 (see Regulatory Guides 1.23 and 1.97).

- The atmospheric transport and diffusion assessment capabilities are described in Section 10.1 of the Seabrook Station Radiological Emergency Plan.

- The capability to remote interrogate all systems producing meteorological data and effluent transport and diffusion estimates by emergency response organizations is not available.

The Seabrook Station Radiological Emergency Plan complies with the requirements of 10 CFR 50, Appendix E, and is based on the criteria in NUREG-0654/REP-1, Rev. 1, with the following clarifications and exceptions:

1. 10 CFR 50, Appendix E, Section IV.D.3. requires licensees to have the capability to notify responsible state and local governmental agencies within 15 minutes after declaring an emergency. For a radiological emergency at Seabrook Station, Massachusetts and New Hampshire state governments are responsible for deciding protective actions to be recommended to the public and for initiating public alert and notification. Therefore, Seabrook Station maintains the capability to notify Massachusetts and New Hampshire state authorities within 15 minutes after declaring an emergency. This capability does not include notification of local governmental agencies. Under the state radiological emergency response plans, the states are responsible for notifying local governmental agencies.

2. NUREG-0654/FEMA-REP-1, Rev. 1, criterion B.5 states that licensees shall have the capability to staff on-shift emergency response functions and to augment on-shift emergency response capabilities in accordance with NUREG-0654, Table B-1. The Seabrook Station On-Shift Emergency Response Organization (ERO) includes one health physics technician versus two specified by Table B-1. The Seabrook Station Augmented ERO does not include eleven (11) 30-minute responders specified on Table B-1. It was determined that the functions specified on Table B-1 could be addressed by on-shift personnel or that no emergency planning related provisions or station procedures require the use of these personnel prior to activation of emergency facilities. (Ref. NRC IR 94-15 and NRC letter to T.C. Feigenbaum dated March 6, 1995.)

3. NUREG-0654/FEMA-REP-1, Rev. 1, criterion J.7 states that licensees shall establish a mechanism for recommending protective actions to appropriate state and local authorities in accordance with the recommendations set forth in the Manual of Protective Action Guides and Protective Actions for Nuclear Incidents (EPA-520/1-75-001). EPA-520/1-75-001 and the protective action guides therein have been superseded by EPA 400, Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, 1991. The SSREP follows the protective action recommendation guidance in EPA 400 and in NUREG-0654/FEMA-REP-1, Rev. 1, Supp. 3, July 1996. NUREG-0654 Supp. 3, Figure 1, recommends prompt evacuation near the plant in the event of actual or projected severe core damage or loss of control of the facility. NUREG-0654, Supp. 3, Figure 1, note 5, advises that shelter may be appropriate for controlled releases from containment if there is assurance that the release is short term and the area near the plant cannot be evacuated before the plume arrives. Based on Atomic Safety and Licensing Board decisions for Seabrook Station, the SSREP does not provide for recommending sheltering in the limited circumstance suggested in NUREG-0654, Supp. 3, Figure 1, note 5.

4. NUREG-0654/FEMA-REP-1, Rev. 1, criterion J.10.a states that radiological emergency plans shall include maps of evacuation areas, relocation centers in host areas and shelter areas. These details are included in the Massachusetts and New Hampshire Radiological Emergency Response Plans only. The Massachusetts and New Hampshire plans are referenced in the SSREP.

5. NUREG-0654/FEMA-REP-1, Rev. 1, criterion J.10.m states that radiological emergency plans shall include expected local protection afforded by residential units or other shelter for direct and inhalation exposure. See exception number 3 above.

6. NUREG-0654/FEMA-REP-1, Rev. 1, criterion O.2 states that the training program for members of the onsite emergency organization shall, besides classroom training, include practical drills. The listed attributes of these practical drills are as follows:

   - Each individual demonstrates his/her ability to perform his/her assigned emergency function.

   - On-the-spot correction of erroneous performance and demonstration of proper performance by the instructor.

   Candidates for the Seabrook Station ERO are required to complete applicable training and a position-specific qualification guide prior to being assigned to the ERO. The process of administering a qualification guide to a candidate includes the attributes noted above, including a proficiency demonstration with applicable procedures and equipment. All such demonstrations are supervised and assessed by a qualified instructor. Where needed, the instructor corrects erroneous performance and demonstrates proper performance.

7. NUREG-0654/FEMA-REP-1, Rev. 1, criterion P.5 states that revised pages of emergency plans shall be dated and marked to show where changes have been made. The Seabrook Station manuals and procedures administration program requires that manual (the SSREP is a manual) and procedure changes shall be delineated in a figure or section titled "Summary of Changes" that is created and updated for each revision or change. This is done in lieu of revision bars and individually dated pages. The SSREP also contains a list of effective pages (LOEP) allowing the user to identify the current revision number applicable to each page.

8. NUREG-0654/FEMA-REP-1, Rev. 1, criterion P.8 recommends that plans submitted for review should be cross-referenced to NUREG-0654 criteria. The SSREP contains a cross-reference to NUREG-0654 criteria. The cross-reference is submitted with plan changes only if the changes cause the cross-reference to change. If the cross-reference is not submitted with a plan change, the extant cross-reference in the SSREP continues to reference correctly where the SSREP addresses NUREG-0654 criteria.

9. NUREG-0654/FEMA-REP-1, Rev. 1, Appendix 1, Example Initiating Condition Alert #4 reads: "Steam line break with significant (e.g., greater than 10 gpm) primary to secondary leak rate (PWR) or MSIV malfunction causing leakage (BWR)." The Seabrook Station Emergency Classification System (SSECS) does not include an initiating condition that explicitly addresses this example initiating condition. The SSECS incorporates Seabrook Station specific initiating conditions that address applicable aspects of Example Initiating Condition Alert #4.

10. NUREG-0654/FEMA-REP-1, Rev. 1. Appendix 1, Example Initiating Condition Alert #9 reads: "Coolant pump seizure leading to fuel failure." The SSECS does not include this initiating condition, because this condition is subsumed under series 8 EALs in the SSECS that consider fuel failure conditions for any cause. There are no specific diagnostics in the Seabrook Station emergency response procedures that tell Control Room operators that a coolant pump seizure has occurred. Under the SSECS, the amount of reactor coolant system activity from the failed fuel would drive the emergency classification rather than the cause of the fuel failure. This approach is consistent with guidance in NRC memorandum, Branch Position on Acceptable Deviations to Appendix 1 to NUREG-0654/FEMA-REP-1, dated July 11, 1994.

11. NUREG-0654/FEMA-REP-1, Rev. 1, Appendix 3 states that every year, or in conjunction with an exercise, FEMA, in cooperation with the utility operator, and/or the state and local governments will take a statistical sample of residents within about 10 miles to assess the public's ability to hear the sirens and their awareness of the meaning of the prompt notification message and availability of public information. Based on subsequent FEMA guidance, Guidance Memorandum AN-1, April 1987, FEMA has not conducted, nor required, an additional statistical survey for the Seabrook Station Public Alert and Notification System following the initial system acceptance test.

12. NUREG-0654/FEMA-REP-1, Rev. 1, Appendix 3 suggests the following type and frequency of siren tests: (1) silent test every two weeks; (2) growl test quarterly and when preventive maintenance is performed; and (3) a complete cycle test annually and as required for formal exercises. The Seabrook Station siren system testing program does not include a quarterly growl test or annual complete cycle test, because the capability of each siren to receive an activation signal to rotate for a full cycle and to emit an alert tone is tested every two weeks using vendor designed ultra-sonic "Silent Test™" circuitry.

13. NUREG-0654/FEMA-REP-1, Rev. 1, Supp. 3, Figure 1, note 5, advises that shelter may be an appropriate protective action for a controlled, short-term release of radioactive material from containment. The option to recommend sheltering as a protective action is not considered in Seabrook Station protective action recommendation procedures. See exception number 3 above.

Regulatory Guide 1.102

<u>(Rev. 1, 9/76)</u> <u>Flood Protection for Nuclear Power Plants</u>

The flood protection design reflects full compliance with the guidance presented in Regulatory Guide 1.102, Rev. 1. For further discussion, refer to Section 2.4 and Subsection 3.4.1.

Regulatory Guide 1.103

<u>(Rev. 1, 10/76)</u> <u>Post-Tensioned Prestressing Systems for Concrete Reactor Vessels and Containments</u>

This regulatory guide is not applicable to Seabrook Station. It was with-drawn on July 8, 1981 and superseded by Regulatory Guide 1.136, Rev. 2, 6/81.

Regulatory Guide 1.104

<u>(Rev. 0, 2/76)</u> <u>Overhead Crane Handling Systems for Nuclear Power Plants</u>

This regulatory guide was withdrawn by the NRC on August 16, 1979.

Regulatory Guide 1.105

(Rev. 1, 11/76) Instrument Spans and Setpoints

The recommendations of this regulatory guide have been followed with the following exceptions and clarifications:

> The Technical Specifications for limiting safety system settings provide the margin from the nominal setpoint to the Technical Specification allowable value to account for drift when measured at the rack during periodic testing. The allowances between the Technical Specification allowable value and the safety limit include the following items: (a) the inaccuracy of the instrument, (b) process measurement accuracy, (c) uncertainties in the calibration, (d) the potential transient overshoot determined in the accident analyses (this may include compensation for the dynamic effect) and (e) environmental effects on equipment accuracy caused by postulated or limiting postulated events (only for those systems required to mitigate consequences of an accident). The setpoints were chosen for Seabrook so that the accuracy of the instrument is adequate to meet the assumptions of the safety analysis.

The range of instruments has been chosen based on the span necessary for the instrument's function. Narrow range instruments are being used where necessary. Instruments have been selected based on expected environmental and accident conditions. Qualification testing of instrumentation has been performed as necessary to verify the functionality of the instruments.

Seismic qualification testing has verified that setpoint securing devices are not required to maintain accuracy or minimize setpoint changes. Integral setpoint securing devices have not been supplied.

The assumptions used in selecting the setpoint values in Regulatory Position C.1, and the minimum margin with respect to the Technical Specification limit and calibration uncertainty, are documented in the setpoint calculations.

BOP safety-related setpoints have been established using the same methodology as was used for the NSSS setpoints.

Regulatory Guide 1.106

(Rev. 1, 3/77) Thermal Overload Protection for Electric Motors on Motor-Operated Valves

Overload protection is in conformance with the recommendations of Regulatory Guide 1.106, Rev. 1. The subject matter of this guide is further discussed in Subsections 8.1.5.3 and 8.3.1.1.

Regulatory Guide 1.107

(Rev. 1, 2/77) Qualifications for Cement Grouting for Prestressing Tendons in Containment Structures

This guide is not applicable to Seabrook Station.

Regulatory Guide 1.108

(Rev. 1, 8/77)
(Errata 9/77) Periodic Testing of Diesel Generators Used As Onsite Electric Power Systems at Nuclear Power Plants

The diesel generator testing is in conformance with the recommendations of Regulatory Guide 1.108 except as noted below.

The requirements of position C.1.c are met with the following exception:

> Temporary jumpers are used on a limited basis during the performance of periodic tests for the emergency diesel generators.

The above exception to Regulatory Guide 1.108 is determined to be acceptable because the NRC has previously accepted the use of temporary jumpers for testing of protection system circuits addressed in UFSAR Section 7.1.2.11.d. This position is further supported by the discussion in SER Section 7.3.2.14. The NRC based its acceptance on the combination of explicit test procedures and administrative controls (independent second-person verification) which met the guidelines in NRC IE Information Notice No. 84-37, Use of Lifted Leads and Jumpers During Maintenance or Surveillance Testing. These guidelines provide reasonable assurance that the instrumentation will be restored to the correct configuration following testing. The use of jumpers is minimized and is performed only where permanent hardware changes are not practical or cannot be justified.

The requirements of position C.2.a(5) were met for preoperational testing as follows:

> The functional capability at full load temperature was demonstrated by performing the test outlined in position C.2.a(l) and (2) immediately following the full load carrying capability test described in position C.2.a(3). The full load carrying capability of position C.2.c(2) was demonstrated for greater than or equal to five minutes.

The above exception to Regulatory Guide 1.108 met the intent of position C.2.a(5) by demonstrating the capability of the diesel generator to start and accept load at full load temperature.

The requirements of position C.2.a(3) will be met every 18 months as follows:

> Full load carrying capability will be verified by operating the diesel generator at a load of greater than or equal to 5600 kW and less than or equal to 6100 kW. The 2 hour rating of the diesel generator will be verified by operating the diesel generator at a load of greater than or equal to 6363 kW and less than or equal to 6700 kW.

The above exception to Regulatory Guide 1.108 meets the intent of position (3) by demonstrating that the diesel generators are capable of carrying approximate full load for an interval of not less than 24 hours.

The requirements of position C.2.a(5) will be met every 18 months as follows:

> The functional capability at full load temperature will be demonstrated by verifying that the diesel generator will start from a manual or automatic start signal within five minutes of shutdown following the 24 hour surveillance run. The generator voltage and frequency shall be 4160 ± 420 volts and 60 ± 1.2 Hz within 10 seconds after the start signal, and the diesel generator shall be operated for at least five minutes.[***]

The above exception to Regulatory Guide 1.108 meets the intent of position (5) by demonstrating the capability of the diesel generator to start at normal operating temperature.

The periodic testing requirements of C.2.c(2) will be met as follows:

> Full load carrying capability will be verified by periodically running the diesel generator at a load of greater than or equal to 5600 kW and less than or equal to 6100 kW for at least 60 minutes.

The above exception to Regulatory Guide 1.108 meets the intent of position (2) by demonstrating that the diesel generators are capable of carrying approximate full load for a period of not less than 60 minutes.

[***] If the diesel generator fails to start during this test, then it is not necessary to repeat the preceding 24-hour test. Instead, the diesel generator may be operated at greater than or equal to 5600 kW and less than or equal to 6100 kW for 2 hours or until operating temperature has stabilized. The load range is provided to preclude routine overloading of the diesel generator. Momentary transients outside the load range, due to changing bus conditions, do not invalidate the test.

The periodic testing interval requirements of position C.2.d will be met as follows:

> The periodic testing interval will be no more than 31 days per T/S 4.8.1.1.2.a. The corrective actions for a test failure will be determined by the maintenance rule emergency diesel generator performance criteria.

The above exception to Regulatory Guide 1.108 meets the intent of position C.2.d by maintaining the periodic test interval and ensuring that adequate corrective actions are implemented if a test failure occurs.

The records and reporting requirements of position C.3.b will be met as follows:

> Significant emergency diesel generator failures will be reported in accordance with the provisions of 10 CFR 50.72 and 50.73. Footnote 3 in position C.3.b references Regulatory Guide 1.16. UFSAR Section 1.8 documents compliance with Regulatory Guide 1.16.

The above exception to Regulatory Guide 1.108 meets the intent of position C.3.b by providing NRC notification of diesel generator failures in accordance with the licensee's reporting requirements.

For further discussion, refer to Subsections 8.1.5.3 and 8.3.1.1 and Regulatory Guide 1.22.

Regulatory Guide 1.109

<u>(Rev. 1, 10/77)</u> <u>Calculation of Annual Doses to Man From Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance With 10 CFR Part 50, Appendix I</u>

This guide describes NRC-suggested models and assumptions for estimating the doses to humans from radioactivity expected to be routinely discharged from the plant to the hydrosphere and atmosphere during normal operation. To demonstrate compliance with the "As Low As Is Reasonably Achievable" dose criteria of 10 CFR 50, Appendix I, all dose calculations have used the suggested models and assumptions of this regulatory guide. The details of the dose evaluations are provided in Subsections 11.2.3 and 11.3.3.

Regulatory Guide 1.110

(Rev. 0, 3/76) Cost-Benefit Analysis for Radwaste Systems Systems for Light-Water-Cooled Nuclear Power Reactors

This regulatory guide describes an acceptable method for performing a cost benefit analysis for liquid and gaseous radwaste system components to demonstrate compliance with Section II.D of Appendix I to 10 CFR 50. However, on September 4, 1975 (F.R.172), the Commission amended Appendix I of 10 CFR 50 to allow applicants who filed applications for construction permits for light-water-cooled nuclear power reactors which were docketed on or after January 2, 1971, and prior to June 4, 1976, the option of dispensing with the cost-benefit analysis required by Paragraph II.D of Appendix I. This option permits an applicant to design radwaste management systems to satisfy the Guides on Design Objectives for Light-Water-Cooled Nuclear Power Reactors proposed in the Concluding Statement of Position of the Regulatory Staff in Docket RM-50-2, dated February 20, 1974. As indicated in the Statement of Considerations included with the amendment, the Commission noted it is unlikely that further reductions to radioactive material releases would be warranted on a cost-benefit basis for light-water-cooled nuclear power reactors having radwaste systems and equipment determined to be acceptable under the proposed staff design objectives set forth in RM-50-2.

In a letter to the Commission dated October 8, 1975, Public Service Company of New Hampshire chose to comply with the Commission's September 4, 1975 amendment to Appendix I, eliminating the necessity to perform a cost-benefit analysis as required by Paragraph II.D of Appendix I. Therefore, Regulatory Guide 1.110 is not applicable to the Seabrook design evaluation.

Regulatory Guide 1.111

(Rev. 1, 7/77) Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors

Atmospheric dispersion of routine gaseous effluent releases are calculated using a computer code, as described in Subsection 2.3.5, which is based, in part, on Regulatory Guide 1.111 modeling methodology and applicable procedures.

Regulatory Guide 1.112

(Rev. O-R, 4/76; Reissued 5/77) Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors

The objective of this guide is to provide an acceptable method of calculating realistic radioactive source terms for the evaluation of radioactive waste treatment systems in determining whether the design objectives of Appendix I to 10 CFR 50 are met and in determining the impact of radioactive effluents on the environment. The regulatory guide references NUREG-0017 (PWR-GALE computer code) as an acceptable method for the calculation of radioactive source terms from PWRs. For Seabrook, expected annual average liquid and gaseous radioactive effluents have been estimated utilizing the PWR-GALE code in conformance with this regulatory guide. Subsections 11.2.3 and 11.3.3 list the calculated radioactive releases for liquid effluents and gaseous effluents, respectively.

Regulatory Guide 1.113

(Rev. 1, 4/77) Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I

The aquatic dispersion of effluents was estimated as recommended by Regulatory Guide 1.113, Revision 1, using results from physical model studies and an analytical dispersion model.

The initial dilution (nearfield region) was estimated using results from physical model studies of the thermal discharge performed by Alden Research Laboratories (Reference 13). The model was a 1 to 115 undistorted Fronde model in which temperature rise patterns were measured. Because very little heat transfer occurs in the nearfield region of the model, the initial dilution of any effluent constituent can be determined from the temperature rise reduction as given by the physical model.

The farfield concentration of effluent constituents was estimated using an analytical dispersion model developed by Brocard and Kirby (Reference 14). This model was run with zero heat transfer to simulate the release of a conservative constituent.

Regulatory Guide 1.114

(Rev. 1, 11/76) Guidance on Being Operator at the Controls of a Nuclear Power Plant

The criteria for being a control room operator comply with the requirements of NRC Regulatory Guide 1.114, Rev. 1. For further discussions, refer to Sections 13.1 and 13.2.

Regulatory Guide 1.115

(Rev. 1, 7/77) Protection Against Low-Trajectory Turbine Missiles

The plant design conforms to Regulatory Guide 1.115, Rev. 1, except for Position 4. The probability of damage due to low trajectory missiles is greater than the required 10^{-3}. For further discussion, refer to Subsection 3.5.1.3.

Regulatory Guide 1.117

(Rev. 1, 4/78) Tornado Design Classification

The plant design complies with Regulatory Guide 1.117, Rev. 1.

Although the condensate storage tank is not designed for missiles or a pressure drop, the system will function if the tank fails because the shield wall is designed for missiles and is waterproofed to contain water from the tank.

The Ultimate Heat Sink Cooling Tower is not designed for tornado missiles. The primary source for water is the Atlantic Ocean through the underground tunnels, which will function during a tornado event.

For further discussion on this subject, refer to Section 3.5.

Regulatory Guide 1.118

(Rev. 1, 11/77; Rev. 2, 6/78 and Rev. 3, 4/95) Periodic Testing of Electric Power and Protection Systems

The 1E electric power and safety system testing will comply with Regulatory Guide 1.118, Rev. 1.

Detailed clarifications on the regulatory positions are presented below:

a. Regulatory Position C.2

"Protective Action Systems" is interpreted to mean the electric, instrumentation and controls portions of those protection systems and equipment actuated and controlled by the protection system.

b. Regulatory Position C.6

Equipment performing control functions, but actuated from protection system sensors, is not part of the safety system and will not be tested for time response.

c. Regulatory Position C.10

Testing, although not tied to accident conditions, will be tied to the range of the parameter that is varied. This range is determined by expected design basis event conditions and anticipated operational occurrences.

d. Regulatory Position C.11

Status, annunciating, display, and monitoring functions, except for those related to the Post-Accident Monitoring System (PAMS), are considered to be control functions. Reasonability checks, i.e., comparison between or among similar such display functions, will be made. Otherwise, the clarification note in Item b above, pertaining to Position C.6, is observed.

e. Regulatory Positions C.12 and C.13

Response time testing for control functions operated from protection system sensors will not be performed. Nuclear Instrumentation System detectors will not be tested for time response. (See TS Technical Requirement 1 of the Technical Requirements Manual.)

f. Regulatory Position C.14

Position C.14 has the same requirement as position C.6 of Regulatory Guide 1.1118, Revision 2. Refer to the discussion for position C.6 of Regulatory Guide 1.1118, Revision 2.

Additional clarifications with regard to IEEE 338-1975 are included in Subsection 7.1.2.11.

The 1E electric power and safety system design and testing will also conform to the guidance of Regulatory Guide 1.118, Rev. 2, and the requirements of IEEE 338-1977 with the following clarifications:

a. "Protective Action Systems" is defined to mean the electric, instrumentation and controls portions of those protection systems and equipment actuated and controlled by the protection system.

b. Equipment performing control functions, but actuated from protection system sensors is not part of the safety system and will not be tested for time response.

c. Status, annunciating, display, and monitoring functions, except those related to the Post-Accident Monitoring Systems (PAMS) are considered to be control functions. Reasonability checks, i.e., comparison between or among similar such display functions, will be made.

d. Regulatory Position C.6

Position C.6 states that temporary jumpers may be used with portable test equipment where the safety system equipment to be tested is provided with facilities specifically designed for connection of this test equipment. The intention of this position is to ensure that test setups are of a quality that does not degrade the equipment and that makeshift test setups are not used.

Temporary jumpers are used on a limited basis during the performance of periodic tests for various electric power and protection systems. Regulatory Guide 1.118 does not provide details on what constitutes facilities specifically designed for connection of test equipment. When temporary jumpers are used during testing, they are connected via devices that are suitable for ensuring a reliable connection to the equipment under test. Certain points of connection may not have been specifically designed for the connection of test equipment, but the points are evaluated for acceptability for each application. This meets the intent of the regulatory position to ensure that makeshift test setups are not used. For additional information on the use of temporary jumpers, refer to the discussion under Regulatory Guide 1.108.

The 1E electric power and safety system design and testing will also conform to the guidance of Regulatory Guide 1.118, Rev. 3, specifically for exclusion of testing for process to sensor coupling (flow testing). IEEE 338-1977 stated that response time testing of the process to sensor coupling was not required. Regulatory Guide 1.118, Rev. 2 indicated that the process to sensor coupling test was under evaluation. The Regulatory Guide 1.118, Rev. 3 now endorses the position taken in IEEE 338-1977, that response time testing of the process to sensor coupling is not required.

Regulatory Guide 1.119

(Rev. 0, 6/76) Surveillance Program for New Fuel Assembly Designs

This regulatory guide was withdrawn by the NRC on June 23, 1977.

Regulatory Guide 1.120

(Rev. 1, 11/77) Fire Protection Guidelines for Nuclear Power Plants

Regulatory Guide 1.120 has been issued to provide information to applicants regarding the NRC staff's plans for using this regulatory guide and to solicit public comment. Branch Technical Position APCSB 9.5-1, which is part of the Standard Review Plan (NUREG-75/087), formed the basis for the regulatory guide. Branch Technical Position APCSB 9.5-1, has been revised to Branch Technical Position CMEB 9.5-1, which now contains provisions of Regulatory Guide 1.120; 10 CFR 50, Appendix R; and Branch Technical Position APCSB 9.5-1. This revised Branch Technical Position is now used in the evaluation of fire protection provisions of applicants currently under review for operating licenses for plants under construction.

The existing plant design complies with the Branch Technical Position CMEB 9.5-1 with the exceptions as depicted in "Fire Protection System Evaluation and Comparison to Branch Technical Position APCSB 9.5-1, Appendix A," Rev. 2, and "Fire Protection of Safe Shutdown Capability (10 CFR 50, App. R)," Rev. 1, submitted to the USNRC in August 1984.

Regulatory Guide 1.121

(Rev. 0, 8/76) Bases for Plugging Degraded PWR Steam Generator Tubes

Position C.1

Westinghouse interprets the term "Unacceptable defects" to apply to those imperfections resulting from service induced mechanical or chemical degradation of the tube walls which have penetrated to a depth in excess of the Plugging Limit.

Positions C.2a(2) and C.2.a(4)

Westinghouse will use a 200 percent margin of safety based on the following definition of tube failure. Westinghouse defines tube failure as plastic deformation of a crack to the extent that the sides of the crack open to a nonparallel, elliptical configuration. This 200 percent margin of safety compares favorably with the 300 percent margin requested by the NRC against gross failure.

Position C.2.b

In cases where sufficient inspection data exist to establish degradation allowance, the rate used will be an average time-rate determined from the mean of the test data.

Where requirements for minimum wall are markedly different for different areas of the tube bundle, e.g., U-bend area versus straight length in Westinghouse designs, two plugging limits may be established to address the varying requirements in a manner which will not require unnecessary plugging of tubes.

Positions C.3.d(l) and C.3.d(3)

The combined effect of these requirements would be to establish a maximum permissible primary-to-secondary leak rate which may be below the threshold of detection with current methods of measurement.

Westinghouse has determined the maximum acceptable length of a through-wall-crack based on secondary pipe break accident loadings which are typically twice the magnitude of normal operating pressure loads. Westinghouse will use a leak rate associated with the crack size determined on the basis of accident loadings.

Position C.3.e(6)

Westinghouse will supply computer code names and references rather than the actual codes.

Position C.3.f(l)

Westinghouse will establish a minimum acceptable tube wall thickness (Plugging Limit) based on structural requirements and consideration of loadings, measurement accuracy and, where applicable, a degradation allowance as discussed in this position and in accordance with the general intent of this guide. Analyses to determine the maximum acceptable number of tube failures during a postulated condition are normally done to entirely different bases and criteria are not within the scope of this guide.

Regulatory Guide 1.122

(Rev. 1, 2/78) — Development of Floor Response Spectra for Seismic Design of Floor-Supported Equipment or Components

The plant design conforms to Regulatory Guide 1.122, Rev. 1, with the following exception:

> Regulatory Guide 1.122 requires peaks associated with structural frequencies be broadened by ±0.15 f_i. Seabrook Preliminary Safety Analysis Report Subsection 3.7.2.6 stated that "to account for variations in structural parameters the peaks on the floor response spectra will be widened by ±10 percent."
>
> The justification for this exception is that Regulatory Guide 1.122 was published after the PSAR was submitted. The "implementation" section of Regulatory Guide 1.122 states that it is presently being used "in the evaluation of submittals for construction permit applications." In addition, Regulatory Guide 1.122 states that the +0.15 f_i broadening is to account for such parameters as "material properties of soil . . . and soil structure interaction techniques." Since the Seabrook Plant is founded on rock, the uncertainties associated with soil properties and soil modeling are not of any concern, and less conservative peak broadening is justified.

Regulatory Guide 1.124

(Rev. 1, 1/78) — Service Limits and Loading Combinations for Class 1 Linear-Type Component Supports

The Seabrook NSSS is in partial compliance with this regulatory guide, with the following clarifications/variations:

a. The regulatory guide states in Paragraph B.1(b): "Allowable design limits for bolted connections are derived from tensile and shear stress limits and their nonlinear interaction; they also change with the size of the bolt. For this reason, the increases permitted by NF-3231.1, XVII-2110(a), and F-1370(a) of Section III are not directly applicable to allowable shear stresses and allowable stresses for bolts and bolted connections," and in Paragraph C.4: "This increase of design limits does not apply to limits for bolted connections and shear stresses."

As noted above, the increase in bolt allowable stress under emergency and faulted conditions is not permitted because: (1) the interaction between the allowable tension and shear stress in bolts is nonlinear, and (2) the allowable tension and shear stress vary with the bolt size. The NSSS supplier believes that the present ASME Code rules are adequate since they do satisfy the two objectives raised in the above quoted paragraph and hence will use the present rules without further restrictions or justification. This position is based on the following:

1. It is well recognized after extensive experimental work by several researchers that the interaction curve between the shear and tension stress in bolts is more closely represented by an ellipse and not a line. This has been clearly recognized by the ASME. Code Case 1644 has specified stress limits for bolts and represents this tension/shear relationship as a non-linear interaction equation (ellipse). This equation has since been added to the ASME Code Section III in the Winter '77 Addenda. This interaction equation has a built-in safety factor that ranges between 2 and 3 (depending on whether the bolt load is predominantly tension or shear) based on the actual strength of the bolt as determined by test (Ref: "Guide to Design Criteria for Bolted and Riveted Joints," Fisher and Struik, copyright 1974, John Wiley and Sons, p. 54).

   Study of three interaction curves of allowable tension and shear stress based on the ASME Code (emergency condition allowables per XVII - 2110 and faulted condition allowables per F-1370) and the ultimate tensile and shear strength of bolts (obtained from experimental work published by Chesson, Faustino, and Munse in "Proceedings of ASCE:" October 1975) indicates that there is adequate safety margin between the emergency and faulted condition allowables and failure of the bolts.

   From this study it is observed that:

   (a) For the emergency condition, the safety factor (ratio of ultimate strength to allowable stress) varies between a minimum of 1.63 and a maximum of 2.73 depending upon the actual tensile stress/shear stress (T/S) ratio on the bolt.

   (b) For the faulted condition, the safety factor varies between a minimum of 1.36 to a maximum of 2.29, again depending upon actual T/S ratio on the bolt.

   It is thus reasonable to allow an increase in these limits for the emergency and faulted conditions.

2. In Section III, Subsection NA, Table XVII - 2461.1, the ASME Code provides the criterion for allowable stress on bolts.

   According to this table, the allowable stress depends upon the bolt size as well as the bolt material.

3. The structures designed to meet AISC Manual of Steel Construction have been proven to be adequately designed. It is also recognized that the ASME Code requirements for Class 1 linear type supports (Appendix XVII) have been derived from AISC Manual of Steel Construction. In Paragraph 1.5.6 of Manual of Steel Construction, AISC permits the increased allowables for "occasional loads such as wind and seismic." In view of this, restrictions by NRC on not permitting increased allowables under emergency and faulted conditions which also are "infrequent incidents and limiting faults" are not justified.

Based on Paragraphs 1, 2, and 3 above, for the emergency and faulted conditions, the NSSS supplier will use allowable bolt stresses based upon the equations specified in Code Case 1644-4, as increased according to the provisions of XVII-2110(a) and F-1370(a) (as amended by Regulatory Guide 1.124 Paragraph C.4), respectively. The NSSS supplier will use the revision of Code Case 1644, as amended by Regulatory Guide 1.85, consistent with material procurement for the selection of material properties.

b. Paragraph C.4 of the Regulatory Guide states: "However, all increases (i.e., those allowed by NF-3231.1(a), XVII-2110(a), and F-1370(a)) should always be limited by XVII-2110(b) of Section III." Paragraph XVII-2110(b) specifies that member compressive axial loads shall be limited to $^2/_3$ of critical buckling. Satisfaction of this criteria for the faulted condition is met for the primary equipment supports.

c. Paragraph C.6(a) of the Regulatory Guide appears to erroneously allow the use of faulted stress limits for the emergency condition. The NSSS supplier will interpret this paragraph as follows: "The stress limits of XVII-2000 of Section III and Regulatory Position 3, increased according to the provisions of XVII-2100(a) of Section III, should not be exceeded for component supports designed by the linear elastic analysis method."

   This position was accepted by the NRC via the RESAR 414 Safety Evaluation Report.

Regulatory Guide 1.125

(Rev. 1, 10/78) Physical Models for Design and Operation of Hydraulic Structures and Systems for Nuclear Power Plants

Seabrook does not have any safety-related hydraulic structures which directly interface with surface waters.

Some of the types of physical modeling studies included in Regulatory Guide 1.125, Rev. 1, were, however, used in the design and operation of nonsafety- related hydraulic structures and systems of the plant. A number of these studies were discussed with the NRC staff at the testing facilities. Results of these studies have been transmitted to the NRC staff.

The physical modeling studies are further discussed in Section 3.4 of the Environmental Report.

Regulatory Guide 1.126

(Rev. 1, 3/78) An Acceptable Model and Related Statistical Statistical Methods for the Analysis of Fuel Densification

The fuel densification model presented in Reference 11, which has been approved by the NRC, has been utilized. This model continues to be used with the updated fuel performance models in Reference 18. Results reported in Reference 19 (which has been approved by the NRC) show that the densification has been minimized in Westinghouse fuel through improvements in the fuel manufacturing process, and that formation of significant axial gaps in the fuel stack will not occur.

Regulatory Guide 1.127

(Rev. 1, 3/78) Inspection of Water-Control Structures Associated With Nuclear Power Plants

The recommendations of Regulatory Guide 1.127, Rev. 1, will be met by developing and implementing an appropriate in-service inspection and surveillance program for the flood protective structures. These flood protective structures consist of the stone revetments, reinforced concrete vertical seawall, and the sheet pile retaining wall.

Regulatory Guide 1.128

(Rev. 1, 10/78) Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants

The recommendations of Regulatory Guide 1.128 have been followed.

The subject matter of this guide is discussed in Subsection 8.3.2.

Regulatory Guide 1.129

<u>(Rev. 1, 2/78)</u> <u>Maintenance, Testing and Replacement of Large Lead Storage Batteries for Nuclear Power Plants</u>

The plant design conforms to Regulatory Guide 1.129 except for the following:

The Regulatory Guide states in Position C.1, "The battery service test... should be performed in addition to the battery performance discharge test." The Technical Specifications require service tests at least once per 18 months and performance discharge tests at least once per 60 months. However, the Technical Specifications allow the performance discharge test to be performed in lieu of (not in addition to) the service test once per 60 month interval.

The Regulatory Guide states in Position C.1,
"The battery service test should be performed during refueling operations or at some other outage, with intervals between tests not to exceed 18 months."

The Technical Specifications permit the battery service test to be performed during non-outage periods. The Seabrook Station design incorporates two 100% capacity battery banks per train. Removing one of these battery banks from service for surveillance testing does not reduce the system capabilities. The regulatory guide assumes only one 100% capacity battery bank per train.

The subject matter of this regulatory guide is further discussed in Subsection 8.3.2.

Regulatory Guide 1.130

<u>(Rev. 1, 10/78)</u> <u>Service Limits and Loading Combinations for Class 1 Plate-and-Shell-Type Component Supports</u>

The Seabrook NSSS is in partial compliance with this regulatory guide, with the following exceptions:

a. The regulatory guide states in Paragraph B.l:

   "Allowable design limits for bolted connections are derived on a different basis that varies with the size of the bolt. For this reason, the increases permitted by NF-3224 and F-1323.1(a) of Section III are not directly applicable to bolts and bolted connections."

This requirement is overly conservative. The ASME Code provides stress criteria for the design of bolting for component supports. Paragraph NF-3280 of ASME III specifies the use of the S_y values given in Table I-13.3 as multiplied by the applicable design factors of Table XVII-2461.1-1. Paragraph F-1323.1 specifies the use of the S_m values of Table I-1.3 (NB-3230) specifically for the faulted condition. In addition, Table 4 of Code Case 1644 presents alternative bolting design requirements which may be used.

In Table XVII-2461.1-1, Table I-1.3, and Table 4 of Code Case 1644, the allowable stress values (either Sy or S_m) are dependent upon the size of the bolt as well as bolt material. Thus, since bolt size is already taken into consideration in the formulation of these criteria, it is reasonable to allow an increase in these limits for emergency and faulted conditions. In addition, the bolting design rules presented in Code Case 1644 (starting with Revision 4) provide an acceptable basis for design of bolts and should, therefore, be clearly noted in the regulatory guide.

The NSSS supplier will use allowable bolt stresses specified in Table XVII-2461.1-1), Table I-1.3, and Code Case 1644 for emergency and faulted conditions as increased according to the provisions of NF-3224 and F-1323.1(a), respectively.

b. In Paragraphs C.3, C.4(a), and C.6(a) of the regulatory guide, design margins of 2 for flat plates and 3 for shells are unnecessarily restrictive for normal, upset, and emergency conditions, as well as inconsistent with ASME Code requirements. For these loading conditions, the NSSS supplier will limit the allowable buckling strength to of the critical buckling strength.

c. In Paragraph C.7 of the regulatory guide, inclusion of the upset plant condition is inappropriate in the load combination under discussion. The NSSS supplier will not include the upset plant condition in this combination.

d. In Paragraphs C.7(a) and B.1 of the regulatory guide, the stress limits of F-1370(c) are discussed. The criterion stated in F-1370(c),"...Loads should not exceed 0.67 times the critical buckling strength of the support..," is overly restrictive for the faulted condition. The most significant faulted condition loads on equipment supports result from seismic disturbances and postulated loss-of-coolant accidents, both of which are extremely short duration, dynamic events.

If it is shown that the dynamic effects of the member loading are not detrimental, the NSSS supplier will allow the compressive axial load to go to 0.9 times the critical buckling strength.

e. In Paragraph C.7(b) of the regulatory guide, the limit based on the test load given in the regulatory guide, T.L. x 0.7 S_u/S_u, is overly conservative and is inconsistent the ASME Code requirements.

The NSSS supplier will use the limit as calculated by T.L. x 0.8 S_u/S_u.

This position was accepted by the NRC via the RESAR 414 Safety Evaluation Report.

Regulatory Guide 1.131

(Rev. 0, 8/77) Qualification Tests of Electric Cables, Field Splices and Connections for Light- Water-Cooled Nuclear Power Plants

The qualification test recommendations of this guide have been followed.

The subject is further discussed in Subsections 8.1.5.3a and 8.3.1.4.

Regulatory Guide 1.132

(Rev. 1, 3/79) Site Investigation for Foundations of Nuclear Power Plants

The site investigations performed for the plant complied in part with Regulatory Guide 1.132, Rev. 1, which was issued subsequent to the performance of the site investigation. The investigation was more than adequate to determine the geotechnical characteristics of the site affecting the design, performance and safety of the plant. It was performed under the direction, and with the advice of, experienced personnel familiar with the site and regional geology. The main exception to compliance with the guide was in meeting the general guidelines for subsurface explorations. These explorations were carried out to adequately assess the foundation requirements based on the complexity of the anticipated subsurface conditions. This is further discussed in Subsection 2.5.1 and its associated appendices.

Regulatory Guide 1.133

(Rev. 1, 5/81) Loose-Part Detection Program for the Primary System of Light-Water-Cooled Reactors

Compliance with Regulatory Guide 1.133 is discussed in detail in Subsection 4.4.6.4.

Regulatory Guide 1.134

(Rev. 2, 4/87) Medical Evaluation of Licensed Personnel for Nuclear Power Plants

Endorses ANSI/ANS-3.4-1983.

The medical evaluation of licensed operators complies with the requirements of Regulatory Guide 1.134, Rev. 2. For further discussion, refer to Seabrook Station's Medical Manual. The use of licensed/certified nurse practitioners to perform the hands-on physical examination with an evaluation and sign-off by a licensed physician who makes the final determination per Regulatory Guide 1.134 is documented in References 16 and 17.

Regulatory Guide 1.135

(Rev. 0, 9/77) Normal Water Level and Discharge at Nuclear Power Plants

The structural design criteria for normal ground and surface water levels comply with Regulatory Guide 1.135 by establishing the maximum ground and surface water levels at safety-related structures and facilities at +20 feet MSL (plant grade). Elevation +20 feet MSL is above both the maximum recorded ground water level and also above the postulated probable maximum surge still water level.

Wave runup and overtopping of the protective revetment would occur during the probable maximum surge which would cause ponding on the site of approximately 0.6 feet. All safety-related structures are protected against this site ponding level.

For further discussion, refer to Section 2.4.

Regulatory Guide 1.136

(Rev. 2, 6/81) Materials, Construction, and Testing of Concrete Containments

The requirements of this guide comply with the following exceptions:

a. Paragraph B.8, CC-4333.4.2 - Splice Samples

   This section requires only a production-splice testing program. Sister splices have also been used.

   Sister splices were taken in place of production Cadwelding splices in congested areas or in areas where conditions would be detrimental for providing satisfactory replacement splices.

Where a total sister splice test program was implemented for a series of splices, the testing frequency was in accordance with ASME Section III, Division 2, 1975, CC-4333.4.3(b) and USNRC Regulatory Guide 1.10, Paragraph 4(b), except that all splices were sister splices. Tensile testing was performed on a random selection basis using the testing frequency in either Paragraph (a) or (b) of ASME Section III, Division 2, 1975, CC-4333.4.3. At least one quarter of the total number of splices tested from the containment structure (ASME boundary-exterior mat, shell and dome) were production splices. At least one quarter of the total number of splices tested from all other combined safety related splicing were also production splices.

Prior to forming, all Cadweld splices were inspected to assure that all preparations (e.g., cleaning, drying, aligning) required by the designer and the splice manufacturer were properly carried out. Quality Assurance personnel inspected a minimum of one splice connection per crew per shift, and all other splice connections were inspected by Cadwelding personnel.

b. Paragraph B.9, CC-4352 - Splices

The requirement for staggering mechanical (Cadweld) reinforcing bar splices, as revised in the 1980 issue of ACI-349, has generally been complied with. In the limited number of cases where splices were not staggered, proper technical evaluation was performed to justify the nonstaggered arrangement.

c. Paragraph C.12, CC-5210 - General

All pipes used for rebar supports have not been filled with grout.

Regulatory Guide 1.137
<u>(Rev. 1, 10/79)</u> <u>Fuel Oil Systems for Standby Diesel Generators</u>

The fuel oil system design for the standby diesel generators complies with the requirements of NRC Regulatory Guide 1.137, Rev. 1. Fuel oil testing exceptions are identified in Subsection 9.5.4.4.

For further discussion, refer to Subsection 9.5.4.

Regulatory Guide 1.138

(Rev. 0, 4/78) Laboratory Investigations of Soils for Engineering Analysis and Design of Nuclear Power Plants

The laboratory investigations of soils for engineering analysis and design complied in part with Regulatory Guide 1.138, Rev. 0, dated April, 1978, which was issued subsequent to the performance of the laboratory investigations. The investigations were more than adequate to permit a realistic evaluation of soil and rock properties and subsurface conditions. They were performed under the direction of experienced engineers and geologists who have demonstrated competence in the field of soil and rock mechanics testing and are familiar with the site.

Table 1.8-1 includes the actual testing procedures used in the investigations and identifies the procedures preferred by the NRC, as given in Regulatory Guide 1.138. Table 1.8-1 also notes exceptions taken to the preferred procedures. These exceptions were to make the test results more reliable or applicable to a wider range of soil types. The noted exceptions do not alter the engineering application of the test results.

This subject is further discussed in Subsection 2.5.1.

Regulatory Guide 1.139

(Rev. 0, 5/78) Guidance for Residual Heat Removal

Regulatory Guide 1.139 establishes specific design requirements that address the various system functions that are required to achieve and maintain a safe hot standby and cold shutdown condition.

The NSSS supplier endorses the design objective of Regulatory Guide 1.139 to ensure systems capability for achieving and maintaining the plant in a safe shutdown condition. The NSSS supplier has implemented for Seabrook this design objective by providing systems with the capability to place and maintain the plant in a safe hot standby condition. Suitable design provisions and interface requirements have been provided to permit the plant to be maintained in the safe hot standby condition until (a) normal systems could be restored to permit either return to power operation or cooldown to cold shutdown conditions, or (b) sufficient systems capability could be restored (depending on plant condition) to permit cooldown to cold shutdown conditions under abnormal plant conditions. This design philosophy, when properly implemented, is considered to constitute a safe design, independent of the time period at which the plant is maintained at hot standby or cooled to cold shutdown conditions.

The NSSS supplier's safe shutdown design does not comply in full with the specific design requirements of Regulatory Guide 1.139. However, this traditional safe shutdown design incorporates an inherent level of cold shut-down capability under accident conditions which compares favorably with the specific requirements of Regulatory Guide 1.139 (when reviewed on a case-by-case basis). For this category of plants, the case-by-case implementation requirements of Regulatory Guide 1.139 are considered an endorsement of the traditional NSSS supplier's safe shutdown design basis. For a plant in this category, evaluation of the plant specific safe shutdown design basis against the requirements of Regulatory Guide 1.139 ensures that the system functions that are required to achieve and maintain a safe hot standby and cold shut-down have been properly implemented. A major benefit of such an evaluation is the identification of plant specific equipment and the development of plant specific operating procedures for bringing the plant to cold shutdown under abnormal conditions, including natural circulation. The specific design requirements of Regulatory Guide 1.139 function as a bench mark for this evaluation and identify areas for potential upgrading based on value/impact assessment. Selective upgrading may be beneficial in providing increased operating flexibility and increased margins of safety under abnormal plant conditions.

For plants which must comply with Regulatory Guide 1.139 on a case-by-case basis, the following compliance exemption is identified:

The systems for bringing the plant from normal operating conditions to cold shutdown should not be required to achieve cold shutdown conditions within 36 hours if it can be demonstrated that the plant can be maintained for longer periods of time in a safe hot standby or hot shutdown condition with adequate heat removal via the Auxiliary Feedwater System or Residual Heat Removal System, respectively.

The portions of BOP systems that are utilized to achieve and maintain a safe hot standby, or take the plant from hot standby to the condition where the RHR system can be cut in, are designed and fabricated to safety Class standards, and are provided with appropriate redundancy and remote operability to meet the requirements of this Regulatory Guide.

These systems and components are described in detail in Section 10.3, "Main Steam System," and in Section 6.8, "Emergency Feedwater System."

With regard to plant cooldown capability, either emergency feedwater pump is designed in conjunction with all four atmospheric relief valves to be able to maintain hot standby for 4 hours followed by a cooldown period of 5-hour duration. The condensate storage tank (Subsection 9.2.6.3) has sufficient capacity to support the above.

For situations where all four atmospheric relief valves are not available, there exists sufficient time for the operators to take corrective action.

This corrective action could be the re-establishment of all four atmospheric relief valves to operable, or the line-up of additional water supplies such as water treatment, demineralized water storage tank or fire protection to supplement the condensate storage tank in a prolonged cooldown.

Regulatory Guide 1.140

<u>(Rev. 1, 10/79)</u> <u>Design, Testing and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light Water-Cooled Nuclear Power Plants</u>

The requirements of this guide have been met, with the exceptions discussed in Subsection 9.4, Table 9.4-20, Table 9.4-21, Table 9.4-22, Table 9.4-23.

Section C.5.c requires HEPA filter banks, located upstream of the adsorber section, and Section C.5.d.(4) requires activated carbon adsorbers to be tested following painting, fire, or chemical release in any ventilation zone communicating with the system in such a manner that the HEPA filter or the charcoal adsorbers could become adversely affected by the fumes, chemicals, or foreign material. Painting is administratively controlled to protect the HEPA filters and the charcoal adsorbers from the adverse effects of the fumes.

Regulatory Guide 1.141

<u>(Rev. 0, 4/78)</u> <u>Containment Isolation Provisions for Fluid Systems</u>

The recommendations of Regulatory Guide 1.141 have been followed with the exceptions listed in Subsection 6.2.4.2m.

For further discussion, refer to Subsection 6.2.4 and 7.1.2.2a.

Regulatory Guide 1.142

(Rev. 1, 10/81) Safety-Related Concrete Structures for Nuclear Power Plants (Other Than Reactor Vessels and Containments)

According to the "Implementation" section of this guide, compliance by Seabrook Station to this guide is not required.

ACI-349-76, "Code Requirements for Safety Related Structures," however, was not directly used as a design and construction standard, although the design and construction of the structures do fulfill the intent of the requirements set forth in the publication and in this regulatory guide. By the time this regulatory guide was issued, much of the design and fabrication were completed, and construction was also in progress. Consequently, the work was based on appropriate, corresponding standards, as follows:

a. Loads and load combinations were taken directly from the USNRC Standard Review Plan and ACI-318.

b. Structural analysis and design were consistent with the requirements of the Standard Review Plan and ACI-318.

c. Acceptance criteria were taken directly from the Standard Review Plan and ACI-318.

d. The requirement for staggering mechanical (Cadweld) reinforcing bar splices, as revised in the 1980 issue of ACI-349, has generally been complied with. In the limited number of cases where splices were not staggered, proper technical evaluation was performed to justify the nonstaggered arrangement.

Thus, through the use of the above described, judiciously selected standards, the safety-related structures were designed, fabricated and erected in a manner that ensures that they will withstand the effects of postulated accidents and environmental conditions, as well as those effects associated with normal operating conditions.

Additional information can be found in the appropriate subsections of Section 3.8.

Regulatory Guide 1.143

(Rev. 1, 10/79) — Design Guidance for Radioactive Waste Management Systems, Structures and Components Installed in Light-Water-Cooled Nuclear Power Plants

The recommendations of Regulatory Guide 1.143 have been followed. The following installed plant components are exceptions to the recommendations of Regulatory Guide 1.143:

- Chemical Drain Tank
- Chemical Drain Treatment Tanks

These three tanks are made of plastic and fiberglass and are designed to Standard PS-16-69.

None of the tanks contain a high inventory of radioactive material. For further discussion, refer to Subsection 9.3.3.

A vendor supplied waste liquid processing system is a supplement to the station installed waste liquid (WL) system. The vendor equipment meets the intent of Regulatory Guide 1.143 and of ANSI/ANS 40.37 (1993). The vendor system may have the following components, which are exceptions to the language on Regulatory Guide 1.143, ". . .plastic pipe should not be used.":

- PVC filter housing
- Rubber Hoses for flexible connection to plant system
- Glass fiber reinforced ultra-filtration unit housing

These components are nonmetallic to minimize the effect of system concentrates and cleaning chemicals, and to enhance the ability to install and remove the components for replacement. They are designed to meet the vendor system temperature, pressures and flows, and are tested to the recommendations in ANSI/ANS 40.37.

The steam generator blowdown recovery acid and caustic piping and equipment that supply the resin beds and the acid/caustic drains which connect directly to the waste hold up sump, including the piping and equipment that supplies demineralized water for dilution of the chemical, are considered a maintenance sub-system for the re-generation of the resins inside the demineralizer beds. This equipment is not part of the blowdown pressure boundary used for the treatment of effluent from the steam generators. During the re-generation process, the chemical sub-system is isolated from the inservice steam generator blowdown flow path. The piping and equipment that supply chemicals to the resin beds do not contain, or are not subject to the ingestion of radioactive materials. Therefore, the recommendation of Regulatory Guide 1.143 does not apply.

Regulatory Guide 1.145

(Rev. 0, 8/79) — Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants

The atmospheric dispersion model used to compute potential accident consequence assessments is described in Subsection 2.3.4. The modeling methodology complies with the intent of Regulatory Guide 1.145.

Regulatory Guide 1.147

(Rev. 2, 6/83) — Inservice Inspection Code Case Acceptability ASME Section XI, Division I

This Regulatory Guide is subject to periodic review and revision, and code cases referenced therein are subject to change. Code cases allowed by this Regulatory Guide and applicable to Seabrook will be referenced in the applicable Plant Section XI Program.

Regulatory Guide 1.148

(Rev. 0, 3/81) — Functional Specification for Active Valve Assemblies in Systems Important to Safety in Nuclear Power Plants

Regulatory Guide 1.148 is not applicable to Seabrook Station, with the exception of new systems important to safety and replacement valve units ordered after July 1, 1981. New systems important to safety and replacement valve units ordered after July 1, 1981 will be in compliance with Regulatory Guide 1.148.

Regulatory Guide 1.149

(Rev. 3, 10/2001) Nuclear Power Plant Simulation Facilities for Use in Operator Training and License Examinations

Endorses ANSI/ANS 3.5-1998

Revision 3 of this Regulatory Guide endorses the 1998 version of ANSI/ANS 3.5 without exception. Seabrook internal instructions for simulator software configuration control and testing have been revised to reflect the guidelines of the 1998 edition of ANSI/ANS 3.5.

Regulatory Guide 1.150

(Rev. 1, 2/83) Ultrasonic Testing of Reactor Vessel Welds During Pre-Service and Inservice Examinations

FPLE Seabrook implemented Regulatory Guide 1.150, Rev. 1 at the Seabrook site for the pre-service and in-service inspection of the reactor vessels. Specific plans for the implementation of Regulatory Guide 1.150 are contained in the Pre-Service Program Plan and were developed in a similar manner for the In-Service Inspection Programs.

Regulatory Guide 1.151

(Rev. 0, 7/83) Instrument Sensing Lines

The recommendations of Regulatory Guide 1.151 have been followed, with the exceptions as discussed in Subsections 3.2.2.2 and .1.2.12.

Regulatory Guide 1.152

(Rev. 1, 1/96) Criteria for Programmable Digital Computer System Software in Safety-Related Systems of Nuclear Power Plants

This Regulatory Guide endorses ANSI/IEEE-ANS 7-4.3.2-1993 for general guidance on stage-by-stage testing, overall performance assurance, and documentation of software for programmable digital computer systems in safety-related systems of nuclear power plants. The recommendations of Regulatory Guide 1.152 have been followed for upgrade of programmable digital computer systems used in the safety-related control room air conditioning system application at the Seabrook site. Refer to FSAR Subsection 9.4.1.1.

Regulatory Guide 1.153

(Rev. 0, 6/96) Criteria for Power, Instrumentation and Control Portions of Safety Systems

This Regulatory Guide endorses the guidance provided in IEEE Standard 603-1991 with appropriate supplements for the design, reliability, qualification, and testability of the power instrumentation and control portions of safety-related systems. IEEE Standard 603-1991 provides the same criteria as IEEE-279-1971 for protection systems, but is expanded in scope to provide additional guidance by including criteria for protection system actuation functions and auxiliary systems including digital systems.

The recommendations of Regulatory Guide 1.153 and Guidance provided in IEEE-603-1991 have been followed for upgrade of the digital computer systems used in the safety-related control room air conditioning system application at Seabrook Station.

Regulatory Guide 1.155

(Rev. 0, 6/88) Station Blackout

The requirements of Regulatory Guide 1.155 have been met as described in UFSAR Section 8.4. As allowed by Regulatory Guide 1.155, Section B, the guidelines of NUMARC 87-00, "Guidelines and Technical Bases for NUMARC Initiatives Addressing Station Blackout at Light Water Reactors" were followed except where the Regulatory Guide took precedence.

Regulatory Guide 1.157

(Rev. 0, 5/89) Best Estimate Calculations of Emergency Core Cooling System Performance

This guide provides guidance for the use of best estimate codes for use in ECCS evaluation models. The Large Break LOCA analysis was performed using the Westinghouse Best Estimate Large Break LOCA Methodology and is discussed in Chapter 15.6.5.2.

Regulatory Guide 1.163

(Rev. 0, 9/95) Performance-Based Containment Leak-Test Program

The requirements of Regulatory Guide 1.163 have been incorporated into UFSAR Subsection 6.2.6. The Regulatory Guide is listed in Subsection 3.8.2. As allowed by Regulatory Guide 1.163, the guidelines of NEI 94-01, dated July 26, 1995, "Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50 Appendix J" were followed except where Regulatory Guide 1.163 took precedence.

Regulatory Guide 1.183

(Rev. 0 7/00) Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors

The requirements of Regulatory Guide 1.183 have been incorporated into UFSAR Chapter 15. Regulatory Guide 1.183 is referenced in subsections 15.1.5.3, 15.3.3.3, 15.4.8.3, 15.6.2.3, 15.6.3.3, 15.6.5.4, 15.7.1.3, 15.7.2.3, 15.7.4.3, and Appendix 15C.

Regulatory Guide 1.190

(Rev. 0, 3/01 Calculational and Dosimetry methods for Determining Pressure Vessel Neutron Fluence

The methods and assumptions described in this guide are for the calculation and measurement of vessel fluence for core and vessel geometrical and material configurations that are typical of current light water reactor designs. The methodology presented is intended as a best estimate, rather than a bounding or conservative fluence determination.

The determination of the pressure vessel fluence is based on both calculations and measurements; the fluence predication is made with a calculation, and the measurements are used to qualify the calculational methodology. Because of the importance and the difficulty of these calculations, the methods must be qualified by comparison to measurements to ensure a reliable and accurate vessel fluence determination.

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10. Letter NS-CE-784, dated September 22, 1975, C. Eicheldinger (Westinghouse) to the Secretary of the Nuclear Regulatory Commission.

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17. Letter, dated April 18, 1984, D. Beckham, Operator Licensing Branch of the Nuclear Regulatory Commission to J. DeVincentis (PSNH), "Response to February 28, 1984 letter."

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1.9 COMPLIANCE WITH NUREG-0737: CLARIFICATION OF TMI ACTION PLAN REQUIREMENTS

1.9.1 Compliance with Requirements

On October 31, 1980, D. G. Eisenhut, Director, Division of Licensing, Office of Nuclear Reactor Regulation, issued a letter to "All Licensees of Operating Plants and Applicants for Operating Licenses and Holders of Construction Permits" addressing Post TMI Requirements (NUREG-0737). Enclosure 2 to this document identified TMI Action Plan Requirements for Applicants for an Operating License approved for implementation by the Commission at the time of issuance.

This section addresses Seabrook Station's compliance with the positions of applicable NUREG-0737 and NUREG-0737, Supplement 1 (Generic Letter 82-33) Requirements. For each requirement, the NRC staff position, a brief summary of NHY's method for compliance and/or the appropriate Updated FSAR reference(s) where compliance is addressed are presented. It should be noted, that the responses to the various tasks below, address the NRC staff's position as well as clarifications provided in NUREG-0737, even though the clarifications were not specifically stated in the staff position quoted.

Task I.A.1.1 Shift Technical Advisor (NUREG-0737)

Position:

Each licensee shall provide an on-shift technical advisor to the shift supervisor. The Shift Technical Advisor (STA) may serve more than one unit, at a multi-unit site, if qualified to perform the advisory function for the various units.

The STA shall have a bachelor's degree, or equivalent, in a scientific or engineering discipline and have received specific training in the response and analysis of the plant for transients and accidents. The STA shall also receive training in plant design and layout, including the capabilities of instrumentation and controls in the control room. The licensee shall assign normal duties to the STAs that pertain to the engineering aspects of assuring safe operations of the plant, including the review and evaluation of operating experience.

Response:

See Updated FSAR Subsection 13.2.1.2.

Task I.A.1.2 Shift Supervisor Administrative Duties (NUREG-0660)

Position:

The objective is to increase the shift supervisor's attention to his command function by minimizing ancillary responsibilities. NRR has required that all operating plant licensees review the administrative duties of the shift supervisor. The review should be performed by the senior officer at each utility who is responsible for plant operations. Administrative functions that detract from, or are subordinate to, the management responsibility for assuring the safe operation of the plant are to be delegated to other operations personnel not on duty in the control room. The same requirement will be imposed by the licensing review staff on all operating license applicants.

Response:

See Updated FSAR Subsection 13.5.1.

Task I.A.1.3 Shift Manning (NUREG-0737)

Position:

This position defines shift manning requirements for normal operation. The letter of July 31, 1980 from D. G. Eisenhut to all power reactor licensees and applicants sets forth the interim criteria for shift staffing (to be effective pending general criteria that will be the subject of future rulemaking). Overtime restrictions were also included in July 31, 1980 letter.

Response:

See Updated FSAR Subsection 13.5.1.

Task I.A.2.1 Immediate Upgrading of Reactor Operator and Senior Reactor Operator Training and Qualifications (NUREG-0737)

Position:

Effective December 1, 1980, an applicant for a senior reactor operator (SRO) license will be required to have been a licensed operator for 1 year.

Response:

A retraining and replacement licensed training program for the Station Staff shall be maintained under the direction of the Training Manager in accordance with the Seabrook Station's INPO Accredited Programs. NUREG-1021 Examiner Standards, ES-202, Eligibility Requirements for Reactor Operator or Senior Reactor Operator Candidates at Power Reactors, will also be used. ES-202 provides alternative equivalence guidelines.

In addition, see Updated FSAR Subsection 13.2.1.

Task I.A.2.3 Administration of Training Programs (NUREG-0737)

Position:

Pending accreditation of training institutions, licensees and applicants for operating licenses will assure that training center and facility instructors who teach systems, integrated responses, transient, and simulator courses demonstrate senior reactor operator qualifications and be enrolled in appropriate requalification programs.

Response:

See Updated FSAR Subsection 13.2.1.

Task I.A.3.1 Revise Scope and Criteria for Licensing Examinations - Simulator Exams (Item 3) (NUREG-0737)

Position:

Simulator examinations are included as part of the licensing examinations.

Response:

See Updated FSAR Subsection 13.2.1.

Task I.B.1.2 Independent Safety Engineering Group (NUREG-0737)

Position:

Each applicant for an operating license shall establish an onsite Independent Safety Engineering Group (ISEG) to perform independent reviews of plant operations.

The principal function of the ISEG is to examine plant operating characteristics, NRC issuances, Licensing Information Service advisories, and other appropriate sources of plant design and operating experience information that may indicate areas for improving plant safety. The ISEG is to perform independent review and audits of plant activities including maintenance, modifications, operational problems, and operational analysis, and aid in the establishment of programmatic requirements for plant activities. Where useful improvements can be achieved, it is expected that this group will develop and present detailed recommendations to corporate management for such things as revised or equipment modifications.

Another function of the ISEG is to maintain surveillance of plant operations and maintenance activities to provide independent verification that these activities are performed correctly and that human errors are reduced as far as practicable. ISEG will then be in a position to advise utility management on the overall quality and safety of operations. ISEG need not perform detailed audits of plant operations and shall not be responsible for sign-off functions such that it becomes involved in the operating organization.

Response:

FPLE Seabrook ensures that the reviews addressed in Task I.B.1.2 are performed as required. See FPL Quality Assurance Topical Report for details.

Task I.C.1 Guidance for the Evaluation & Development of Procedures for Transients and Accidents (NUREG-0737)

Position:

In letters of September 13 and 27, October 10 and 30, and November 9, 1979, the Office of Nuclear Reactor Regulation required licensees of operating plants, applicants for operating licenses, and licensees of plants under construction to perform analyses of transients and accidents, prepare emergency procedure guidelines, upgrade emergency procedures (including procedures for operating with natural circulation conditions), and to conduct operator retraining (see also Item I.A.2.1). Emergency procedures are required to be consistent with the actions necessary to cope with the transients and accidents analyzed. Analyses of transients and accidents were to be completed in early 1980 and implementation of procedures and retraining were to be completed 3 months after emergency procedure guidelines were established; however, some difficulty in completing these requirements has been experienced. Clarification of the scope of the task and appropriate schedule revisions are being developed. In the course of review of these matters on Babcock & Wilcox (B&W) designed plants, the staff will follow up the bulletin and orders matters relating to analysis methods and results, as listed in NUREG-0660, Appendix C (see Table C.1, Items, 3, 4, 16, 18, 24, 25, 26, 27; Table C.2, Items 4, 12, 17, 18, 19, 20; and Table C.3; Items 6, 35, 37, 38, 39, 41, 47, 55, 57).

Response:

See Updated FSAR Subsection 13.5.2.

Task I.C.2 Shift and Relief Turnover Procedures (NUREG-0660)

Position:

Licensees are to review plant procedures for shift and relief turnover to ensure that each on-coming shift is made aware of critical plant status information and system availability.

Response:

See Updated FSAR Subsection 13.5.1.

Task I.C.3 Shift Supervision Responsibilities (NUREG-0660)

Position:

Licensees are to review plant procedures to assure that duties, responsibilities and authority of the shift supervisor and control room operators are properly defined.

Response:

See Updated FSAR Subsection 13.5.1.

Task I.C.4 Control Room Access (NUREG-0660)

Position:

Licensees are to review procedures that establish the authority and responsibility of the person in charge of access, and that establish a clear line of authority and responsibility in the control room in the event of an emergency.

Response:

See Updated FSAR Subsection 13.5.1.

Task I.C.5 Procedures for Feedback of Operating Experience to Plant Staff (NUREG-0737)

Position:

In accordance with Task Action Plan I.C.5, Procedures for Feedback of Operating Experience to Plant Staff (NUREG-0660), each applicant for an operating license shall prepare procedures to assure that operating information pertinent to plant safety originating both within and outside the utility organization is continually supplied to operators and other personnel and is incorporated into training and retraining programs. These procedures shall:

(1) Clearly identify organizational responsibilities for review of operating experience, the feedback of pertinent information to operators and other personnel, and the incorporation of such information into training and retraining programs;

(2) Identify the administrative and technical review steps necessary in translating recommendations by the operating experience assessment group into plant actions (e.g., changes to procedures, operating orders);

(3) Identify the recipients of various categories of information from operating experience (i.e., supervisory personnel, shift technical advisors, operators, maintenance personnel, health physics technicians), or otherwise provide means through which such information can be readily related to the job functions of the recipients;

(4) Provide means to assure that affected personnel become aware of and understand information of sufficient importance that should not wait for emphasis through routine training and retraining programs;

(5) Assure that plant personnel do not routinely receive extraneous and unimportant information on operating experience in such volume that it would obscure priority information or otherwise detract from overall job performance and proficiency;

(6) Provide suitable checks to assure that conflicting or contradictory information is not conveyed to operators and other personnel until resolution is reached; and,

(7) Provide periodic internal audit to assure that the feedback program functions effectively at all levels.

Response:

See Updated FSAR Subsection 13.5.1.

Task I.C.6 Guidance on Procedures for Verifying Correct Performance of Operating Activities (NUREG-0737)

Position:

It is required (from NUREG-0660) that licensees' procedures be reviewed and revised, as necessary, to assure that an effective system of verifying the correct performance of operating activities is provided as a means of reducing human errors and improving the quality of normal operations. This will reduce the frequency of occurrence of situations that could result in, or contribute to, accidents. Such a verification system may include automatic system status monitoring, human verification of operations and maintenance activities independent of the people performing the activity (see NUREG-0585, Recommendation 5), or both.

Implementation of automatic monitoring, if required, will reduce the extent of human verification of operations and maintenance activities, but will not eliminate the need for such verification in all instances. The procedures adopted by the licensees may consist of two phases - one before and one after installation of automatic status monitoring equipment, if required, in accordance with Item I.D.3.

Response:

See Updated FSAR Subsection 13.5.1.

Task I.C.7 NSSS Vendor Review of Procedures (NUREG-0660)

Position:

Operating license applicants are required to obtain reactor vendor review of their low-power, power-ascension, and emergency procedures as a further verification of the adequacy of the procedures.

Response:

Applicable procedures were submitted to Westinghouse for its review after the procedures were approved by the Station Operation Review Committee (SORC). For additional information, see Updated FSAR Section 14.2 and Table 14.2-1.

Task I.C.8 Pilot Monitoring of Selected Emergency Procedures for Near Term Operating License Applicants (NUREG-0660)

Position:

Licensees will be required to correct any deficiencies identified before full power operation.

Response:

Information has been provided to the NRC in Letter SBN-358 (dated November 8, 1982).

Task I.D.1 Control Room Design Reviews (NUREG-0737)

Position:

In accordance with Task Action Plan I.D.1, Control Room Design Reviews (NUREG-0660), all licensees and applicants for operating licenses will be required to conduct a Detailed Control Room Design Review (DCRDR) to identify and correct design deficiencies. This Detailed Control Room Design Review is expected to take about a year. Therefore, the Office of Nuclear Reactor Regulation (NRR) requires that those applicants for operating licenses who are unable to complete this review prior to issuance of a license make preliminary assessments of their control rooms to identify significant human factors and instrumentation problems and establish a schedule approved by NRC for correcting deficiencies. These applicants will be required to complete the more Detailed Control Room Reviews on the same schedule as licensees with operating plants.

Response:

DCRDR information has been submitted to the NRC in the following letters:

- SBN-274 (5/12/82)
- SBN-499 (4/14/83)
- SBN-530 (7/7/83)
- SBN-544 (8/10/83)
- SBN-701 (7/30/84)
- SBN-748 ((1/7/85)
- SBN-839 (7/17/85)
- SBN-914 (12/27/85)
- SBN-948 (2/20/86)

Task I.D.2 Plant Safety Parameter Display Console (NUREG-0737)

Position:

In accordance with Task Action Plan I.D.2, Plant Safety Parameter Display Console (NUREG-0660), each applicant and licensee shall install a Safety Parameter Display System (SPDS) that will display to operating personnel a minimum set of parameters which define the safety status of the plant. This can be attained through continuous indication of direct and derived variables as necessary to access plant safety status.

Response:

A description of the "Safety Parameter Display System" was submitted to the NRC via letter SBN-920 (dated January 6, 1986). Additional information was provided in the following letters:

- SBN-499 (4/14/83)
- SBN-987 (4/2/86)
- NYN-87026 (3/6/87)
- NYN-87049 (4/9/87)

Task I.G.1 Training Requirements (NUREG-0660)

Position:

Licensees will (1) define training prior to loading fuel and (2) conduct training prior to full power operation.

Response:

A set of low power tests to be performed was identified three month's prior to fuel load. However, since Seabrook has a site specific simulator which is maintained current with Unit 1 design as per ANSI/ANS 3.5-1979, each operating crew performed the designated low power tests on the simulator. Therefore, only the crew on shift performed the low power testing on the actual plant.

Task II.B.1 Reactor Coolant System Vents (NUREG-0737)

Position:

Each applicant and licensee shall install Reactor Coolant System (RCS) and reactor vessel head high point vents, remotely operated from the control room. Although the purpose of the system is to vent noncondensible gases from the RCS which may inhibit core cooling during natural circulation, the vents must not lead to an unacceptable increase in the probability of a loss-of-coolant accident (LOCA) or a challenge to containment integrity. Since these vents form a part of the reactor coolant pressure boundary, the design of the vents shall conform to the requirements of Appendix A to 10 CFR, Part 50, "General Design Criteria." The vent system shall be designed with sufficient redundancy that assures a low probability of inadvertent or irreversible actuation.

Each licensee shall provide the following information concerning the design and operation of the high point vent system.

(1) Submit a description of the design, location size, and power supply for the vent system along with the results of analyses for loss-of-coolant accidents initiated by a break in the vent pipe. The results of the analyses should demonstrate compliance with the acceptance criteria of 10 CFR 50.46.

(2) Submit procedures and supporting analysis for operator use of the vents that also include the information available to the operator for initiating or terminating vent usage.

Response:

See Updated FSAR Subsection 5.2.6.

Task II.B.2 Design Review of Plant Shielding and Environmental Qualification of Equipment for Spaces/Systems Which May Be Used in Post-Accident Operations (NUREG-0737)

Position:

With the assumption of a post-accident release of the radioactivity equivalent to that described in Regulatory Guides 1.3 and 1.4 (i.e., the equivalent of 50 percent of the core radioiodine, 100 percent of the core noble gas inventory, and 1 percent of the core solids are contained in the primary coolant), each licensee shall perform a radiation and shielding design review of the spaces around systems that may, as a result of an accident, contain highly radioactive materials. The design review should identify the location of vital areas and equipment, such as the control room, radwaste control stations, emergency power supplies, motor control centers, and instrument areas in which personnel occupancy may be unduly limited or safety equipment may be unduly degraded by the radiation fields during post-accident operations of these systems.

Each licensee shall provide for adequate access to vital areas and protection of safety equipment by design changes, increased permanent or temporary shielding, or post-accident procedural controls. The design review shall determine which types of corrective actions are needed for vital areas throughout the facility.

Response:

A copy of Seabrook's "Post-Accident Dose Engineering Manual" was submitted to the NRC via letter SBN-425 (dated January 21, 1983). In addition, see Updated FSAR Subsection 12.3.2.2.

Task II.B.3 Post-Accident Sampling Capability (NUREG-0737)

Position:

A design and operational review of the Reactor Coolant and Containment Atmosphere Sampling Line Systems shall be performed to determine the capability of personnel to promptly obtain (less than 1 hour) a sample under accident conditions without incurring a radiation exposure to any individual in excess of 3 and 18 rem to the whole body or extremities, respectively. Accident conditions should assume a Regulatory Guide 1.3 or 1.4 release of fission products. If the review indicates that personnel could not promptly and safely obtain the samples, additional design features or shielding should be provided to meet the criteria.

A design and operational review of the radiological spectrum analysis facilities shall be performed to determine the capability to promptly quantify (in less than 2 hours) certain radionuclides that are indicators of the degree of core damage. Such radionuclides are noble gases (which indicate cladding failure), iodines and cesiums (which indicate high fuel temperatures), and nonvolatile isotopes (which indicate fuel melting). The initial reactor coolant spectrum should correspond to a Regulatory Guide 1.3 or 1.4 release. The review should also consider the effects of direct radiation from piping and components in the Auxiliary Building and possible contamination and direct radiation from airborne effluents. If the review indicates that the analyses required cannot be performed in a prompt manner with existing equipment, then design modifications or equipment procurement shall be undertaken to meet the criteria.

In addition to the radiological analyses, certain chemical analyses are necessary for monitoring reactor conditions. Procedures shall be provided to perform boron and chloride chemical analyses, assuming a highly radioactive initial sample (Regulatory Guide 1.3 or 1.4 source term). Both analyses shall be capable of being completed promptly (i.e., the boron sample analysis within an hour and the chloride sample analysis within a shift).

Response:

See Updated FSAR Subsection 9.3.2.

WCAP-14986-A, "Post Accident Sampling System Requirements: A Technical Basis," provided justification for eliminating the various PASS sampling requirements. The NRC issued a Safety Evaluation dated June 14, 2000, approving this topical report. Amendment 78 to Facility Operating License NPF-86 deleted the PASS Administrative Controls from the Technical Specifications, superceding the NUREG-0737 requirements. The Post Accident Sampling System, as modified, maintains the capability to obtain archive samples from the RCS and containment sump, and to sample the containment atmosphere.

Percent hydrogen in gaseous samples is analyzed by gas chromatography. The method is applicable in the range of 1% to pure hydrogen. High concentrations are determined by varying sample injection volume.

It has been determined that hydrogen is most accurately determined in the presence of helium by calibration of the gas chromatograph with standards containing equal amounts of both gases with a balance of argon. Good peak separation is obtained with good reproducibility.

The column is baked at 125°C after the peak has been analyzed in order to prevent xenon poisoning.

Task II.B.4 Training for Mitigating Core Damage (NUREG-0737)

Position:

Licensees are required to develop a training program to teach the use of installed equipment and systems to control or mitigate accidents in which the core is severely damaged. They must then implement the training program.

Response:

See Updated FSAR Subsections 13.2.1 and 13.2.2.

Task II.D.1 Performance Testing of Boiling Water Reactor and Pressurized Water Reactor Relief and Safety Valves (NUREG-0737)

Position:

Pressurized water reactor licensees and applicants shall conduct testing to qualify the reactor coolant system relief and safety valves under expected operating conditions for design basis transients and accidents.

Response:

Seabrook complies with Task II.D.1. Refer to SBN-969, dated March 17, 1986, NYN-87136, dated November 23, 1987 and NYN-89057, dated May 8, 1989 for a discussion of testing to qualify Seabrook's reactor coolant system relief and safety valves.

Task II.D.3 Direct Indication of Relief and Safety Valve Position (NUREG-0737)

Position:

Reactor coolant system relief and safety valves shall be provided with a positive indication in the control room derived from a reliable valve position detection device or a reliable indication of flow in the discharge pipe.

Response:

See Updated FSAR Section 7.5 and Subsection 5.2.2.

Task II.E.1.1 Auxiliary Feedwater System Evaluation (NUREG-0737)

Position:

The Office of Nuclear Reactor Regulation is requiring re-evaluation of the Auxiliary Feedwater (AFW) Systems for all PWR operating plant licensees and operating license applications. This action includes:

(1) Perform a simplified AFW system reliability analysis that uses event-tree and fault-tree logic techniques to determine the potential for AFW system failure under various loss of main feedwater transient conditions. Particular emphasis is given to determining potential failures that could result from human errors, common causes, single point vulnerabilities, and test and maintenance outages;

(2) Perform a deterministic review of the AFW system using the acceptance criteria of Standard Review Plan Subsection 10.4.9 and associated Branch Technical position ASB 10-1 as principal guidance; and

(3) Re-evaluate the AFW system flowrate design bases and criteria.

Response:

See Updated FSAR Sections 6.8 and 7.3.

Task II.E.1.2 Auxiliary Feedwater System Automatic Initiation and Flow Indication (NUREG-0737) Part 1: Auxiliary Feedwater System Automatic Initiation

Position:

Consistent with satisfying the requirements of General Design Criterion 20 of Appendix A to 10 CFR, Part 50, with respect to the timely initiation of the Auxiliary Feedwater System (AFWS), the following requirements shall be implemented in the short term:

(1) The design shall provide for the automatic initiation of the AFWS.

(2) The automatic initiation signals and circuits shall be designed so that a single failure will not result in the loss of AFWS function.

(3) Testability of the initiating signals and circuits shall be a feature of the design.

(4) The initiating signals and circuits shall be provided from the emergency buses.

(5) Manual capability to initiate the AFWS from the control room shall be retained and shall be implemented so that a single failure in the manual circuits will not result in the loss of system function.

(6) The AC motor driven pumps and valves in the AFWS shall be included in the automatic actuation (simultaneous and/or sequential) of the loads onto the emergency buses.

(7) The automatic initiating signals and circuits shall be designed so that their failure will not result in the loss of manual capability to initiate the AFWS from the control room.

In the long term, the automatic initiation signals and circuits shall be upgraded, in accordance with safety grade requirements.

Response:

Seabrook Station refers to its Auxiliary Feedwater System as an Emergency Feedwater System (see Updated FSAR Sections 6.8 and 7.3).

Task II.E.1.2
Part (2) Auxiliary Feedwater System Automatic Initiation and Flow Indication (NUREG-0737) Part 2: Auxiliary Feedwater System Flowrate Indication

Position:

Consistent with satisfying the requirements set forth in General Design Criterion 13 to provide the capability in the control room to ascertain the actual performance of the AFWS when it is called to perform its intended function, the following requirements shall be implemented:

(1) Safety-grade indication of auxiliary feedwater flow to each steam generator shall be provided in the control room.

(2) The auxiliary feedwater flow instrument channels shall be powered from the emergency buses, consistent with satisfying the emergency power diversity requirements of the AFWS set forth in Auxiliary System Branch Technical Position 10-1 of the Standard Review Plan, Subsection 10.4.9.

Response:

The flows in all four individual emergency feedwater lines are indicated at the main control board and at the remote safe shutdown panels. The design details of the safety-related display instrumentation are presented in Updated FSAR Sections 6.8 and 7.5.

Task II.E.3.1 Emergency Power Supply for Pressurizer Heaters (NUREG-0737)

Position:

Consistent with satisfying the requirements set forth in General Design Criteria 10, 14, 15, 17, and 20 of Appendix A to 10 CFR, Part 50, for the event of loss of offsite power, the following requirements shall be implemented:

(1) The pressurizer heater power supply design shall provide the capability to supply, from either the offsite power source or the emergency power source (when offsite power is not available), a predetermined number of pressurizer heaters and associated controls necessary to establish and maintain natural circulation at hot standby conditions. The required heaters and their controls shall be connected to the emergency buses in a manner that will provide redundant power supply capability.

(2) Procedures and training shall be established to make the operator aware of when and how the required pressurizer heaters shall be connected to the emergency buses. If required, the procedures shall identify under what conditions selected emergency loads can be shed from the emergency power source, to provide sufficient capacity for the connection of the pressurizer heaters.

(3) The time required to accomplish the connection of the preselected pressurizer heater to the emergency buses shall be consistent with the timely initiation and maintenance of natural circulation conditions.

(4) Pressurizer heater motive and control power interfaces with the emergency buses shall be accomplished through devices that have been qualified in accordance with safety grade requirements.

Response:

See Updated FSAR Subsection 8.3.1.

Task II.E.4.1 Dedicated Hydrogen Penetrations (NUREG-0737)

Position:

Plants using external recombiners or purge systems for post-accident combustible gas control of the containment atmosphere should provide containment penetration systems for external recombiner or purge systems that are dedicated to that service only, that meet the redundancy and single failure requirements of the General Design Criteria 54 and 56 of Appendix A to 10 CFR 50, and that are sized to satisfy the flow requirements of the recombiner or purge system.

The procedures for the use of combustible gas control systems following an accident that results in a degraded core and release of radioactivity to the containment must be reviewed, and revised, if necessary.

Response:

Seabrook Station utilizes two separate and redundant Westinghouse thermal hydrogen recombiners located on the 25'-0" elevation inside the Containment Building. Thus, no pipe penetrations are required.

The backup purge system consists of two separate and redundant pipeline/isolation valve/penetration systems sized for a normal 2 of containment volume/day (38.1 cfm) flow and a maximum of 1,000 cfm.

See Updated FSAR Subsection 6.2.5.

Task II.E.4.2 Containment Isolation Dependability (NUREG-0737)

Position:

(1) Containment isolation system designs shall comply with the recommendations of Standard Review Plan Subsection 6.2.4 (i.e., that there be diversity in the parameters sensed for the initiation of containment isolation);

(2) All plant personnel shall give careful consideration to the definition of essential and nonessential systems, identify each system determined to be essential, identify each system determined to be nonessential, describe the basis for selection of each essential system, modify their containment isolation designs accordingly, and report the results of the re-evaluation to the NRC;

(3) All nonessential systems shall be automatically isolated by the containment isolation signal;

(4) The design of control systems for automatic containment isolation valves shall be such that resetting the isolation signal will not result in the automatic reopening of containment isolation valves. Reopening of containment isolation valves shall require deliberate operator action;

(5) The containment setpoint pressure that initiates containment isolation for nonessential penetrations must be reduced to the minimum compatible with normal operating conditions;

(6) Containment purge valves that do not satisfy the operability criteria set forth in Branch Technical Position CSB 6-4 or the Staff Interim Position of October 23, 1979 must be sealed closed as defined in SRP 6.2.4, item III.3.f, during operational conditions 1, 2, 3, and 4. Furthermore, these valves must be verified to be closed at least every 31 days; and

(7) Containment purge and vent isolation valves must close on a high radiation signal.

Response:

See Updated FSAR Section 7.3 and Subsection 6.2.4

Task II.F.1 Additional Accident Monitoring Instrumentation

Task II.F.1 Attachment 1: Noble Gas Effluent Monitor (NUREG-0737)

Position:

Noble gas effluent monitors shall be installed with an extended range designed to function during accident conditions as well as during normal operating conditions. Multiple monitors are considered necessary to cover the range of interest.

(1) Noble gas effluent monitors with an upper range capability of 10^5 µCi/cc (Xe-133) are considered to be practical and should be installed in all operating plants.

(2) Noble gas effluent monitoring shall be provided for the total range of concentration extending from normal condition (As Low As Reasonably Achievable - ALARA) concentrations to a maximum of 10^5 µCi/cc (Xe-133). Multiple monitors are considered to be necessary to cover the range of interest. The range capacity of individual monitors should overlap by a factor of ten.

Response:

See Updated FSAR Section 7.5, and Subsections 11.5.2.1j, 11.5.2.1k, and 12.3.4.2. Additional information on this subject was submitted to the NRC, SBN-1063, dated May 20, 1986.

Task II.F.1 Attachment 2: Sampling and Analysis of Plant Effluents (NUREG-0737)

Position:

Because iodine gaseous effluent monitors for the accident condition are not considered to be practical at this time, capability for effluent monitoring of radioiodines for the accident condition shall be provided with sampling conducted by absorption on charcoal or other media, followed by on-site laboratory analysis.

Response:

See Updated FSAR Section 7.5, and Subsections 12.3.4.2 and 12.5.2. Additional information is presented in a NHY letter to the NRC, NYN-89068, dated May 30, 1989.

Task II.F.1 Attachment 3: Containment High-Range Radiation Monitor (NUREG- 0737)

Position:

In containment radiation level monitors with a maximum range of 10^8 rad/hr shall be installed. A minimum of two (2) such monitors that are physically separated shall be provided. Monitors shall be developed and qualified to function in an accident environment.

Response:

See Updated FSAR Section 7.5 and Subsection 12.3.4.

Task II.F.1 Attachment 4: Containment Pressure Monitor (NUREG-0737)

Position:

A continuous indication of containment pressure shall be provided in the control room of each operating reactor. Measurement and indication capability shall include three (3) times the design pressure of the containment for concrete, four (4) times the design pressure for steel, and -5 psig for all containments.

Response:

See Updated FSAR Sections 7.3 and 7.5.

Continuous indication and recording of containment pressure is provided. This indication covers the full range from -5 psig to three times design pressure, and supplements other narrow range indication provided for containment pressure. These channels fully meet the requirements for Design Category 1 instrumentation. Design details are provided in Table 7.5-1.

ANSI/ANS 4.5 recommends an accuracy of ±10 percent of span for this wide range measurement. The accuracy of this measurement has been determined and satisfies this recommendation. The response time is similar to the 0-60 psig containment pressure channels used for ESF actuation.

The operating crews will use the 0-60 psig containment pressure indication in support of the Emergency Response Procedures (ERPs). Further discussion of this indication is provided in Updated FSAR Section 7.3 and the ERP background documents.

Task II.F.1 Attachment 5: Containment Water Level Monitor (NUREG-0737)

Position:

A continuous indication of containment level shall be provided in the control room for all plants. A narrow range instrument shall be provided for PWRs and cover the range from the bottom, to the top of the containment sump. A wide range instrument shall also be provided for PWRs and shall cover the range from the bottom of the containment to the elevation equivalent to a 600,000 gallon capacity. For BWRs, a wide range instrument shall be provided and cover the range from the bottom to 5 feet above the normal water level of the suppression pool.

Response:

See Updated FSAR Section 7.5 and Subsection 6.2.2.

Task II.F.1 Attachment 6: Containment Hydrogen Monitor (NUREG-0737)

Position:

A continuous indication of hydrogen concentration in the containment atmosphere shall be provided in the control room. Measurement capability shall be provided over the range of 0 to 10 percent hydrogen concentration under both positive and negative ambient pressure.

Response:

See Updated FSAR Section 7.5 and Subsections 6.2.2 and 6.2.5.2.

Task II.F.2 Instrumentation for Detection of Inadequate Core Cooling (NUREG-0737)

Position:

Licensees shall provide a description of any additional instrumentation or controls (primary or backup) proposed for the plant to supplement existing instrumentation (including primary coolant saturation monitors) in order to provide an unambiguous, easy-to-interpret indication of Inadequate Core Cooling (ICC). A description of the functional design requirements for the system shall also be included. A description of the procedures to be used with the proposed equipment, the analysis used in developing these procedures, and a schedule for installing the equipment shall be provided.

Response:

See Updated FSAR Subsection 4.4.6.5. In addition, a complete description of Seabrook's "Instrumentation for Detection of Inadequate Core Cooling" was submitted to the NRC via letter SBN-952 (dated February 24, 1986).

Task II.G.1 Emergency Power for Pressurizer Equipment (NUREG-0737)

Position:

Consistent with satisfying the requirements of General Design Criteria 10, 14, 15, 17, and 20, of Appendix A to 10 CFR, Part 50, for the event of loss of offsite power, the following positions shall be implemented.

Power Supply for Pressurizer Relief and Block Valves and Pressurizer Level Indicators

(1) Motive and control components of the power operated relief valves (PORVs) shall be capable of being supplied from either the offsite power source or the emergency power source when the offsite power is not available.

(2) Motive and control components associated with the PORV block valves shall be capable of being supplied from either the offsite power source or the emergency power source when the offsite power is not available.

(3) Motive and control power connections to the emergency buses for the PORVs and their associated block valves shall be through devices that have been qualified in accordance with safety grade requirements.

(4) The pressurizer level indication instrument channels shall be powered from the vital instrument buses. The buses shall have the capability of being supplied from either the offsite power source or the emergency source when offsite power is not available.

Response:

See Updated FSAR Section 7.5 and Subsection 8.3.1.

Task II.K.1 IE Bulletins on Measures to Mitigate Small Break LOCAs and Loss of Feedwater Accidents (NUREG-0694)

Task II.K.1.5 Review ESF Valves (NUREG-0660, Table C.1)

Position:

Review all valve position and positioning requirements and positive controls and all related test and maintenance procedures to assure proper ESF functioning.

Response:

Proper ESF functioning was verified through completion of the applicable portions of the startup test program prior to fuel load.

Task II.K.1.10 Operability Status (NUREG-0660, Table C.1)

Position:

Review and modify (as required) procedures for removing safety-related systems from service (and restoring to service) to assure operability status is known.

Response:

See Updated FSAR Subsection 13.5.1.

Task II.K.1.17 Trip Per Low-Level Bistables (NUREG-0694)

Position:

For Westinghouse designed reactors, trip the pressurizer low-level coincident signal bistables, so that safety injection would be initiated when the pressurizer low pressure setpoint is reached regardless of the pressurizer level. See Bulletin 79-06A and Revision 1, Item 3 in NUREG-0560.

Response:

Reactor trip and safety injection are initiated on low pressurizer pressure without any requirement for coincident low pressurizer level. See Updated FSAR Figure 7.2-8.

Task II.K.2 Commission Orders on B&W Plants

These items from Task II.K.2 have been made requirements for other pressurized water reactor designs. These are discussed below.

Task II.K.2.13 Thermal Mechanical Report - Effect of High Pressure Injection on Vessel Integrity for Small Break Loss-of-Coolant Accident with No Auxiliary Feedwater (NUREG-0737)

Position:

A detailed analysis shall be performed of the thermal mechanical conditions in the reactor vessel during recovery from small breaks with an extended loss of all feedwater.

Response:

Reference 8 describes the probabilistic methodology developed by the Westinghouse Owners Group (WOG) and Westinghouse for treating the Pressurized Thermal Shock (PTS) issue. It also documents the results of applying this methodology to Westinghouse designed PWRs such as Seabrook. It goes beyond the specific concern of NUREG-0737, Item II.K.2.13 and considers the risk of PWR reactor vessel failure from all PTS events. It supports the basis for the requirements of 10 CFR 50.61, "Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events." Namely, PWR pressure vessels with conservatively calculated values of RT_{NDT} less than 270°F for plate material and axial welds, and less than 300°F for circumferential welds, present an acceptably low risk of vessel failure from PTS events.

In Reference 9, the RT_{NDT} value for the Seabrook reactor vessel was conservatively calculated in accordance with the requirements of 10 CFR 50.61. The total RT_{NDT} value at end-of-life (32 EFPY) is 126°F. This value satisfies the screening criteria stated above.

The results of Reference 8 are applicable if plant emergency procedures based on the Emergency Response Guidelines (ERGs) are available and the operators are properly trained to follow the procedures. Since the Seabrook Emergency Operating Procedures (EOPs) are based on the ERGs, and the operators are trained in the use of the EOPs (see Updated FSAR Section 13.2), the Reference 8 results are applicable.

It is therefore concluded that operation of Seabrook Station will not pose an undue risk of vessel failure from PTS events.

Task II.K.2.17 Potential for Voiding in the Reactor Coolant System During Transients

Position:

Analyze the potential for voiding in the Reactor Coolant System (RCS) during anticipated transients.

Response:

Westinghouse (in support of the Westinghouse Owners Group) has performed a study which addresses the potential for void formation in Westinghouse designed nuclear steam supply systems during natural circulation cooldown/depressurization transients. This study has been submitted to the NRC by the Westinghouse Owners Group (Reference 1) and is applicable to Seabrook Station.

In addition, the Westinghouse Owners Group is currently developing appropriate modifications to the Westinghouse Owners Group Reference Operating Instructions to take the results of the study into account to preclude void formation in the upper head region during natural circulation cooldown/depressurization transients, and to specify those conditions under which upper head voiding may occur. NHY utilized the generic guidance developed by the Westinghouse Owners Group in the development of plant specific operating procedures.

Task II.K.2.19 Sequential Auxiliary Feedwater Flow Analysis

Position:

Provide a benchmark analysis of sequential Auxiliary Feedwater (AFW) flow to the steam generators following a loss of feedwater.

Response:

Not applicable to Westinghouse pressurized water reactors per NRC letter to Duquesne Light, dated June 29, 1981.

Task II.K.3 Final Recommendations of B&O Task Force (NUREG-0737)

Task II.K.3.1 Installation and Testing of Automatic Power-Operated Relief Valve Isolation System (NUREG-0737)

Position:

All PWR licensees should provide a system that uses the PORV block valve to protect against a small break loss-of-coolant accident. This system will automatically cause the block valve to close when the reactor coolant system pressure decays after the PORV has opened. Justification should be provided to assume that failure of this system would not decrease overall safety by aggravating transients and accidents.

Each licensee shall perform a confirmatory test of the automatic block valve closure system following installation.

Response:

Westinghouse, as part of the response prepared for the Westinghouse Owners Group to address Item II.K.3.2, has evaluated the necessity of incorporating an automatic pressurizer power-operated relief valve isolation system. This evaluation is documented in Reference 2 and concluded that such a system should not be required.

In addition, information has been submitted to the NRC in SBN-1038 dated May 7, 1986.

Task II.K.3.2 Report on Overall Safety Effect of Power-Operated Relief Valve Isolation System (NUREG-0737)

Position:

(1) The licensee should submit a report for staff review documenting the various actions taken to decrease the probability of a small break loss-of-coolant accident (LOCA) caused by a stuck-open power-operated relief valve (PORV) and show how those actions constitute sufficient improvements in reactor safety.

(2) Safety valve failure rates based on past history of the operating plants designed by the specific Nuclear Stream Supply System (NSSS) vendor should be included in the report submitted in response to (1) above.

Response:

As stated in the response to item II.K.3.1, the Westinghouse Owners Group has submitted a Westinghouse prepared report (Reference 2) that provides a probabilistic analysis to determine the probability of a PORV LOCA, estimates the effect on the post-TMI modifications, evaluates an automatic PORV isolation concept, and provides PORV and safety valve operational data for Westinghouse plants. Because of the sensitivity analyses included in the report, the report is generic and is applicable to Seabrook Station. The report identifies a significant reduction in the PORV LOCA probability as a result of post-TMI modifications, and the calculations compare favorably with the operational data for Westinghouse plants (included as an appendix to the report).

In addition, information has been submitted to the NRC in SBN-1038 dated May 7, 1986.

Task II.K.3.3 Reporting SV and PORV Challenges and Failures (NUREG-0694)

Position:

Assure that any failure of a PORV or safety valve to close will be reported to the NRC promptly. All challenges to the PORVs or safety valves should be documented in the annual report.

Response:

Any failure of a safety or relief valve will be reported promptly to the NRC using the established "License Event Report" (LER) System, and all challenges to such valves will be reported annually in accordance with the Technical Specifications.

Task II.K.3.5 Automatic Trip of Reactor Coolant Pumps During Loss-of-Coolant Accident (NUREG-0737)

Position:

Tripping of the reactor coolant pumps in case of a loss-of-coolant accident (LOCA) is not an ideal solution. Licensees should consider other solutions to the small break LOCA problem (for example, an increase in safety injection flow rate). In the meantime, until a better solution is found, the reactor coolant pumps should be tripped automatically in case of small break LOCA. The signals designated to initiate the pump trip are discussed in NUREG-0623.

Response:

In response to IE Bulletins 79-05C and 79-06C, Westinghouse (in support of the Westinghouse Owners Group) performed an analysis of delayed Reactor Coolant Pump (RCP) trip during small break LOCAs. This analysis is documented in Reference 3 and is the basis for the Westinghouse position on RCP trip (i.e., automatic RCP trip is not necessary since sufficient time is available for manual tripping of the RCPs).

Westinghouse (again in support of the Westinghouse Owners Group) has performed test predictions of the LOFT Experiment L3-6. The results of these predictions are documented in References 4, 5 and 6. The results constitute both a best estimate model prediction with the NOTRUMP computer program and an evaluation model prediction with the Westinghouse FLASH computer program using the supplied set of initial boundary assumptions.

Subsequently, the NRC issued Generic Letters 83-10C and 83-10D which superseded IE Bulletins 79-05C and 79-06C. In response, the Westinghouse Owners Group (with assistance from Westinghouse) developed the generic response to Generic Letters 83-10C and 83-10D. This response has been submitted to the NRC (Reference 7).

With regard to the plant specific requirements of Generic Letters 83-10C and 83-10D, Seabrook Station has the following:

> The Revision 1 to the WOG Emergency Response Guidelines has been implemented into the plant specific procedures.
>
> The training program includes instruction to operators in their responsibility for performing RCP trip in the event of a small break LOCA. In particular, the operators are trained in prioritization of actions following engineered safety features actuation.
>
> The instrumentation the operators use to determine the need for RCP trip is part of the instrumentation used for ICC (see Item II.F.2).

In light of the above information, Seabrook Station does not consider that design modifications are necessary.

Supplementary information on this subject as a result of a discussion between the NRC staff and the applicant, is summarized in an NRC letter to NHY dated May 20, 1986, and in NHY's response to the NRC submitted in SBN-1068, dated May 27, 1986.

Task II.K.3.7 Evaluation of Power-Operated Relief Valve Opening Probability During Overpressure Transient (NUREG-0737)

Position:

Most overpressure transients should not result in the opening of the Power-Operated Relief Valve (PORV). Therefore, licensees should document that the PORV will open in less than 5 percent of all anticipated overpressure transients using the revised setpoints and anticipatory trips for the range of plant conditions which might occur during a fuel cycle.

Response:

The Westinghouse Owners Group has submitted a report (Reference 2) which provides probabilistic analysis of PORV operational data for Westinghouse plants. The report is generic and applicable to Seabrook Station. For high-head plants with post-TMI modifications (i.e., Seabrook Station), the report shows that a PORV will open in less than 5 percent of all anticipated overpressure transients for the range of plant conditions during a fuel cycle.

Task II.K.3.9 Proportional Integral Derivative Controller Modification Position (NUREG-0737)

Position:

The Westinghouse recommended modifications to the Proportional Integral Derivative (PID) controller should be implemented by affected licensees.

Response:

The Seabrook design includes a Proportional Integral Derivative (PID) controller in the power-operated relief valve control circuit (see Updated FSAR Figure 7.7-4 and Figure 7.2-11). The time derivative constant in the PID controller for the pressurizer PORV will be turned to "OFF." The appropriate plant procedure for calibrating the setpoints in this nonsafety-grade system will reflect this decision.

Setting the derivative time constant to "OFF," in effect removes the derivative action from the controller. Removal of the derivative action will decrease the likelihood of opening the pressurizer PORV since the actual signal for the valve is then no longer sensitive to the rate of change of pressurizer pressure.

Task II.K.3.10 Proposed Anticipatory Trip Modification (NUREG-0737)

Position:

The anticipatory trip modification proposed by some licensees to confine the range of use to high power levels should not be made until it has been shown on a plant-by-plant basis that the probability of a small break loss-of-coolant accident (LOCA) resulting from a stuck-open Power-Operated Relief Valve (PORV) is substantially unaffected by the modifications.

Response:

The Seabrook design includes the capability to undergo a 50 percent load reduction without requiring a reactor trip. This capability is made available through the use of a nominal 40 percent steam bypass to the condenser and automatic rod control to reduce core power by 10 percent. Plant analysis shows that pressurizer power-operated relief valves (PORVs) will not be challenged by a 50 percent load reduction from full power. An evaluation of a full load reduction from 50 percent power also shows that PORVs will not be challenged even though the reactor is not tripped. The deletion of a direct (or anticipatory) reactor trip from turbine trip below 50 percent power will not cause the PORVs to be challenged. Therefore, the probability of a small break loss-of-coolant accident (LOCA) from a stuck-open PORV is substantially unaffected by the deletion of an anticipatory reactor trip from turbine trip below 50 percent power.

Task II.K.3.11 Justification for Use of Certain PORVs (NUREG-0694)

Position:

Demonstrate that the PORV installed in the plant has a failure rate equivalent to, or less than, the values for which there is an operating history.

Response:

The PORVs utilized at Seabrook are a relatively new design developed by the Garrett Pneumatic Systems Division of the Garrett Corporation. Similar type valves are presently being supplied to both Combustion Engineering and Westinghouse for use in their NSSS design. At this time, there is insufficient operating data upon which to base a statistically accurate failure rate history.

However, a valve of similar design to that supplied to both Combustion Engineering and Westinghouse was tested at the Wyle Laboratories as a part of the EPRI/PWR Safety and Relief Valve Test Program. In addition to the successful functional test results, the Garrett valve operated normally, with no tendency to fail to operate, either open or closed, through at least 79 cycles.

As operating history is gained on this particular valve design, and should an abnormal failure rate become apparent, appropriate corrective action will be taken.

Task II.K.3.12 Confirm Existence of Anticipatory Reactor Trip Upon Turbine Trip (NUREG-0737)

Position:

Licensees with Westinghouse-designed operating plants should confirm that their plants have an anticipatory reactor trip upon turbine trip. The licensee of any plant where this trip is not present should provide a conceptual design and evaluation for the installation of this trip.

Response:

The Seabrook design includes an anticipatory reactor trip upon turbine trip at power levels above P-9 (see Updated FSAR Figure 7.2-2 and Figure 7.2-15).

Task II.K.3.17 Report on Outage of Emergency Core-Cooling Systems Licensee Report and Proposed Technical Specification Changes (NUREG-0737

Position:

Several components of the Emergency Core Cooling (ECC) Systems are permitted by technical specifications to have substantial outage times (e.g., 72 hours for one diesel generator; 14 days for the HPCI system). In addition, there are no cumulative outage time limitations for ECC systems. Licensees should submit a report detailing outage dates and lengths of outages for all ECC systems for the last 5 years of operation. The report should also include the causes (i.e., controller failure, spurious isolation).

Response:

Procedures for collecting and submitting information concerning the unavailability of the ECC system due to outages have been developed. Seabrook Station will submit ECC system outage information in accordance with the INPO Safety System Unavailability Monitoring program. All functional failures of ECC systems shall also be included in the Equipment Performance and Information Exchange System (EPIX). This method of reporting will provide for a current, on-line reporting system.

See Updated FSAR Subsection 13.5.1.

Task II.K.3.25 Effect of Loss of Alternating Current Power on Pumps Seals (NUREG-0737)

Position:

The licensee should determine, on a plant-specific basis, by analysis or experiment, the consequence of a loss of cooling water to the reactor recirculation pump seal coolers. The pump seals should be designed to withstand a complete loss of alternating current (AC) power for at least 2 hours. Adequacy of the seal design should be demonstrated.

Response:

During normal operation, seal injection flow from the Chemical and Volume Control System is provided to cool the RCP seals, and the Component Cooling Water System provides flow to the thermal barrier heat exchanger to limit the heat transfer from the reactor coolant to the RCP internals. In the event of loss of offsite power, the RCP motor is de-energized and both of these cooling supplies are terminated; however, the diesel generators are automatically started and either seal injection flow or component cooling water to the thermal barrier heat exchanger is automatically restored within 12 or 32 seconds, respectively. Either of these cooling supplies is adequate to provide seal cooling and prevent seal failure due to loss of seal cooling during a loss of offsite power for at least 2 hours.

Task II.K.3.30 Revised Small Break Loss-of-Coolant Accident Methods to Show Compliance with 10 CFR Part 50, Appendix K (NUREG-0737)

Position:

The analysis methods used by Nuclear Steam Supply System (NSSS) vendors and/or fuel suppliers for small break loss-of-coolant accident (LOCA) analysis for compliance with Appendix K to 10 CFR Part 50 should be revised, documented, and submitted for approval. The revisions should account for comparisons with experimental data, including from the LOFT Test and Semiscale Test facilities.

Response:

The Westinghouse small break evaluation model (NOTRUMP) used to analyze Seabrook Station is in conformance with 10 CFR Part 50, Appendix K and was approved by the NRC on May 21, 1985. This completes the TMI Action Item II.K.3.30 for Seabrook Station.

In accordance with TMI Action Item II.K.3.31., generic analysis was submitted in June 1986 to demonstrate that the analysis performed with NOTRUMP is conservative.

Task II.K.3.31 Plant Specific Calculations to Show Compliance with 10 CFR, Part 50.46 (NUREG-0737)

Position:

Plant-specific calculations using NRC-approved models for small break Loss-of-Coolant Accidents (LOCAs) as described in Item II.K.3.30 to show compliance with 10 CFR 50.46 should be submitted for NRC approval by all licensees.

Response:

NHY letter (SBN-1175) dated July 31, 1986, references WCAP-11145 which demonstrates, generically, the plant's compliance with 10 CFR 50.46. This completes TMI Action Item II.K.3.31 for Seabrook Station.

Task III.A.1.1 Upgrade Licensee Emergency Preparedness - Short Term (NUREG-0660)

Position:

Licensees will upgrade emergency preparedness in accordance with the requirements described in the NRC "Action Plan for Promptly Improving Emergency Preparedness" (SECY 79-450), which was distributed to all licensees during regional meetings in August, 1979, and in accordance with subsequently issued criteria (NUREG-0654).

Response:

Refer to the Seabrook Station Radiological Emergency Plan.

Task III.A.1.2 Upgrade Emergency Support Facilities

Position:

Each operating nuclear power plant shall maintain an onsite Technical Support Center (TSC) separate from, and in close proximity to, the control room that has the capability to display and transmit plant status to those individuals who are knowledgeable of, and responsible for, engineering and management support of reactor operations in the event of an accident. The center shall be habitable to the same degree as the control room for postulated accident conditions. The licensee shall revise his emergency plans, as necessary, to incorporate the role and location of the TSC. Records that pertain to the as-built conditions and layout of structures, systems, and components shall be readily available to personnel in the TSC.

An Operational Support Center (OSC) shall be established separate from the control room and other emergency response facilities as a place where operations support personnel can assemble and report in an emergency situation to receive instructions from the station staff. Communications shall be provided between the OSC, TSC, EOF, and control room.

An Emergency Operation Facility (EOF) will be operated by a licensee for continued evaluation and coordination of all licensee activities related to an emergency having, or potentially having, environmental consequences.

Response:

See Section 6, "Emergency Facilities and Equipment," and Section 8, "Organization," of the Seabrook Station Radiological Emergency Plan.

Task III.A.2 Improving Licensee Emergency Preparedness Long Term

Position:

Each nuclear facility shall upgrade its emergency plans to provide reasonable assurance that adequate protective measures can and will be taken in the event of a radiological emergency. Specific criteria to meet this requirement is delineated in NUREG-0654 (FEMA-REP-1), "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparation in Support of Nuclear Power Plants."

Response:

Refer to the Seabrook Station Radiological Emergency Plan.

Task III.D.1.1 Integrity of Systems Outside Containment Likely to Contain Radioactive Material for Pressurized Water Reactors & Boiling Water Reactors (NUREG-0737)

Position:

Applicants shall implement a program to reduce leakage from systems outside containment that would, or could, contain highly radioactive fluids during a serious transient or accident to as-low-as-practical levels. This program shall include the following:

(1) Immediate Leak Reduction -

(a) Implement all practical leak reduction measures for all systems that could carry radioactive fluid outside the containment.

(b) Measure actual leakage rates with system in operation and report them to the NRC.

(2) Continuing Leak Reduction - Establish and implement a program of preventive maintenance to reduce leakage to as-low-as practical levels. This program shall include periodic integrated leak tests at intervals not to exceed each refueling cycle.

Response:

a. Systems

The surveillance program includes the following systems:

Residual Heat Removal (RHR)
Containment Spray Recirculation (CBS)
Charging System (CS) (Note 1)
Safety Injection (SI)
Primary Coolant Sampling (SS) (Note 2)
Hydrogen Detection (CGC) (Note 3)

Systems that may contain radioactive fluids under post-accident conditions that are not included in this surveillance are:

Hydrogen recombiners (CGC)

Basis: Seabrook's hydrogen recombiners are located inside the Primary Containment Building.

Waste Gas (VG)

Basis: The vent gas headers in the containment are only used during infrequent maintenance operations during refueling outages such as the fill and vent of the Reactor Coolant System. Use of the system involves containment entry to open normally closed manual valves. This system is not required for post-accident monitoring or for accident mitigation. Refer to Note 1.

b. Immediate Leak Reduction

Leak reduction program base line data was taken during initial plant start-up testing. The leakage found was measured and corrective action has been initiated for affected components. The leakage obtained during preoperational surveillance and inspections is contained in the Preoperational Leakage Reduction Tracking and History Report submitted to the NRC by letter NYN-87033, March 16, 1987.

c. Continuing Leak Reduction

The leakage reduction program will continue throughout the life of the plant. A periodic surveillance procedure will be conducted on an interval of once per refueling cycle. The surveillance procedure contains inspection sheets that are used to indicate systems/lines which are visually inspected. Findings will be documented. Visual inspections are performed either with the system in operation or inspected after a functional system test for leakage determination.

Types of potential leakage locations include: valve body/bonnet joints, packing, mechanical flange connections, pump mechanical seals, etc. Boric acid deposit locations will be documented on the data sheets. The findings of the surveillance will be documented such that repetitive locations can be addressed for corrective actions. Corrective maintenance will be per the applicable work control documents.

d. "North Anna" Concerns (Note 4)

Actions have been taken (and will continue) to reduce potential release paths due to design and operation deficiencies. Preoperational design reviews have been completed to ensure the best possible system configuration and leakage reduction features such as valve stem leakoff, capped drain connections, orientation for maintenance access, etc. Operational issues such as component tagging, preoperational checkout of operating procedures, and the corrective action/root cause features of the plant problem reporting system will ensure the highest possible degree of operator performance.

Notes:

1. The high head safety injection portion of the Chemical and Volume Control System including the suction piping used during ECCS actuation (injection and recirculation modes) outside containment is included in the leakage reduction program. The letdown, degasifier, and purification subsystems are isolated during an accident situation and are not required for emergency core cooling. Seal water supply to the reactor coolant pumps does not require letdown flow and does not require makeup from the chemical and volume control tank.

2. The Post-Accident Sampling (PAS) subsystem is included in the leakage reduction surveillance test for the Primary Sample System. The gaseous post-accident samples are part of the hydrogen detection subsystem in the Combustible Gas Control System (CGC), (refer to Note 3).

3. The hydrogen detection subsystem of the Combustible Gas Control System (CGC) including the sample lines for post - accident gas samples are in the scope of the leakage reduction program. System to be tested either by a markup air local leak rate test (similar to an Appendix, J, LLRT) or by using helium detection techniques.

4. NRC letter dated October 17, 1986.

Task III.D.3.3 Improved In-Plant Iodine Instrumentation Under Accident Conditions (NUREG-0737)

Position:

Each licensee shall provide equipment and associated training and procedures for accurately determining the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident.

Response:

See Updated FSAR Sections 7.5, 11.5, 12.5 and Subsection 12.3.4

Task III.D.3.4 Control Room Habitability Requirements (NUREG-0737)

Position:

In accordance with Task Action Plan, Item III.D.3.4, and control room habitability, licensees shall assure that control room operators will be adequately protected against the effects of accidental release of toxic and radioactive gases and that the nuclear power plant can be safety operated or shut down under design basis accident conditions (Criterion 19, "Control Room," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR, Part 50).

Response:

See Updated FSAR Sections 6.4, 9.4, 9.5 and 12.3 that describe the methods employed to maintain the habitability of the control room during accident conditions.

1.9.2 References

1. Letter OG-57, dated April 20, 1981, R. W. Jurgensen (Chairman, Westinghouse Owners Group) to P. S. Check (NRC).
2. Wood, D. C. and Gottshall, C. L. "Probabilistic Analysis and Operational Data in Response in NUREG-0737, Item II.K.3.2 for Westinghouse NSSS Plants," WCAP-9804, February 1981.
3. "Analysis of Delayed Reactor Coolant Pump Trip During Small Loss-of-Coolant Accidents for Westinghouse Nuclear Steam Supply Systems," WCAP-9584 (Proprietary) and WCAP-9585 (Nonproprietary), August 1979.
4. Letter OG-49, dated March 3, 1981, R. W. Jurgensen (Chairman, Westinghouse Owners Group) to D. F. Ross, Jr. (NRC).
5. Letter OG-50, dated March 13, 1981, R. W. Jurgensen (Chairman, Westinghouse Owners Group) to D. F. Ross, Jr. (NRC).
6. Letter OG-60, dated June 15, 1981, R. W. Jurgensen (Chairman, Westinghouse Owners Group) to P. S. Check (NRC).
7. Letter OG-117, dated March 9, 1984, J. J. Sheppard (Chairman, Westinghouse Owners Group) to R. J. Mattson (NRC).
8. "A Generic Assessment of Significant Flaw Extension, Including Stagnant Loop Conditions, From Pressurized Thermal Shock of Reactor Vessels on Westinghouse Nuclear Power Plants," WCAP-10319, October 1983.

9. "Calculation of Operating and NTOL Vessel RT_{NDT} Values," Letter WOG-82-290, dated December 31, 1982, R. A. Muench to WOG Representatives.

TABLE 2.1-1 **POPULATIONS OF MUNICIPALITIES WHOLLY OR PARTIALLY WITHIN 10 MILES OF THE SITE**

	1970(1)	1980(2)	1983(4)
New Hampshire			
Brentwood	1,468	2,170	2,668
East Kingston	838	1,190	1,376
Exeter	8,892	10,720	11,230
Greenland	1,784	2,210	2,564
Hampton	8,011	10,820	12,278
Hampton Falls	1,254	1,500	1,602
Kensington	1,044	1,350	1,518
Kingston	2,882	4,640	5,018
Newfields	843	1,000	1,060
Newton	1,920	4,060	4,678
North Hampton	3,259	4,910	5,888
Portsmouth	25,717	28,430	28,580
Rye	4,083	5,230	6,034
Seabrook	3,053	6,000	6,672
South Hampton	558	800	920
Stratham	1,512	2,500	3,040
Massachusetts			
Amesbury	11,388	16,560(3)	17,000
Haverhill	46,120	46,340	47,300
Merrimac	4,245	4,710	4,800
Newbury	3,804	4,920	5,010

	1970(1)	1980(2)	1983(4)
Newburyport	15,807	16,740	17,000
Salisbury	4,179	5,150	5,250
West Newbury	2,254	2,690	2,750

(1) U. S. Census of Population, 1970

(2) Interim Revisions, New Hampshire Population Projections for Towns and Cities to the Year 2000. August 1977. NH Office of Comprehensive Planning. Projected 1980 populations for East Kingston, Exeter, Seabrook, and Stratham are less than 1978 population estimates for the same communities, Rockingham and Stratford County Population Data: 1978 Estimates - Rockingham Stratford Census Project. This is also noted for these same communities and Portsmouth in the 1978 Population Estimates of N. H. Cities and Towns, prepared by the NH Office of Comprehensive Planning, August 1979.

(3) Population Projections 1980-1985, Massachusetts Department of Public Health, Office of State Health Planning, August 1978.

(4) Estimates based on same sources indicated in footnotes (2) and (3) and interpolated for 1983.

TABLE 2.1-2 PROJECTED POPULATION BY SECTOR – 0 TO 10 MILES

Sector	Year	0-1 Mile	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	Cumulative Totals By Sector
N	1980	20	80	470	700	700	4,440	6,110
	1983	20	80	530	800	470	5,190	7,090
	1990	20	100	700	1,050	630	6,920	9,420
	2000	20	100	760	1,150	760	9,420	12,210
	2010	20	100	840	1,270	970	13,010	16,210
	2020	20	100	920	1,400	1,220	18,210	21,870
	2025	20	100	970	1,470	1,380	22,010	25,950
NNE	1980	0	0	1,700	1,980	370	8,180	12,230
	1983	0	0	1,930	2,250	430	8,820	13,430
	1990	0	0	2,540	2,960	580	10,300	16,380
	2000	0	0	2,780	3,250	720	12,260	19,010
	2010	0	0	3,060	3,570	910	14,830	22,370
	2020	0	0	3,370	3,930	1,150	18,200	26,650
	2025	0	0	3,540	4,120	1,310	20,410	29,380
NE	1980	0	70	790	1,350	820	980	4,010
	1983	0	70	900	1,540	940	1,140	4,590
	1990	0	100	1,180	2,020	1,240	1,520	6,060
	2000	0	110	1,290	2,220	1,400	2,000	7,020
	2010	0	120	1,420	2,440	1,590	2,640	8,210
	2020	0	130	1,570	2,680	1,800	3,480	9,660
	2025	0	140	1,640	2,820	1,940	4,040	10,580

Sector	Year	0-1 Mile	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	Cumulative Totals By Sector
ENE	1980	0	440	820	110	0	0	1,370
	1983	0	500	930	120	0	0	1,550
	1990	0	670	1,230	160	0	0	2,060
	2000	0	730	1,350	180	0	0	2,260
	2010	0	800	1,480	200	0	0	2,480
	2020	0	880	1,630	220	0	0	2,730
	2025	0	920	1,710	230	0	0	2,860
E	1980	0	480	0	0	0	0	480
	1983	0	540	0	0	0	0	540
	1990	0	710	0	0	0	0	710
	2000	0	780	0	0	0	0	780
	2010	0	860	0	0	0	0	860
	2020	0	940	0	0	0	0	940
	2025	0	990	0	0	0	0	990
ESE	1980	0	930	0	0	0	0	930
	1983	0	1,040	0	0	0	0	1,040
	1990	0	1,290	0	0	0	0	1,290
	2000	0	1,530	0	0	0	0	1,530
	2010	0	1,830	0	0	0	0	1,830
	2020	0	2,190	0	0	0	0	2,190

Sector	Year	0-1 Mile	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	Cumulative Totals By Sector
	2025	0	2,410	0	0	0	0	2,410
SE	1980	0	50	530	0	0	0	580
	1983	0	60	570	0	0	0	630
	1990	0	70	640	0	0	0	710
	2000	0	90	730	0	0	0	820
	2010	0	110	840	0	0	0	950
	2020	0	130	970	0	0	0	1,100
	2025	0	150	1,040	0	0	0	1,190
SSE	1980	10	90	260	330	520	4,340	5,550
	1983	10	100	280	330	520	4,420	5,560
	1990	20	120	320	340	550	4,600	5,950
	2000	20	150	360	360	570	4,790	6,250
	2010	20	180	420	370	590	4,980	6,560
	2020	30	220	490	390	600	5,180	6,910
	2025	30	250	530	400	630	5,280	7,120
S	1980	120	250	540	570	990	7,620	10,090
	1983	140	270	600	580	1,010	7,760	10,360
	1990	170	330	710	600	1,050	8,080	10,940
	2000	210	410	750	620	1,100	8,400	11,490
	2010	250	500	1,030	650	1,140	8,730	12,300

Sector	Year	0-1 Mile	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	Cumulative Totals By Sector
	2020	310	600	1,240	680	1,190	9,080	13,100
	2025	340	670	1,380	690	1,210	9,270	13,560
SSW	1980	250	280	420	510	400	9,000	10,860
	1983	280	310	440	510	400	9,160	11,100
	1990	340	380	470	540	420	9,540	11,690
	2000	410	460	510	540	440	9,920	12,280
	2010	500	560	560	580	450	10,320	12,970
	2020	610	680	610	600	470	10,730	13,700
	2025	680	750	650	610	480	10,950	14,120
SW	1980	60	670	390	230	3,290	11,720	16,360
	1983	60	750	390	230	3,350	11,930	6,710
	1990	80	910	410	240	3,480	12,420	17,540
	2000	100	1,110	430	250	3,620	12,920	18,430
	2010	120	1,350	440	260	3,770	13,430	19,370
	2020	140	1,650	460	270	3,920	13,970	20,410
	2025	160	1,830	470	280	4,000	14,530	21,270
WSW	1980	0	670	650	300	3,370	7,570	12,560
	1983	0	750	710	310	3,420	7,800	12,990
	1990	0	910	850	340	3,560	8,340	14,000
	2000	0	1,110	1,020	370	3,710	9,030	15,240

Sector	Year	0-1 Mile	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	Cumulative Totals By Sector
	2010	0	1,360	1,220	400	3,860	9,930	16,760
	2020	0	1,660	1,470	440	4,010	11,170	18,740
	2025	0	1,850	1,620	460	4,090	12,060	20,060
W	1980	110	680	270	320	650	2,230	4,260
	1983	120	750	290	360	740	2,560	4,820
	1990	140	920	350	450	950	3,320	6,130
	2000	170	1,120	410	530	1,330	4,510	8,070
	2010	210	1,360	480	640	1,920	6,250	10,860
	2020	260	1,660	670	760	2,890	8,820	14,910
	2025	290	1,850	620	840	3,580	10,750	17,930
WNW	1980	170	70	250	70	650	2,660	3,880
	1983	180	80	270	80	740	2,960	4,310
	1990	190	90	320	90	930	3,660	5,280
	2000	210	90	320	90	1,080	4,730	6,520
	2010	240	100	330	100	1,250	6,200	8,220
	2020	270	100	340	100	1,450	8,250	10,510
	2025	280	100	340	100	1,560	9,700	12,080
NW	1980	20	220	150	120	120	6,440	7,070
	1983	30	240	160	120	120	6,760	7,430
	1990	30	280	190	140	140	7,540	8,320

Sector	Year	0-1 Mile	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles	Cumulative Totals By Sector
	2000	30	280	190	150	150	8,550	9,350
	2010	30	290	200	150	150	9,750	10,570
	2020	30	290	200	150	150	11,170	11,990
	2025	30	300	210	160	150	12,030	12,880
NNW	1980	30	270	140	170	290	3,480	4,380
	1983	30	280	160	200	330	4,050	5,050
	1990	30	330	190	260	440	5,360	6,610
	2000	30	340	190	280	480	7,600	8,920
	2010	40	340	220	310	530	11,130	12,570
	2020	40	350	230	340	580	16,680	18,220
	2025	40	360	240	360	610	21,110	22,720

Table 2.1-2

PROJECTED POPULATION BY SECTOR - 0 TO 10 MILES

	Year	0-1 Mile	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles
Cumula-	1980	790	5,250	7,390	6,760	11,870	68,660
tive	1983	870	5,820	8,160	7,430	12,470	72,550
Ring	1990	1,020	7,210	10,100	9,190	13,970	81,600
Totals	2000	1,200	8,410	11,090	9,990	15,360	94,130
-	2010	1,430	9,850	12,540	10,940	17,130	111,200
-	2020	1,710	11,570	14,070	11,960	19,380	134,940
-	2025	1,870	12,650	14,960	12,540	20,940	152,140

	Year	0-1 Mile	1-2 Miles	2-3 Miles	3-4 Miles	4-5 Miles	5-10 Miles
Cumula-	1980	790	6,040	13,430	20,190	32,060	100,720
tive	1983	870	6,690	14,850	22,280	34,750	107,300
Totals	1990	1,020	8,230	18,330	27,520	41,490	123,090
-	2000	1,200	9,610	20,700	30,690	46,050	140,180
-	2010	1,430	11,280	23,820	34,760	51,890	163,090
-	2020	1,710	13,280	27,350	39,310	58,690	193,630
-	2025	1,870	14,520	29,480	42,020	62,960	215,100

TABLE 2.1-3 TOTAL ESTIMATED SEASONAL AND YEAR ROUND LIVING UNITS FOR TOWNS WITHIN 5 MILES OF SEABROOK STATION (BASED ON 1978-79 ELECTRIC METER USE DATA)

		Estimated Number Seasonal Living Units	Estimated Number Year Round Living Units	Total Seasonal & Year Round Living Units
New Hampshire*				
(1)	Hampton	2526	4084	6610
	Hampton Beach	(2425)	(1721)	(4146)
	Hampton	(101)	(2363)	(2464)
(2)	Hampton Falls	64	439	503
(3)	Kensington	28	429	457
(4)	South Hampton	13	217	230
(5)	Seabrook	429	2444	2936
	Total New Hampshire	3060	7613	10736
Massachusetts				
(6)	Amesbury	373	4368	4741
(7)	Salisbury	857	2048	2905
	Total Massachusetts	1230	6416	7646
	Total New Hampshire & Massachusetts	4290	14029	18382

* North Hampton not included, since electric data not available.

** Note: Estimates of seasonal units based on electric meter use for an annual period. Individual meters with residential rate codes were reviewed for the "Seasonal Months" of July and August and compared to the "Off-Season Months" of November and March. Seasonal meters were defined as those for which the "seasonal" electric use (i.e., KWhr/Mo) was at least three (3) times greater than the "Off-Season" use of electricity. Meters not classified as "seasonal" were classified as year-round and assumed to be associated with the permanent resident population.

TABLE 2.1-4 PROJECTED POPULATION BY SECTOR - 0 TO 50 MILES

Sector	Year	0-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles	Cumulative Totals By Sector
N	1980	6,100	2,800	30,400	20,000	6,200	85,500
	1983	7,100	23,500	30,800	20,500	6,300	88,200
	1990	9,400	25,200	31,800	21,500	6,600	94,500
	2000	12,200	27,400	32,700	22,300	6,900	101,500
	2010	16,200	28,400	33,800	23,200	7,200	108,800
	2020	21,900	30,400	35,000	24,100	7,500	118,900
	2025	26,000	35,000	35,600	24,600	7,700	128,900
NNE	1980	12,200	30,600	10,300	16,500	38,900	108,500
	1983	13,400	31,300	10,500	16,800	39,700	111,700
	1990	16,400	32,800	11,000	17,600	41,700	119,500
	2000	19,000	34,800	11,500	18,300	43,300	126,900
	2010	22,400	37,000	11,900	19,100	45,000	135,400
	2020	26,700	39,700	12,400	19,800	46,900	145,500
	2025	29,400	41,300	12,700	20,200	47,800	151,400
NE	1980	4,000	2,100	0	0	0	6,100
	1983	4,600	2,200	0	0	0	6,800
	1990	6,100	2,500	0	0	0	8,600
	2000	7,000	2,800	0	0	0	9,800
	2010	8,200	3,200	0	0	0	11,400
	2020	9,700	3,700	0	0	0	13,400

Sector	Year	0-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles	Cumulative Totals By Sector
	2025	10,600	4,100	0	0	0	14,700
ENE	1980	1,400	0	0	0	0	1,400
	1983	1,600	0	0	0	0	1,600
	1990	2,100	0	0	0	0	2,100
	2000	2,300	0	0	0	0	2,300
	2010	2,500	0	0	0	0	2,500
	2020	2,700	0	0	0	0	2,700
	2025	2,900	0	0	0	0	2,900
E	1980	500	0	0	0	0	500
	1983	500	0	0	0	0	500
	1990	700	0	0	0	0	700
	2000	800	0	0	0	0	800
	2010	900	0	0	0	0	900
	2020	900	0	0	0	0	900
	2025	1,000	0	0	0	0	1,000
ESE	1980	900	0	0	0	0	900
	1983	1,000	0	0	0	0	1,000
	1990	1,300	0	0	0	0	1,300
	2000	1,500	0	0	0	0	1,500
	2010	1,800	0	0	0	0	1,800

Sector	Year	0-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles	Cumulative Totals By Sector
	2020	2,200	0	0	0	0	2,200
	2025	2,400	0	0	0	0	2,400
SE	1980	600	8,100	800	0	0	9,500
	1983	600	8,200	900	0	0	9,700
	1990	700	8,500	900	0	0	10,100
	2000	800	8,900	900	0	0	10,600
	2010	1,000	9,200	1,000	0	0	11,200
	2020	1,100	9,600	1,000	0	0	11,700
	2025	1,200	10,000	1,000	0	0	12,200
SSE	1980	5,600	13,400	22,000	0	0	41,000
	1983	5,700	13,700	22,400	0	0	41,800
	1990	6,000	14,200	23,300	0	0	43,500
	2000	6,300	14,800	24,300	0	0	45,400
	2010	6,600	15,400	25,200	0	0	47,200
	2020	6,900	16,000	26,300	0	0	49,200
	2025	7,100	16,300	26,800	0	0	50,200
S	1980	10,100	18,600	171,400	97,500	206,700	504,300
	1983	10,400	18,900	174,500	99,300	210,500	513,600
	1990	10,900	19,700	181,700	103,400	219,100	534,800
	2000	11,500	20,500	189,000	107,500	227,900	556,400

Sector	Year	0-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles	Cumulative Totals By Sector
	2010	12,300	21,300	196,500	111,800	237,000	578,900
	2020	13,100	22,200	204,400	116,300	246,500	602,500
	2025	13,600	22,600	210,000	118,600	251,400	616,200
SSW	1980	10,900	20,200	161,100	869,000	801,500	1,862,700
	1983	11,100	20,600	164,000	884,600	815,900	1,896,200
	1990	11,700	21,400	170,800	921,100	849,600	1,974,600
	2000	12,300	22,300	177,600	957,100	883,600	2,052,900
	2010	13,000	23,200	184,700	996,300	918,900	2,136,100
	2020	13,700	24,100	192,100	1,036,100	955,700	2,221,700
	2025	14,100	24,600	196,000	1,056,800	974,800	2,266,300
SW	1980	16,400	66,300	185,600	176,000	127,300	571,600
	1983	16,700	67,500	189,000	179,100	129,600	581,900
	1990	17,500	70,300	196,700	186,500	135,000	606,000
	2000	18,400	73,100	204,600	194,000	140,400	630,500
	2010	19,400	76,100	212,800	201,800	146,000	656,100
	2020	20,400	79,100	221,300	209,800	151,800	682,400
	2025	21,300	80,700	225,700	214,000	154,900	696,600
WSW	1980	12,600	26,100	95,000	113,700	34,700	282,100
	1983	13,000	26,500	100,200	120,300	35,800	295,800
	1990	14,000	27,600	112,500	135,700	38,500	328,300

Sector	Year	0-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles	Cumulative Totals By Sector
	2000	15,200	28,700	125,800	151,200	41,200	362,100
	2010	16,800	29,900	141,100	168,100	44,300	400,200
	2020	18,700	31,100	158,500	187,200	47,900	443,400
	2025	20,100	31,700	168,400	198,000	50,200	468,400
W	1980	4,300	15,600	47,600	84,900	21,500	173,900
	1983	4,800	17,300	50,400	90,700	23,200	186,400
	1990	6,100	21,100	57,000	104,100	27,000	215,300
	2000	8,100	24,300	63,600	118,800	30,800	245,600
	2010	10,900	28,100	71,300	136,500	35,200	282,000
	2020	14,900	32,500	80,200	58,000	40,300	325,900
	2025	17,900	35,000	85,400	171,000	43,300	352,600
WNW	1980	3,900	7,900	12,900	61,400	33,300	119,400
	1983	4,300	9,000	13,400	63,300	34,500	124,500
	1990	5,300	11,700	14,800	67,700	37,300	136,800
	2000	6,500	16,300	16,200	72,700	40,600	152,300
	2010	8,200	23,800	17,800	78,200	44,300	172,300
	2020	10,500	36,200	19,600	84,400	48,300	199,000
	2025	12,100	46,900	20,700	87,900	50,600	218,200
NW	1980	7,100	8,000	3,600	10,300	16,100	45,100
	1983	7,400	8,800	3,700	10,600	16,700	47,200

Sector	Year	0-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles	Cumulative Totals By Sector
	1990	8,300	10,600	4,000	11,300	18,100	52,300
	2000	9,400	13,200	4,200	12,100	19,800	58,700
	2010	10,600	16,700	4,500	12,900	21,700	66,400
	2020	12,000	21,300	4,700	14,000	23,800	75,800
	2025	12,900	27,500	4,900	14,500	26,200	86,000
NNW	1980	4,400	13,900	18,500	14,200	5,400	56,400
	1983	5,100	14,400	18,900	14,400	5,600	58,400
	1990	6,600	15,400	19,800	15,000	6,000	62,800
	2000	8,900	16,900	20,700	15,900	6,400	68,800
	2010	12,600	19,000	21,600	16,800	7,000	77,000
	2020	18,200	22,100	22,700	17,900	7,500	88,400
	2025	22,700	24,400	23,200	18,500	7,900	96,700

	Year	0-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles	
Incre-	1980	100,700	253,600	759,200	1,463,500	1,291,600	
mental	1983	107,300	261,900	778,700	1,499,600	1,317,800	
Ring	1990	123,100	281,000	824,300	1,583,900	1,378,900	
Totals	2000	140,200	304,000	871,100	1,669,900	1,440,900	
	2010	163,100	331,300	922,200	1,764,700	1,506,600	
	2020	193,600	368,000	978,200	1,867,600	1,576,200	
	2025	215,100	400,100	1,010,400	1,924,100	1,614,800	

	Year	0-10 Miles	10-20 Miles	20-30 Miles	30-40 Miles	40-50 Miles	
Cumula-	1980	100,700	354,300	1,113,500	2,577,000	3,868,600	
tive	1983	107,300	369,200	1,147,900	2,647,500	3,965,300	
Totals	1990	123,100	404,100	1,228,400	2,812,300	4,191,200	
	2000	140,200	444,200	1,315,300	2,985,200	4,426,100	
	2010	163,100	494,400	1,416,600	3,181,300	4,687,900	
	2020	193,600	561,600	1,539,800	3,407,400	4,983,600	
	2025	215,100	615,200	1,625,600	3,549,700	5,164,500	

TABLE 2.1-5 OVERNIGHT ACCOMMODATIONS

Guest House Hotel/Motel	Location (sector)	No. of Rooms	Maximum Capacity	Y=All Year S=Seasonal
HAMPTON				
American Hotel, Apt.	(E 1-2)	6 apts.	20	Y
Ashworth Hotel Inc.	(ENE 1-2)	111	358	Y
Barnes Motel	(NE 3-4)	14	34	6 units-Y 8 units-S
Blue Lantern Motel	(NE 3-4)	20	70	S
Century House Motel	(ENE 2-3)	24	48	S
Grayhurst Guest House	(ENE 1-2)	11 rooms 2 apts. 1 cottage	48	S Y
Jen's Ocean Manor	(NE 2-3)	10 apts.	90	S
Rainbow Village Hotel	(E 1-2)	11	30	Y
Rockey's Real Estate	(NE 2-3)	23	207	4-5 rooms-Y
Sea Squire Motor Lodge	(NE 4-5)	12	24	S
Sheraton Motor Inn Lamie's Tavern	(N 2-3)	30	118	Y
Town & Beach Motel	(N 3-4)	23	60	Y
Villager Motel	(N 2-3)	17	34	S
Hillcrest Motor Inn	(ENE 1-2)	31	93	S
Westport Motel	(ENE 1-2)	16	64	S
Pine Haven Motel	(N 2-3)	16	32	Y
Wishing Well	(N 2-3)	16	60	Y
Dalton	(N 2-3)	13	26	Y
Allen's House	(ENE 2-3)	6	12	NA
Nor' Easter Motel	(ENE 2-3)	6-8	16	NA
Wave Motel	(ENE 2-3)	17	34	NA
Boulevard Motel	(ENE 2-3)	25	50	NA

Guest House Hotel/Motel	Location (sector)	No. of Rooms	Maximum Capacity	Y=All Year S=Seasonal
Sun 'n Surf	(ENE 2-3)	21	60	12-Y 9-S
Santa Maria Duffey's Island View Duffey's Manor	(ENE 2-3)	60	120	Y
Reef Motel	(ENE 2-3)	14	28	S
Drop Anchor Motel	(NE 2-3)	15	45	S
Motel	(NE 3-4)	3 apts.	6	NA
Yearly Rentals	(NE 3-4)	5	10	Y
Ocean Edge	(NE 3-4)	6	15	S
Spindrift	(NE 3-4)	32	64	NA
Bailey Motel	(NE 3-4)	28 apts.	56	NA
The Carriage	(NE 2-3)	24	48	9-Y (avg. 6 in winter) 15-S
Martins Motor Court	(NNE 2-3)	27	54	NA
Twin Oaks	(NE 2-3)	17	68	S
White Gables Motor Court	(NE 2-3)	10	30	S
Belle & Regis Motel	(ENE 1-2)	7	25	S
Lincoln House	(E 1-2)	17	40	S
Rocky Wold Motel	(ENE 2-3)	14	50	S
Sea Farer Guest House	(ENE 1-2)	10	25	Y
Windjammer Motel	(NE 3-4)	16	48	S
Seascape Motel	(NE 3-4)	19	57	S
Rhea's Motel	(NE 3-4)	6	20	S
Acorn Village Motel	(NE 3-4)	5 rooms 1 house 14 cottages	90	7-Y
Cove Motel	(NE 3-4)	25	75	S
McGurk Rentals	(ENE 1-2)	--	25	S
St. Jean Court	(ENE 1-2)	11	50	S

Guest House Hotel/Motel	Location (sector)	No. of Rooms	Maximum Capacity	Y=All Year S=Seasonal
Bea Cottages	(ENE 1-2)	12-15	30	NA
Felka Cottages	(ENE 1-2)	6	12	NA
Marguerite Motel	(ENE 1-2)	42	84	S
Jane's Court	(NE 3-4)	8	16	NA
Ocean Motel	(NE 3-4)	20	80	S
Holiday Shores	(NE 3-4)	16	32	NA
Broadview Guest House	(E 1-2)	4-5	10	NA
Mayflower Inn	(E 1-2)	7	18	Y
Surfside	(E 1-2)	23	46	S
Drop In Cottages	(E 1-2)	9	18	NA
Joy's Rooms and Cottages	(E 1-2)	3	6	NA
Blue Jay Motel	(E 1-2)	16	32	S
Seaside Chalet	(E 1-2)	11	66	S
Brownie's	(E 1-2)	20	40	S
The Cavalier	(ENE 1-2)	10	20	NA
The Austin	(ENE 1-2)	8	16	NA
Seaside Village Motel	(NE 4-5)	22	70	S
Kitty-Lou Cottages & Motel	(ENE 1-2)	17	50	S
Duthie's	(ENE 3-4)	12	24	NA
Sherry Marie	(ENE 1-2)	5	10	NA
Greycliff Rooms	(ENE 1-2)	5	10	S
Eastern Shore Apts	(ENE 1-2)	2	4	S
Deerfield Rooms	(ENE 1-2)	8	15	S
Danahy Apts. & Rms.	(ENE 1-2)	11	22	NA
Ocean Breeze Motel	(E 1-2)	8	24	S
Beach View	(E 1-2)	30	120	Y = 25 units off season 1 prs./unit
The Puritan	(NNE 1-2)	25	50	S

Guest House Hotel/Motel	Location (sector)	No. of Rooms	Maximum Capacity	Y=All Year S=Seasonal
Surf Hotel	(ENE 2-3)	36	72	NA
East Wind	(ENE 2-3)	25-30	60	NA
Atlantic (all of them)	(ENE 2-3)	60	180	Y
Seven Gables	(ENE 2-3)	21	42	S
Ocean Spray Court	(ENE 2-3)	35	70	NA
Jonathan's	(ENE 2-3)	16	64	5-Y/11-S
Merrimac	(ENE 2-3)	20	40	S
Sea Den	(ENE 2-3)	43	172	April - October
Ocean Air Apts.and Cottages	(ENE 2-3)	7	14	NA
Riviera Motel	(ENE 2-3)	18	35	S
The Edgewater Cabins	(ENE 2-3)	12	40	S
Sea Breeze Village Cabins	(ENE 2-3)	17	34	NA
Hollywood Motel	(ENE 2-3)	6	20	S
The Alecia Apt. & Kitchenettes	(ENE 2-3)	8	16	NA
Vista Motel	(ENE 2-3)	23	46	S
Colony Motel	(ENE 1-2)	32	64	NA
Main Sail Motel	(ENE 1-2)	9 cottages 16 rooms 8 apts	100	Rooms, apt-Y Cottages-S
Sand Motel	(ENE 1-2)	61	225	23-Y
Sunny Motel	(ENE 1-2)	3	6	S
Chesterfield	(ENE 1-2)	6 apts.	12	NA
Wilbert Motel	(ENE 1-2)	12	24	NA
Sea Horse	(ENE 1-2)	4-5	10	NA
Canadian House	(ENE 1-2)	18	72	S
Longview Apts.	(ENE 1-2)	8-10 at 1&2 bedrooms	40	Y
Sunset Haven	(ENE 1-2)	8 apts.	16	NA
Westport Motel	(ENE 1-2)	16	64	S

Guest House Hotel/Motel	Location (sector)	No. of Rooms	Maximum Capacity	Y=All Year S=Seasonal
Mari Anne	(E 1-2)	24 apts.	40	10-15/Y
Motel Drift	(E 1-2)	23	78	Y
Voyager Motor Lodge	(E 1-2)	8	32	Y
Surfside Chalet	(E 1-2)	10	20	NA
Harris Sea Ranch	(E 1-2)	30	70	S
Springfield Motor Court	(E 1-2)	6	12	NA
The Pelham	(E 1-2)	36	144	S
Moulton Hotel	(ENE 1-2)	23	92	S
Green Briar	(ENE 1-2)	21	42	NA
The OceanSide Guest House	(ENE 1-2)	15	60	S
Young's	(ENE 2-3)	61	244	Y
Laughlin's Grand View	(ENE 2-3)	30	60	NA
The Algiers	(ENE 2-3)	22	44	Y
The Vandemere	(ENE 2-3)	20	80	S
The Shirley	(ENE 2-3)	14	40	S
The Kentville	(ENE 2-3)	30	60	NA
Duffey's Apts. & Inn	(ENE 1-2)	20 rooms 6 apts.	61	S
Elmdale	(ENE 1-2)	10	20	NA
Admiral's Choice	(ENE 1-2)	9	18	NA
Sea Mist	(ENE 1-2)	6	12	Y
Bromfield	(ENE 1-2)	5	10	NA
Windsor Motel	(ENE 1-2)	11	37	S
The Pirates' Den (same no. as Admiral's)	(ENE 1-2)	12	24	NA
Star & Key Cottages	(ENE 1-2)	5-10	20	Y
The Helm Rooms	(ENE 1-2)	7	14	Y
Days End	(E 1-2)	10-12	24	NA

Guest House Hotel/Motel	Location (sector)	No. of Rooms	Maximum Capacity	Y=All Year S=Seasonal
Springfield	(E 1-2)	30	60	Y
Paine's Guest House	(ENE 1-2)	9	31	S
Silver Spring Kitchenettes	(ENE 1-2)	9	27	S
Vellia	(ENE 1-2)	16	32	Y
The Dorna Room	(ENE 2-3)	8	16	NA
Lismore	(ENE 2-3)	8	16	S
Bon Air	(ENE 2-3)	7	14	NA
June Ville	(ENE 2-3)	7	21	S
Wahl Cottages	(ENE 1-2)	9	18	NA
Adrian's Cottages	(ENE 1-2)	3	6	Y
Clifford House	(ENE 1-2)	3	6	NA
Bartlett Rooms	(ENE 1-2)	8-10	20	NA
Shore Winds	(ENE 1-2)	8	16	NA
Tropical Inn	(ENE 1-2)	5	10	NA
Kenmore Inn	(ENE 1-2)	5	10	NA
Janmere Inn	(ENE 1-2)	50	100	S
Dolphyn	(ENE 1-2)	29	38	S
Bobbie's & Sandpiper Kimball R.E.	(ENE 1-2)	6	12	NA
Styers Motel	(ENE 1-2)	3	6	NA
Motel Tides	(ENE 1-2)	24	48	S
Royal Crest Motor Inn	(ENE 1-2)	40	80	NA
Sunset Chalet	(ENE 1-2)	8	16	NA
Conn. Village Guest House	(ENE 1-2)	10	20	NA
The Milton House	(ENE 1-2)	10	20	NA
Richmond Motel & Apts.	(ENE 1-2)	4	8	Y
Laurentain Motel	(ENE 1-2)	61	184	S

Guest House Hotel/Motel	Location (sector)	No. of Rooms	Maximum Capacity	Y=All Year S=Seasonal
The Avon	(ENE 1-2)	25	50	NA
Hollingsworth	(ENE 1-2)	63	120	S
Debonair	(ENE 1-2)	19	38	S
Seagate	(ENE 1-2)	15	60	Y
Beachcroft	(ENE 1-2)	15	98	S
Royall Hampton Inn	(ENE 1-2)	43-48	96	NA
The Lift Inn	(E 1-2)	4	8	S
Hampton House	(E 1-2)	1	2	NA
The Old Salt	(ENE 1-2)	8	14	S
Nourage Guest House	(ENE 1-2)	3 Apt 1 Cottage	16	Y
Beacon Hotel	(E 1-2)	14	33	S
Mermaid Apts.	(ENE 1-2)	8	16	NA
Apts.	(ENE 1-2)	4	8	NA
A Street Apts.	(ENE 1-2)	6	12	NA
Boar's Head Inn	(ENE 2-3)	12	24	S
Colonial Inn	(E 1-2)	NA	NA	NA
Drolet Jean L.	(E 1-2)	60	180	S
HAMPTON TOTAL			8068	
AMESBURY				
Susse Chalet Motor Lodge	(SW 4-5)	60	180	Y

Guest House Hotel/Motel	Location (sector)	No. of Rooms	Maximum Capacity	Y=All Year S=Seasonal
Alan's Motel & Diner	(SW 4-5)	28	36	Y
AMESBURY TOTAL			216	
SALISBURY				
Ocean Gate	(SSE 4-5)	52	200	S
Clear Inn House	(SSE 4-5)	22	45	Y
Colonial Arms Hotel	(SSE 4-5)	10	16	Y
Johnson's Hotel	(SSE 4-5)	6	14	Y
Sea Crest Motel	(SSE 3-4)	18	66	S
Knotty Pine Motel	(S 4-5)	21	50	S
Village Inn Motel	(SSW 2-3)	10	20	Y
Beach Road Grove Cabins	(S 4-5)	27	54	Y
Henry Sun & Sand and George's Motel & Cottages	(S 4-5)	Both motels combined--100 units	250	S
El Rancho	(SSE 4-5)	37	101	S
Beach Way Motor Court	(S 4-5)	33	66	S
Sunshine Cabins	(SSW 2-3)	3	6	NA
Olde Farm Motel	(SSW 2-3)	10	20	Y
Hearthstones	(S 3-4)	5	10	NA
Edwards By The Sea	(SSE 4-5)	24	32	S
Sundowner Motel	(SSE 4-5)	11	17	S

Guest House Hotel/Motel	Location (sector)	No. of Rooms	Maximum Capacity	Y=All Year S=Seasonal
Surfway	(SSE 4-5)	27	54	NA
The Hungry Traveller	(SSE 4-5)	4	8	NA
The Dunes	(SSE 4-5)	8 units 2 rooms	32	NA
McCarthy's	(SSE 4-5)	10	20	NA
Haggarty's	(SSE 3-4)	14 with 1-2 rooms	56	S
Sea Gate Cottages	(SSE 3-4)	8	40	Y
Sun 'n Sand	(SSE 4-5)	10	20	NA
SALISBURY TOTAL			1197	
SEABROOK				
Hawaiian Garden Motor Inn	(W 1-2)	27	34	Y
Seabrook Cottages & Motel Sleepy Hollow	(WSW 1-2)	17	34	NA
Phoenicia Motel	(SW 1-2)	18	36	NA
Village Motel	(SW 1-2)	11 Cottages	22	NA
Spruce Manor	(WSW 1-2)	17	34	NA
McInnis	(SW 1-2)	10	20	NA
Stoddard Cabins	NA	NA	NA	NA
Best Western	(W 1-2)	53	106	Y

Guest House Hotel/Motel	Location (sector)	No. of Rooms	Maximum Capacity	Y=All Year S=Seasonal
SEABROOK TOTAL			286	
NORTH HAMPTON				
Langiells Motor Court	(N 4-5)	4	4	Y
Knox Motel	(N 4-5)	10	26	Y
Gregory's Motel	(N 4-5)	14	32	S
Whispering Pines	(N 4-5)	9	18	S
King Motel	(N 4-5)	16	96	Y
Slumber Manor	(N 4-5)	8	16	
Seaside Inn	(NE 4-5)	NA	NA	NA
NORTH HAMPTON TOTAL			192	
HAMPTON FALLS				
Blue Mist Motel	(NNW 1-2)	6 winter 20 summer	40	Y
New England Village Cabins	(NNW 1-2)	10	20	NA
HAMPTON FALLS TOTAL			60	
KENSINGTON - NONE within 10-mile radius				

Guest House Hotel/Motel	Location (sector)	No. of Rooms	Maximum Capacity	Y=All Year S=Seasonal
SOUTH HAMPTON - NONE within 10-mile radius				
RYE				
Historic Cable House	(NE 8-9)	8 – Large 1 - Small	26	S
Salty Breeze Inn	(NE 9-10)	7 - Cabins	40	S
Rye Harbor Motel	(NE 8-9)	16	32	NA
Farragut Hotel	(NE 7-8)	72	144	NA
Sleepy Hollow Motel	(NNE 7-8)	19 units	50	1 or 2 days in August
Rye Beach Motel & Cottages	(NE 8-9)	7	14	S
Dunes Motel	(NE 7-8)	36	72	
Crown Colony Cottages	(NE 9-10)	3 motel units 12 efficiency 3 apartments 1 house 19 units total	84	S
RYE TOTAL			462	
EXETER				
The Exeter Inn	(NW 8-9)	55	110	Y
Hearthside Motor Inn	(NW 7-8)	35	138	Y

Guest House Hotel/Motel	Location (sector)	No. of Rooms	Maximum Capacity	Y=All Year S=Seasonal
EXETER TOTAL			248	
NEWBURYPORT				
Essex Street Inn (Rooming House)	(S 6-7)	20	20	Y
Everett Clarke Cottages	(SSE 5-6)	8 (2-3 B/Rms)	34	S
Hunter Guest Houses	(SSE 7-8)	2 cottages 2-3 Rms. 6 people in each.	12	S
Kenmore Cottages	(SSE 7-8)	6 cottages/1 apt.	24	Y
Walton's Ocean Front	(SSE 7-8)	17	50	S
Benj. Choate House	(SSW 5-6)	5	14	Y
Civic Center	(S 6-7)	3	65	June-Labor Day or by reservation in winter (groups 15)
Windsor House	(S 6-7)	6	15	Y
Beaumanor at Amesbury	(SSW 5-6)	6	11	Y
NEWBURYPORT TOTAL			245	
PORTSMOUTH				
Wren's Nest Motel	(NNE 8-9)	14 rooms 7 Cottages	50	NA

TABLE 2.1-6 CAMPING FACILITIES WITHIN 10 MILES OF THE SITE

Name	Location (Sector)	Approximate No. of Sites	Estimated Capacity	Season
Tidewater	Hampton (N 2-3)	100 trailers + 25 tent sites = 125 total	500	May - October
Wakeda	Hampton Falls (NW 4-5)	300	1,200	May 1 - Oct. 15
Adams	Seabrook (S 1-2)	75	300	May 15 - Oct. 1
Shel Al Mobile Estates & Camping	N. Hampton (N 5-6)	190	800	May 15 - Oct. 1
Hampton Beach Trailer	Hampton (NE 3-4)	190	760	May 1 - Oct. 1
Rusnick Campground (daycamp)	Salisbury (SSW 2-3)	NA	NA	NA
Pike's Camping Area	Salisbury (S 4-5)	40 trailer + 40 tent sites = 80 total	400	NA

* No camping facilities identified within 0-5 miles in either Kensington, South Hampton or Amesbury.

Salisbury Beach State Reservation (camping area only)	Salisbury (SSE 5-6)	350 trailer + 135 tent sites = 485 total	1,940	NA
Weemac Campground	Amesbury (WSW 7-8)	100 sites 7 cabins	556	Mid-May - Mid-Oct.
Camp Bauercrest	Amesbury (WSW 7-8)			Summer Camp
Tuxbury Pond Camping Area	S. Hampton (WSW 7-8)	130 sites	520	Mid-May-Oct. 1
Camp Holiday	Amesbury (WSW 7-8)		NA	
Camp Treefoil (Camp Kent)	Amesbury (WSW 5-6)		NA	Summer Camp
Pinebrook Campground	Kingston (WSW 10)		NA	
The Green Gate Camping Area	Exeter (NW 7-8)	80 sites	400	May 26 - Oct. 1
Exeter Elms Campground	S. Exeter (NW 7-8)	68 sites	272	May 30 - Oct. 1
				____
		TOTAL		7648

TABLE 2.1-7 **BEACH PARKING LOT CAPACITIES AND OBSERVED PEAKS 0-10 MILE RADIUS**

Sector	Marked Spaces [(1)] (including leased)	Estimated Unmarked Spaces	Estimated Total Parking Lot Capacity[(2)]	Observed Single Peak Day Count 7/22/79
SSE 8-9	0	71	71	13
SSE 7-8	180	419	599	396
SSE 6-7	125	300	425	389
SSE 5-6	1861	60	1921	1130
SSE 4-5	876 (30)	738	1614	1187
SSE 3-4	297	714	1011	461
SE 2-3	61	141	202	188
ESE 1-2	0	317	317	289
E 1-2	0	2551	2551	1914
ENE 1-2	1882 (318)	620	2502	2283
ENE 2-3	435 (211)	479	914	875
ENE 3-4	0	35	35	13
NE 3-4	562	52	614	547
NE 4-5	135	177	312	190
NE 5-6	115	36	151	151
NE 7-8	80	167	247	247
NE 8-9	0	409	409	248
Total	**6609 (559)**	**7286**	**13,895**	**10,521**

(all sectors)

1. Estimate of leased spaces in brackets and included in estimate of total marked parking lot spaces.

2. Includes marked and unmarked parking lot spaces.

TABLE 2.1-8 BEACH AREA PARKING LOT USAGE SALISBURY/SEABROOK/HAMPTON BEACH (WEEKENDS - 1979)

DATE	HR[1]	DAY CODE[2]	CAR COUNT	% TOTAL CAPACITY
6/09/79	13	6	3682	31
6/10/79	13	7	4981	42
6/16/79	13	6	6875	58
6/17/79	13	7	6442	54
6/23/79	13	6	3014	25
6/25/79	13	7	4852	41
7/07/79	15	6	5110	43
7/08/79	15	7	8376	70
7/14/79	14	6	6397	54
7/21/79	13	6	7648	64
7/22/79	13	7	9097	76
7/28/79	16	6	3850	32
7/29/79	13	7	7637	64
8/04/79	13	6	5598	47
8/11/79	13	6	2010	17
8/18/79	13	6	2579	22
8/25/79	14	6	2075	17
8/26/79	13	7	5765	48
9/01/79	13	6	4683	39
9/02/79	13	7	5618	47
9/08/79	13	6	1193	10
9/16/79	13	7	1304	11

TOTAL CAPACITY IN LOTS = 11,993 including leased spaces.

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(1) 12 = noon, 13 = 1:00 p.m., etc.

(2) Key for day code:
1 = Monday
2 = Tuesday
3 = Wednesday
4 = Thursday
5 = Friday
6 = Saturday
7 = Sunday

TABLE 2.1-9 BEACH AREA PARKING LOT USAGE SALISBURY/SEABROOK/HAMPTON BEACH (WEEKDAYS – 1979)

DATE	HR[2]	DAY CODE[3]	CAR COUNT	% TOTAL CAPACITY
6/08/79	13	5	1547	13
6/11/79	13	1	1283	11
6/14/79	13	4	2069	17
6/15/79	13	5	3471	29
6/18/79	14	1	1660	14
6/19/79	13	2	1896	16
6/20/79	13	3	2909	24
6/21/79	13	4	3130	26
6/22/79	13	5	1976	17
6/25/79	14	1	1351	11
6/27/79	13	3	3045	26
6/28/79	14	4	2058	17
6/29/79	13	5	1535	13
7/02/79	14	1	2871	24
7/03/79	13	2	4135	35
7/04/79[1]	14	3	6613	55
7/05/79	13	4	2174	18
7/06/79	13	5	3216	27
7/09/79	13	1	4703	39
7/10/79	13	2	4888	41
7/11/79	13	3	2821	24
7/13/79	13	5	4703	39
7/17/79	13	2	2611	22
7/19/79	13	4	4787	40
7/20/79	13	5	5099	43
7/23/79	15	1	4268	36
7/24/79	14	2	4415	37
7/26/79	13	4	3192	27
7/27/79	13	5	3852	32
7/30/79	13	1	4425	37
7/31/79	13	2	4622	39
8/01/79	14	3	3471	29
8/02/79	16	4	2564	22
8/03/79[1]	13	5	4731	40
8/06/79	13	1	3872	32
8/07/79	13	2	4514	38
8/08/79	13	3	4494	38
8/09/79	14	4	4058	34
8/15/79	13	3	2371	20

DATE	HR[(2)]	DAY CODE[(3)]	CAR COUNT	% TOTAL CAPACITY
8/23/79	13	4	2043	17
8/31/79	18	5	1321	11
9/03/79	13	1	2791	23
9/12/79	13	3	588	5
9/19/79	13	3	328	3

TOTAL CAPACITY IN LOTS = 11,993 including leased spaces.

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(1) Holiday date included with weekend survey dates.

(2) 12 = noon, 13 = 1:00 p.m., etc.

(3) Key for day code:

1 = Monday
2 = Tuesday
3 = Wednesday
4 = Thursday
5 = Friday
6 = Saturday
7 = Sunday

TABLE 2.1-10 **BEACH TRAVEL ORIGIN DESTINATION SURVEY RESULTS WEEKDAY – WEEKEND TOTALS**

Trip Origin (Radial Distance From Seabrook Station	Summary of Weekday Survey Results		Summary of Weekend Survey Results		Total All Survey Days	
	Number of Surveys	%	Number of Surveys	%	Number of Surveys	%
0-5	100	6.3	54	3.3	154	4.8
5-10	119	7.5	57	3.5	176	5.5
10-20	128	8.1	65	4.0	193	6.0
20-30	264	6.7	234	14.4	498	15.5
30-40	333	21.0	427	26.3	760	23.7
40-50	88	5.6	134	8.3	222	6.9
50+	552	34.8	651	40.1	1203	37.5
Total	1584	100.0	1622	100.0	3206	100.0

TABLE 2.1-11 MONTHLY PEAK ATTENDANCE AT SEABROOK GREYHOUND PARK

January 1977 - September 1979

Year 1977	Daily (Peak)	Year 1978	Daily (Peak)	Year 1979	Daily (Peak)
Jan. (1/22-evening)	3,516	Jan. (1/6-day)	3,837	Jan. (1/27-evening)	3,686
		(1/28-evening)	4,400		
Feb. (2/26-evening)	5,138	Feb. (2/20-matinee)	4,915	Feb. (2/19-matinee)	4,391
March (3/5-evening)	5,508	March (3/11-evening)	5,144	March. (3/24-matinee)	3,447
April (4/30-evening)	4,225	April (4/29-evening)	4,473	April (4/14-matinee)	3,429
May (5/28-evening)	4,038	May (5/6-evening)	4,512	May (5/28-matinee)	4,095
June (6/25-evening)	4,667	June (6/17-evening)	4,187	June (6/12-matinee)	3,801
July (7/23-evening)	6,230	July (7/4-matinee)	5,186	July (7/28-evening)	4,415
		(7/28-evening)	5,333		
Aug. (8/20-evening)	5,477	Aug. (8/26-evening)*	6,960	Aug. (8/11-evening)	4,944
Sept. (9/3-evening)	5,772	Sept. (9/2-evening)	5,032	Sept. (9/1-evening)*	7,027
				(9/17-matinee)	3,800
Oct. (10/15-evening)	3,916	Oct. (10/28-evening)	3,015		
Nov. (11/5-evening)	3,915	Nov. (11/11-matinee)	3,145		
Dec. (12/26-matinee)	4,225	Dec. (12/29-matinee)	3,127		

* Highest daily attendance for year.

TABLE 2.1-12 **AERIAL BOATING SURVEY – OCCUPIED BOATS**

Photo Date[(1)]	Brown's River	Hampton River	Blackwater River	Atlantic Ocean (5-Mile Radius)
7/13	0	6	0	10
7/14*	0	15	3	5
7/19	0	1	2	20
7/20	0	0	0	31
7/21*	0	4	2	72
7/22*	0	-	-	81
7/23	0	-	-	28
7/24	0	0	0	30
7/26	0	2	0	5
7/27	0	4	3	11
7/28*	0	2	0	13
7/29*	0	4	3	180
7/30	0	1	2	8
7/31	0	1	0	5
8/1	0	0	1	1
8/2	0	1	0	13
8/3	0	0	0	7
8/4*	0	1	0	105
8/5*	0	2	1	45
8/6	0	1	0	15
8/7	0	0	0	27
8/8	0	5	0	33
8/9-6 AM	0	0	0	9
8/9-9 AM	0	1	0	16
8/9-11 AM	0	2	0	27
8/9-2 PM	0	4	0	55
8/9-5 PM	0	2	0	37
8/9-7 PM	0	0	0	15
8/11*	0	3	1	28
8/13	0	1	0	8
8/14	0	2	0	15
8/15	0	2	1	18
8/16	0	0	0	10
8/18*	0	6	0	52
8/20	0	4	0	26
8/21	0	3	0	24
8/23	0	2	1	14
8/25*	5	1	1	21
8/26*	1	5	1	352**
8/30	0	1	0	5

Photo Date[1]	Brown's River	Hampton River	Blackwater River	Atlantic Ocean (5-Mile Radius)
9/1*	1	7	2	300
9/2-7 AM*	0	3	1	9
9/2-10 AM*	0	1	0	-
9/2-1 PM*	1	5	1	200
9/2-4 PM*	1	5	3	200
9/2-6 PM*	0	4	1	50
9/3*	0	5	0	75
9/8*	0	4	0	150
9/12	0	0	0	10
9/16*	0	2	0	98
9/19	0	0	0	0
9/23*	0	3	0	5

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(1) Photos taken in early afternoon

* Indicates Saturday, Sunday, or holiday.

** 10-mile radius boat count.

NOTE: No occupied boats were observed on Hunt's Island Creek, the Boston and Maine Railroad landing, Farm Dock Landing, or Walton Landing during the survey period.

TABLE 2.1-13 MAJOR EMPLOYERS WITHIN 10 MILES OF THE SEABROOK SITE AND ESTIMATED NUMBER OF EMPLOYEES

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees [(1)]
Hampton			
J.D. Cahill Co.	Scott Road (N 4-5)	Polyethylene coated paperboard	40
Charles Greenman Co.	70 High Street (NNE 4-5)	Leather and rubber soles	14
Hampton Machinery	Exeter Road (N 4-5)	Tannery equipment repairing	30
Hopkin Hunt Co.	Colonial Circle (N 4-5)	Special industrial machinery	3
Palmer & Sicard	Lafayette Road (N 3-4)	Sheet metal for heating and ventilating	62
Pearse Leather	7 Kershaw Avenue (NNE 4-5)	Contract leather finishing	12
Foss Manufacturing	Foss Road (N 3-4)	Nonwoven textiles	12
Whites Welding	6 Kershaw Avenue (NNE 4-5)	Welding	1
Advanced Speaker	432 Lafayette Road (N 4-5)	Speakers	25
Exeter Instruments	70 High Street (NNE 4-5)	Medical instruments	5
Hampton Water Works	52 High Street (NNE 2-3)	Water and sewer	N/A
Wands Inc.	1 Lafayette Road (N 1-2)	Oil heating equipment	20
Wheelabrator-Frye Inc.	Liberty Lane	Pollution control	180

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees [1]
	(N 3-4)		
Garnet Lumber Co.	5 Dearborn Avenue (NNE 3-4)	Lumber	4
Merrill Lumber Co.	5 Dearborn Avenue (NNE 3-4)	Lumber	6
Mibo, Inc.	12 Evergreen Road (N 3-4)	Buckles and bows	6
Rockingham County Newspapers	Depot Square (NNE 3-4)	Newspaper publishing	12
Stark-MacDonald, Inc.	40 Sweetbriar Lane (N 3-4)	Leather material	2
TDR Electronics	625 Lafayette Road (NNE 3-4)	Time delay relays	7
Hampton Falls			
Golden Eagle Coppersmiths	Lafayette Road (N 1-2)	Weathervanes and lanterns	10
Stillmeadow Glass Works	Lafayette Road (NW 1-2)	Blown glass for labs	9
Kensington			
None			
North Hampton			
Arc-Way Welding	203 Lafayette Road (N 4-5)	Steel fabrication	1
Giant Lift Equipment Co. Inc.	136 Lafayette Road (N 4-5)	Vertical lift equipment	16
LTP Enterprises Inc.	34 Lafayette Road (N 4-5)	Structure fiberglass	10

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees [(1)]
Hampton Pattern Works	91 Post Road (N 5-6)	Wood and metal patterns	6
Seabrook			
Adhesive Machinery Corp. (Ornsteen Chemicals)	Folly Mill Road (WSW 2-3)	Hot melt adhesives and applicating equipment	38
Cargocaire Engineering Corp.	Route 107 (W 2-3)	Industrial dehumidifiers	20
Circle Machine Co.	Stard Road (W 1-2)	Shoe machinery	48
Hale Bros.	Stard Road (W 1-2)	Small chains	8
House of White Birches	Folly Mill Road (SW 1-2)	Publishing books and magazines	32
K. J. Quinn & Co.	Folly Mill Road (SW 1-2)	Industrial coatings and polyurathane elastomers	40
Rockingham Fireworks Manufacturing Co.	Lafayette Road (W 1-2)	Fireworks	4
Spherex Inc.	Walton Road (S 1-2)	Light duty wheels	75
Tower Press Inc.	Folly Mill Road (SW 1-2)	Magazine publishing	50
USM, Bailey Division	Lafayette Road (WSW 1-2)	Plastic, rubber and metal	930
Welpro Inc.	New Zealand Road (W 1-2)	Ladies shoes	350
Withey Press	Lafayette Road (SW 1-2)	Commercial printing	24

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees [1]
Protective Materials Corp.*	Folly Mill Road (WSW 2-3)	Firearms parts	25
D.G. O' Brien Inc.	1 Chase Park (W 1-2)	Electrical connector, atomic reactor parts	100
Amesbury Machine Shop	(W 1-2)		50
*Data from Town of Seabrook Planner			
South Hampton			
None			
Salisbury			
Austin Precision Tool	40 Ferry Street (S 4-5)	Precision parts and gages	4
Barton Corp.	40 Ferry Street (S 4-5)	Custom shipping boxes and crates	25
Manson Boat Works	68 Bridge Road (S 4-5)	Boat building and repairing	25
Tucker Machine Corp.	284 Elm St. Rte. 110 (SSW 4-5)	Screw machine products	10
Vaughn Corp.	386 Elm Street (SW 4-5)	Stonelined water heaters and tanks, solar heaters	65
Vaughn Woodworking Inc.	386 Elm Street (SW 4-5)	Wirebound boxes and crates	9
Weld Machine Corp.	47 Lafayette Road (SSW 2-3)	Machining, prototype hand screw milling	5
Elm Knoll Farm	240 Main Street (SW 3-4)	Lumber	3
Handicapped Artists	8 Sandy Lane (S 4-5)	Prints booklets, etc.	10

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees [1]
Amesbury			
Advanced Absorber Products	10 Morrill Street (SW 4-5)	Microwave absorbers and radomes	21
Amesbury Chair	63 Clinton Street (WSW 4-5)	Chairs	5
Amesbury Metal Product	39 Oakland Street (SW 4-5)	Metal stamping, fluorescent lighting fixtures, metal plating	100
Vulcan Plastic Inc.	Noel St. (SW 5-6)	Injection molder and finisher heels	200
Amesbury Tool & Die Corp.	24 Oakland Street (SW 4-5)	Tool and die stampings	11
Bartley Machine and Manufacturing	Water Street (SW 4-5)	Machinery parts	19
Bocra Engineering	R Street (WSW 4-5)	Special tools and dies, jigs and fixtures	24
Cado Fabricating	144 Elm Street (SW 4-5)	Transit cases, consoles (machine work only)	65
Cargocaire Engineering	6 Chestnut Street (SW 4-5)	Dehumidifiers, heat exchangers	150
New Plant Building	Monroe Street (SW 4-5)		150
Dalton Manufacturing	5 Clark Street (WSW 4-5)	Display fixtures and educational materials	6
Durasol Drug & Chemical	1 Oakland Street (SW 4-5)	Erasers, dental adhesives, cleaners	20
Henschel Corp.	14 Cedar Street (WSW 4-5)	Marine signal systems, communication systems	150

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees [1]
LeBaron-Bonney Co.	14 Washington (SW 4-5)	Upholstery and top product kits	55
MAT Reinforced Plastic	79 Elm Street (SW 4-5)	Molded fiberglass products	20
Merrimac Valley Foundry	58 Mill St. (SW 5-6)	Iron castings, brass, bronze aluminum	50
North Shore Weeklies	21 Elm Street (SW 4-5)	Newspapers and printing	60
Oakland Industries	11 Oakland Street (SW 4-5)	Sheet metal fabrication	35
R&G Manufacturing (Amesbury Chair)	63 Clinton Street (SW 4-5)	Metal kitchen cabinets	65
Reid Foundry	Mill Street (SW 5-6)	Grey iron castings	25
Sagamore Industrial Finishes	Rocky Hill Road (SW 4-5)	Industrial finishes	11
Scandia Plastic	36 High Street (WSW 5-6)	Extrusion of plastic tubing	32
Alexander Syvinski	38 Collins Avenue (SW 4-5)	Leather tanning and finishing	99
Dreamboat Corp.	10 Merrill Street (WSW 4-5)	Boat building and repairing	9
Whittier Press and North Shore Weeklies	21 Elm Street (SW 4-5)	Commercial printing	4
Brazonics, Inc.	Haverhill Road (SW 6-7)	Primary metals	80
Flexaust Company	Chestnut Street (SW 5-6)	Flexible hose	50

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees [1]
Haverhill Gas Company	Hunt Road (SW 6-7)	Natural gas	139
Maple Wood Products Co., Inc.	60 Merrimac Street (SW 5-6)	Toys and furniture	56
Michele Silverware & Jewelry Co., Inc.	36 Main Street (SW 5-6)	Jewelry	40
Microfab, Inc.	Haverhill Road (SW 6-7)	Printed circuit boards	190
Christesen Machine Co. Inc.	Haverhill Road (SW 6-7)	Machinery and parts	3
Country Kitchens	34 Pond Street (SW 5-6)	Kitchen and bath vanity cabinets	2
Denis Brass Foundry	250 Main Street (SW 5-6)	Brass and aluminum castings	10
R.E. Kimball & Co.	73 Merrimac Street (SW 5-6)	Jellies, jams, and relishes	3
Lowell's Boat Shop	459 Main Street (SW 5-6)	Boats	6
Erikson-Hedlund Stamponic Co.	39 Oakland Street (SW 4-5)	Tools, dies	8
The Old Newbury Crafters, Inc.	36 Main Street (SW 5-6)	Silverware	10
Merrimac			
Metal Finishing, Inc.	2 Littles Court (WSW 8-9)	Metal finishing	23
Engel-Lewis Counter Co, Inc.	Liberty Street (WSW 8-9)	Shoe counters	150

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees [1]
Will-Mor Engineering Co, Inc.	27 E. Main Street (WSW 8-9)	Tools and machine parts	15
Newbury			
Newburyport Press, Inc.	80 Hanover Street (S 7-8)	Printing	18
Parker River Marine	Route 1A (S 9-10)	Marine equipment	6
Newburyport			
A Rhodes Co., Inc.	46 Water Street (S 6-7)	Shirts	27
Amesbury Specialty Co., Inc.	Parker Street (S 6-7)	?	50
Bay State Carbide Tool Corp.	126 Merrimac Street (SSW 5-6)	Tools	30
Berkshire Manufactured Products, Inc.	116 Parker Street (SSW 6-7)	Precision stampings	75
Circle Finishing, Inc.	Rt. 1 Traffic Circle (S 7-8)	Plating	22
Coca-Cola Bottling Co.	504 Merrimac Street (SSW 5-6)	Bottling	19
Contherm Corp.	Newburyport Turnpike (S7-8)	Heat exchangers	37
Geonautics, Inc.	44 Merrimac Street (SSW 5-6)	Plastic molds	40
Gould, Inc.	374 Merrimac Street (SSW 5-6)	Fuses	500
Kemtron Electron	14 Prince Place	Electronic components	25

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees [1]
Products, Inc.	(S 6-7)		
Leary's Beverages, Inc.	504 Merrimac Street (SSW 5-6)	Bottling	80
M & V Electroplating Corp.	5 Greenleaf Street (S 6-7)	Electroplating	64
Newbury Tanning Corp.	12 Federal Street (S 6-7)	Leather finishing	80
Newburyport Daily News	23 Liberty Street (S 6-7)	Newspaper publishing	30
Owens-Illinois, Inc.	Parker Street (SSW 6-7)	Plastic products	200
S. Starensier, Inc.	5 Perkins Way (SSW 6-7)	Fabrics	99
Stride Rite Corp.	Perkins Way (SSW 6-7)	Footwear	100
Towle Mfg. Company	200 Merrimac Street (SSW 5-6)	Silverware	1800
Waverly News Co., Inc.	17 State Street (S 6-7)	Printing	22
Essex Tool & Die, Inc.	Bridge Road (SSW 5-6)	Precision tools and dies	5
International Light Inc.	Dexter Industrial Green (SSW 6-7)	Electro-optical instrumentation	19
Littlefield Press	2 Federal Street (S 6-7)	Commercial printing	9
Piel Craftsmen Co.	307 High Street (SSW 5-6)	Ship models	2
Rivco, Inc.	10 Prince Place (S 6-7)	Rivet setting tools	5

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees [1]
Stem Chemicals, Inc.	7 Mulliken Way (SSW 7-8)	Chemicals	16
Lewis D. Bartley	7 Spofford Street (SSW 5-6)	Metal stampings	3
Alfa-Laval, Inc.	Route l (SSW 6-7)	Heat exchangers	37
West Newbury			
None			
Exeter			
Alrose Shoe Co., Inc.	1 Rockingham Street (NW 8-9)	Footwear	150
Brockhouse Corporation	Exeter Industrial Park (NW 8-9)	Metal fabrication	200
Chemtan Co., Inc.	Hampton Road (NW 7-8)	Leather chemicals	20
Clemson Automotive Fabrics	Chestnut Street (NW 7-8)	Textile finishing	200
Exeter Footwear, Inc.	93 Court Street (NW 7-8)	Women's footwear	100
Exeter Machine Products	Court Street (NW 7-8)	Screw machine products	22
Exeter News-Letter Co.	255 Water Street (NW 7-8)	Newpaper publisher	58
Blue Ribbon Sports, Inc.	156 Front Street (NW 8-9)	Sport shoes	110
GTE Sylvania, Inc.	Portsmouth Avenue (NNW 7-8)	Electrical equipment	500

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees [1]
Ideal Tape Co.	Industrial Park, Off Epping Road (NW 8-9)	Tapes and adhesives	12
Prescott RE Mfg. Co., Inc.	10 Railroad (NW 8-9)	Pump equipment	12
Vaporpak, Inc.	Hampton Road (NW 7-8)	Fuel Catalyst System	20
Hampshire Controls	P.O. Box M (NW 7-8)	Electronic controls	N/A
Curtain Shop	43 Water Street (NW 7-8)	Draperies	5
Drew-It Corp.	256 Front Street (NW 8-9)	Can-crushers	5
Miljo Chemical Co., Inc.	94 Epping Road (NW 8-9)	Leather coatings	3
Squamscott Press	17 Court Street (NW 7-8)	Printing	2
Tyco Laboratories Inc.	Tyco Park (NW 7-8)	Electronic	33
Exeter & Hampton Electric Co.	225 Water Street (NW 7-8)	Electric light and power	139
Freedom Shoe Co., Inc.	15 Front Street (NW 7-8)	Sport shoes	N/A
Milliken & Company	Chestnut Street (NW 7-8)	Industrial cotton finishing	200
Wise Shoe Co., Inc.	156 Front Street (NW 8-9)	Shoes	300
Raw Thong Corp.	96 High Street (NW 7-8)	Rawhide laces	8

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees [1]
Donnelly Mfg. Co.	Industrial Park, Epping Road (NW 8-9)	Sheet metal fabrication	N/A
Import Leather, Inc.	Industrial Park, Epping Road (NW 8-9)	Leather imports	N/A
Laurel Farms Dairy, Inc.	Pickpocket Road (NW 8-9)	Dairy	13
Regall Coatings, Inc.	94 Epping Road (NW 8-9)	Coatings for plastics	4
Greenland			
GTE Sylvania, Inc.	Route 101 (N 10)	Glass tubing	74
Ocean and Forest Products Co.	755 Portsmouth Ave. (N 9-10)	Sweeping compounds	7

(1) Sources
a. Directory of Massachusetts Manufacturers: 1981-82 Edition, George D. Hall Company, 1981
b. Directory of New England Manufacturers: 1980, New England Council, 1980
c. MacRae's New Hampshire State Industrial Directory: 1982, MacRae's Blue Book, Inc., 1981
d. Exeter, N.H. Industrial & Manufacturer's Guide and Exeter Grown Products, Exeter Area Chamber of Commerce, 1981

TABLE 2.1-14 SCHOOLS WITHIN 10 MILES OF THE SEABROOK SITE

TOWN	SCHOOL	GRADES	DISTANCE & DIRECTION (SECTOR)	(B) NO. OF STUDENTS	(C) NO. OF TEACHERS	(D) NO. OF STAFF	(A) TOTAL FALL 1979 POPULATION (B+C+D=A)
Hampton	Aslans' Pride Nursery School 200 High Street	N	NNE 3m (NNE 2-3)	20 - 3 da/wk 18 - 2 da/wk 38 students	3	0	41
Hampton	Center Elementary Sch. Winnacunnet Road	K-4	NNE 2½m (NNE 2-3)	351	25	12	388
Hampton	Marston Elementary Off of High Street	1-4	NNE 3m (NNE 2-3)	290	22	10	322
Hampton	Hampton Academy Jr. High School 29 Academy Avenue	5-8 s.p.	NNE 3m (NNE 2-3)	537	37	16	590
Hampton	Winnacunnet Coopera-tive High School Landing Road	9-12	NNE 2½m NNE(2-3)	88	36	1,442	1,318
Hampton	Sacred Heart Elementary	1-8	NNE 3m (NNE 2-3)	212	8	27	247
Hampton Falls	Hampton Falls Kinder-garten & Nursery Sch. Rt. 84	N&K	NW 1½m (NW 1-2)	38	3 full-time 1 part-time	0	42

TOWN	SCHOOL	GRADES	DISTANCE & DIRECTION (SECTOR)	(B) NO. OF STUDENTS	(C) NO. OF TEACHERS	(D) NO. OF STAFF	(A) TOTAL FALL 1979 POPULATION (B+C+D=A)
Hampton Falls	Lincoln-Ackerman Elementary Exeter Road	1-8	NW 1½m (NW 1-2)	178	15	12	205
Kensington	Kensington Elementary	1-6	WNW 5m (WNW 4-5)	156	6 full-time 9 part-time	17	188
North Hampton	Busy Beaver Kinder-garten 17 Pine Street	K	NNE 5m (NNE 4-5)	23 (divided into 2 shifts)	2	0	25
North Hampton	Montessori School of Creative Learning 229 Atlantic Avenue	Up to 14 years old	N 5½m (N 5-6)	25 morning 15 afternoon	2	3-5	47
North Hampton	N. Hampton Elementary Atlantic Ave	K-8	NNE 5¼m (NNE 5-6)	459	35	17	511
Seabrook	Seabrook Elementary and Jr. High Walton Road	K-8	S 1¼m (S 1-2)	671	44	24	739
South Hampton	Barnard Elementary Jewell Street	K-8	WSW 6m (WSW 5-6)	89	9	3	101
Amesbury	Amesbury Elementary S. Hampton Road	1-4	WSW 5m (WSW 4-5)	527	21	43	591

TOWN	SCHOOL	GRADES	DISTANCE & DIRECTION (SECTOR)	(B) NO. OF STUDENTS	(C) NO. OF TEACHERS	(D) NO. OF STAFF	(A) TOTAL FALL 1979 POPULATION (B+C+D=A)
Amesbury	Amesbury Middle Sch. Main Street	6-8	SW 5½m (SW 5-6)	701	43	26	770
Amesbury	Amesbury High School Highland Street	9-12	SW 5½m (SW 5-6)	840	5	22	927
Amesbury	Horace Mann School Congress Street	K	SW 4½m (SW 4-5)	207 (divided into 2 shifts)	12	4	223
Amesbury	Amesbury Country Day School 186 Market	Pre K & K	WSW 4½m (WSW 4-5)	125 (divided into 3 shifts)	4	2	131
Amesbury	Seventh Day Advent-ists School Monroe Street	1-8	SW 5m (SW 4-5)	14	1	3	18
Amesbury	Charles C. Cashman Friend Street	1-5	WSW 5¾m (WSW 5-6)	641	32	24	697
Salisbury	Kiddie Corner Nursery 16 John Street	N	SW 2½m (SW 2-3)	32	2	0	34

TOWN	SCHOOL	GRADES	DISTANCE & DIRECTION (SECTOR)	(B) NO. OF STUDENTS	(C) NO. OF TEACHERS	(D) NO. OF STAFF	(A) TOTAL FALL 1979 POPULATION (B+C+D=A)
Amesbury	Harbor Schools, Inc. (2 units) Pleasant Valley Rd.	Special	SW -7¼m (SW 7-8)	20	5	0	25
Amesbury	Miss Rose's Child Care Center Rte. 110 & Main Street	N-K + Daycare	SW 5½m (SW 5-6)	68	6	0	74
Salisbury	Salisbury Memorial Sch. (also called Jacob F. Spalding) Maple Street	K-6	S 4m (S 3-4)	654	28	19	701
Salisbury	Salisbury Plains School Main Street	K	SW 3m (SW 2-3)	90	3	0	93
Merrimac	Helen R. Donaghue School Union Street	3-6	WSW 9¼m (WSW 9-10)	323	23	3	347
Merrimac	Merrimac Child Care Center High Street	K	SW 8¾m (SW 8-9)	24	3		27
Merrimac	Red Oak School Church Street	K-3	SW 9¼m (WSW 9-10)	211	29		240

TOWN	SCHOOL	GRADES	DISTANCE & DIRECTION (SECTOR)	(B) NO. OF STUDENTS	(C) NO. OF TEACHERS	(D) NO. OF STAFF	(A) TOTAL FALL 1979 POPULATION (B+C+D=A)
Haverhill	Rocks Village School	K-3	SW 10m (SW 9-10)	27	2	1	30
Newbury	Newbury Elementary 63 Hanover Street	K-6	S 7½m (S 7-8)	382	15	8	405
Newbury	Woodbridge School Graham Avenue	1-2	S-7m (S 7-8)	91	4	3	98
Newbury	Harbor School 24 Rolfe's Lane	Special	S 6¾m (S 6-7)	22	6		28
Newbury	Harbor School 28 Rolfe's Lane	Special	S 6¾m (S 6-7)	24	7		31
Newburyport	Belleville School 333 High Street	K-4	SSW 6½m (SSW 6-7)	577	28	2	607
Newburyport	George W. Brown School Milk Street	K-4	S 6½m (S 6-7)	322	17	2	341
Newburyport	Davenport School Congress Street	K-4	SSW 6m (SSW 6-7)	105	5	2	112
Newburyport	Kelley School 149 High Street	K-4	SSW 6¼m (SSW 6-7)	116	7	2	125

TOWN	SCHOOL	GRADES	DISTANCE & DIRECTION (SECTOR)	(B) NO. OF STUDENTS	(C) NO. OF TEACHERS	(D) NO. OF STAFF	(A) TOTAL FALL 1979 POPULATION (B+C+D=A)
Newburyport	Ruppert A. Nook Middle Sch. Low Street	5-8	SSW 6½m (SSW 6-7)	966	68	17	1,051
Newburyport	Newburyport High School 241 High Street	9-12	SSW 6m (SSW 6-7)	871	56	15	942
Newburyport	Immaculate Conception Green & Washington Streets	1-8	S 6½m (S 6-7)	182	NA	Approx.---20	202
Newburyport	Living & Learning School 151 Low Street	N-K	SSW 6½m (SSW 6-7)	90	13		103
Newburyport	Mrs. Haley's Pre-school 29 Marlboro Street	N-K	S 6½m (S 6-7)	NA	NA		NA
Newburyport	My School YMCA - State Street	N-K	S 6½m (S 6-7)	24	4		28
Newburyport	Spring Street School 6 Parsons Street	N-3	S 6½m (S 6-7)	39	6		45
Newburyport	The First School 893 Main St., W. Newbury	K-3	SW 7½m (SW 7-8)	11		2 (will expand 3-4 per year)	13

TOWN	SCHOOL	GRADES	DISTANCE & DIRECTION (SECTOR)	(B) NO. OF STUDENTS	(C) NO. OF TEACHERS	(D) NO. OF STAFF	(A) TOTAL FALL 1979 POPULATION (B+C+D=A)
Newburyport	The Children's House 23 Chapel Street	N-K	SSW 5¾m (SSW 5-6)	24	3		27
Newburyport	Mrs. Murray's Nursery Sch. 13 Federal Street	N-K	S 6¼m (S 6-7)	60	4		34
Greenland	Central School Post Road	1-8	N 9¼m (N 9-10)	312	20	6	338
W. Newbury	Central Grammar School 381 Main Street	1, 2	SW-10m (SW 9-10)	141	7	5	153
W. Newbury	Dr. Page School 694 Main Street	3-6	SW 8¼m (SW 8-9)	228	12	7	247
Rye	Elementary School 461 Sagamore Road	1-5	NNE 10m (NNE 9-10)	200	20		220
Rye	Rye Junior High School 501 Washington Road	6-8	NNE 9¼m (NNE 9-10)	300	20		320
Stratham	Memorial School Bunker Hill Avenue	1-6	NNW 8½m (NNW 8-9)	251	17	7	275
Stratham	Acorn School Winnicut Road	K-3	N 8½m (N 8-9)		4	(May Expand)	55

TOWN	SCHOOL	GRADES	DISTANCE & DIRECTION (SECTOR)	(B) NO. OF STUDENTS	(C) NO. OF TEACHERS	(D) NO. OF STAFF	(A) TOTAL FALL 1979 POPULATION (B+C+D=A)
E. Kingston	Elementary School Andrews Lane	3-6	WNW 8½m (WNW 8-9)	92	9		101
E. Kingston	Brown's Academy	1, 2	WNW 8½m (WNW 8-9)	35	2		37
Newton	Teddy Bear Nursery School 40 Highland Road	N	W 10m (W 9-10)	54	4		58
Exeter	Montessori School of Exeter 8 Center Street	N-K	NW 7⅔m (NW 7-8)	40	4	(May Expand)	44
Exeter	Rockingham School for Special Children 40 Lincoln Street	Special	NW 7¼m (NW 7-8)	41	NA	NA	NA
Exeter	Richie-McFarland Children's Center, II Prospect Ave.	2-6 yrs.	NW 7¼m (NW 7-8)	20	4	3	27
Exeter	Philips-Exeter Academy	9-12	NW 7¼m (NW 7-8)	970	125	NA approx. 100	1,195
Exeter	Exeter Day Care Center 261 Water Street	N	NW 8m (NW 7-8)	45	9		54

TOWN	SCHOOL	GRADES	DISTANCE & DIRECTION (SECTOR)	(B) NO. OF STUDENTS	(C) NO. OF TEACHERS	(D) NO. OF STAFF	(A) TOTAL FALL 1979 POPULATION (B+C+D=A)
Exeter	Exeter Day School 6 Marlboro Street	3-5 yrs.	NW 7¼m (NW 7-8)	125	8		132
Exeter	Exeter Elementary School Lincoln Street	1 & 2 3 - 6	NW 7½m (NW 7-8)	672 271	75 50		742 321
Exeter	High School Linden Street	9-12	NW 7½m (NW 7-8)	1,305	90		1,395
	Vocational High School (Planned Opening 9/80)	11 & 12	NW 7½m (NW 7-8)	690 max.- 2 sessions	20-40	12	742
Exeter	Jr. High School	6-8	NW 7½m	630	50		680
Exeter	Main Street School Main Street	1,2 special	NW 7½m (NW 7-8)	291	20		311
Exeter	School Street School School Street		NW 7¾m (NW 7-8)	Current Use	Office Space		
Exeter	ABC Preschool 16 Ridgecrest Drive	3-6 yrs.	NW 7¾m (NW 7-8)	32	2		34
Exeter	Child Garden Country Day 9 Chestnut Street	K-3	NW 7¾m (NW 7-8)	NA	NA		NA

TABLE 2.1-15 MEDICAL RELATED FACILITIES WITHIN 10 MILES OF THE SEABROOK PLANT

Name and Type	Location (Sector)	Bed Capacity (Estimated Population)	Planned Expansion
	NEW HAMPSHIRE		
	Hampton		
Odyssey House (Medical and Therapeutic Treatment)	30 Winnacunnett (NNE 2-3)	40 adolescents, 15 staff (55 persons)	None
Seacoast Health Center Inc. (nursing home)	22(NNE 3-4) Tuck Rd	76 beds, staff estimate NA (77 persons)	None
	Exeter		
Exeter Hospital	10 Buzell Ave. (NW 7-8)	100 beds (110 beds), 400 staff (510 persons)	None
Court Street Unit	131 Court St. (NW 7-8)	100 beds, 100 staff (200 persons)	None
Eventide Home	81 High St. (NW 7-8)	21 beds, 12 nurses, 13 staff (46 persons)	None
Goodwin's of Exeter	Hampton Rd. (NW 7-8)	75 beds, 75 staff (150 persons)	None
	MASSACHUSETTS		
	Salisbury		
Greenleaf House Nursing Home	335 Elm St. (SSW 4-5)	60 beds, 60 staff (120 persons)	None
	Amesbury		
Amesbury Hospital	Highland Ave. (SW 5-6)	63 bed max., 47 avg., 230 staff (Total 293)	None
Amesbury Nursing and Retirement Home	22 Maple St. (WSW 5-6)	124 beds, 110 staff (234 persons)	None
Hillside Nursing Home	29 Hillside (SW 5-6)	26 beds, 8 staff (34 persons)	None
Maplewood Manor Nursing Home	Morrill Pl. (SW 5-6)	120 beds, 100 staff (220 persons)	None
Eastwood Rest Home	39 High St. (SW 5-6)	33 beds, 12 staff (45 persons)	None
North Eastwood Rest Home	276 Main (SW 5-6)	20 beds, 10 staff (26 persons)	Possible expansion of 17

Name and Type	Location (Sector)	Bed Capacity (Estimated Population)	Planned Expansion
			beds, 10 staff
Parkside Rest Home	56 Sparhawk (SW 5-6)	30 beds, 8 staff (38 persons)	None
	Newburyport		
Anna Jacques Hospital	Highland Ave. (SSW 6-7)	104 beds, 520 staff (624 persons)	33 bed med/ surg. addition sched.to begin 3/ 1/80
Brigham Manor Nursing Home	77 High St. (S 6-7)	64 beds, 60 staff (124 persons)	None
Country Manor Convalescent Home, Inc	Low St. (SSW 6-7)	123 beds, 100 staff (223 persons)	None
Newburyport Manor Chronic Hospital	Low & Hale St. (SSW 6-7)	102 beds, 100 staff (202 persons)	None
Worcester Park Nursing Home	351 High St. (SSW 5-6)	68 beds, 56 staff (124 persons)	None
Home for Aged Men (Newburyport Society)	361 High St. (SSW 5-6)	9 residents, 8 full and part-time staff (17 persons)	None
Line House Treatment Center	37 Washington (SSW 6-7)	12 beds, 5 staff (17 persons)	None
Home for Aged Women (Newburyport Society)	75 High St. (S 6-7)	10 residents, 9 full and part-time staff (19 persons)	None

TABLE 2.1-16 ESTIMATE OF 1970 SEASONAL UNITS FOR COUNTIES WITHIN 50 MILES

County	Population	All Housing Units	Vacant-- Seasonal & Migratory
MASSACHUSETTS			
Essex	637,887	216,201	5,540
Middlesex	1,397,268	431,012	766
Suffolk	735,190	264,471	249
Norfolk	605,051	181,192	561
Plymouth	333,314	110,662	9,182
Worcester	637,969	204,083	2,931
NEW HAMPSHIRE			
Carrol	18,548	14,838	5,830
Belknap	32,367	16,230	3,604
Merrimack	80,925	29,250	2,607
Hillsborough	223,941	74,666	2,126
Strafford	70,431	23,874	1,810
Rockingham	138,951	53,132	8,274
MAINE			
York	111,576	48,530	9,373

Source: 1970 U.S. Census of Housing, Maine, Massachusetts, and New Hampshire (Table 60).

TABLE 2.1-17 **EMPLOYMENT STATISTICS BY PLACE OF RESIDENCE**

County	1940 Total Employment	1970 Total Employment	1970 Total Employment Inside 50-Mile Radius
MAINE			
York	31,191	44,780	33,585
MASSACHUSETTS			
Essex	181,438	263,698	263,698
Middlesex	337,385	586,238	480,715
Norfolk	116,659	250,241	77,574
Plymouth	58,289	127,539	8,928
Suffolk	300,915	309,594	309,594
Worcester	181,080	266,609	2,666
NEW HAMPSHIRE			
Belknap	8,247	13,235	5,426
Carroll	4,805	7,298	365
Hillsborough	54,132	92,818	44,553
Merrimack	20,935	33,137	15,574
Rockingham	20,616	56,820	56,820
Strafford	16,489	28,823	28,823
		TOTAL	1,328,321

Source: Regional Employment by Industry, 1940-1970, U.S. Department of Commerce

TABLE 2.1-18 **SUMMARY OF 1980 PEAK TRANSIENT POPULATION ESTIMATES WITHIN 0 TO 10 MILES OF THE SITE**

			0-5 Miles	5-10 Miles	0-10 Miles
(1)	Seasonal Resident				
	(a)	Weekend Day	30,500	12,512	43,012
	(b)	Weekday	(21,669)	(8,886)	(30,555)
(2)	Overnight Visitors				
	(a)	Hotels, Motels and Guest houses	10,019	1,005	11,024
	(b)	Camping	3,160	4,488	7,648
(3)	Daily Transient				
	(a)	Fee and Free Lots and Metered On- Street Parking	30,441	12,233	42,674
	(b)	"On-Street" Parking	10,246	2,384	12,630
Total Seasonal Resident, Overnight Visitors and Daily Transients			84,366	32,622	116,988
Total Permanent Population 1980			32,060	68,660	100,720
Total Peak Transient & Permanent Population			116,426	101,282	217,708

TABLE 2.1-19 **PROJECTED RESIDENT POPULATION WITHIN THE LOW POPULATION ZONE**

	Year	0-1 Mile	1-1.25 Miles	Totals 0-1.25 Miles
N	1980	20	0	20
	1983	20	0	20
	1990	20	0	20
	2000	20	0	20
	2010	20	0	20
	2020	20	0	20
	2025	20	0	20
NNE	1980	0	0	0
	1983	0	0	0
	1990	0	0	0
	2000	0	0	0
	2010	0	0	0
	2020	0	0	0
	2025	0	0	0
NE	1980	0	0	0
	1983	0	0	0
	1990	0	0	0
	2000	0	0	0
	2010	0	0	0
	2020	0	0	0
	2025	0	0	0
ENE	1980	0	0	0
	1983	0	0	0
	1990	0	0	0
	2000	0	0	0
	2010	0	0	0
	2020	0	0	0
	2025	0	0	0
E	1980	0	0	0
	1983	0	0	0
	1990	0	0	0
	2000	0	0	0
	2010	0	0	0
	2020	0	0	0
	2025	0	0	0
ESE	1980	0	0	0
	1983	0	0	0

	Year	0-1 Mile	1-1.25 Miles	Totals 0-1.25 Miles
	1990	0	0	0
	2000	0	0	0
	2010	0	0	0
	2020	0	0	0
	2025	0	0	0
SE	1980	0	0	0
	1983	0	0	0
	1990	0	0	0
	2000	0	0	0
	2010	0	0	0
	2020	0	0	0
	2025	0	0	0
SSE	1980	10	0	10
	1983	10	0	10
	1990	20	0	20
	2000	20	0	20
	2010	20	0	20
	2020	30	0	30
	2025	30	0	30
S	1980	120	70	190
	1983	140	80	220
	1990	170	100	270
	2000	210	120	330
	2010	250	140	390
	2020	310	170	480
	2025	340	190	530
SSW	1980	250	70	320
	1983	280	80	360
	1990	340	100	440
	2000	410	120	530
	2010	500	140	640
	2020	610	170	780
	2025	680	190	870
SW	1980	60	260	320
	1983	60	280	340
	1990	80	350	430
	2000	100	420	520
	2010	120	520	640
	2020	140	630	770

	Year	0-1 Mile	1-1.25 Miles	Totals 0-1.25 Miles
	2025	160	700	860
WSW	1980	0	70	70
	1983	0	80	80
	1990	0	100	100
	2000	0	120	120
	2010	0	150	150
	2020	0	180	180
	2025	0	200	200
W	1980	110	510	620
	1983	120	570	690
	1990	140	630	770
	2000	170	710	880
	2010	210	810	1,020
	2020	260	920	1,180
	2025	290	1,000	1,290
WNW	1980	170	90	260
	1983	180	90	270
	1990	190	110	300
	2000	210	110	320
	2010	240	110	350
	2020	270	110	380
	2025	280	110	390
NW	1980	20	40	60
	1983	30	40	70
	1990	30	50	80
	2000	30	50	80
	2010	30	50	80
	2020	30	50	80
	2025	30	50	80
NNW	1980	30	80	110
	1983	30	80	110
	1990	30	100	130
	2000	30	100	130
	2010	40	100	140
	2020	40	100	140
	2025	40	100	140

	Year	0-1 Mile	1-1.25 Miles	Totals 0-1.25 Miles
Totals	1980	790	1,190	1,980
	1983	870	1,300	2,170
	1990	1,020	1,540	2,560
	2000	1,200	1,750	2,950
	2010	1,430	2,020	3,450
	2020	1,710	2,330	4,040
	2025	1,870	2,540	4,410

TABLE 2.1-20 MAJOR TRANSIENT POPULATION ELEMENTS WITHIN THE LOW POPULATION ZONE

Facility Name or Description	Estimated Distance and Direction	Peak Occupancy* or Population
Bailey Division	1 mile--WSW	1,000
Shopping Center	1 mile--W	1,400
Shopping Center	1¼ miles--SW	1,800
Seabrook Elementary And Jr. High School	1¼ miles--S	739
Hawaiian Garden Motor Inn	1 mile--W	52
Sleepy Hollow Motel	1¼ miles--WSW	34
Village Motel	1¼ miles--WSW	22
Spruce Manor	1¼ miles--WSW	34

* 1978 Estimates

TABLE 2.1-21 CUMULATIVE RESIDENT POPULATION DENSITY

Distance (Miles)	Density (Persons Per Square Mile) 1983	2025
0-1	277	596
0-2	532	1155
0-3	525	1043
0-4	443	836
0-5	442	802
0-10	342	685
0-20	294	490
0-30	406	575
0-40	527	706
0-50	505	658

TABLE 2.2-1 SUMMARY OF HAZARDOUS MATERIALS USAGE

	Facility	Location Direction-Miles	Hazardous Materials Status
1.	Bailey Corporation*	WSW 1-2	Storage for 60,000 gals. liquid propane. 10,000 gals. paint.
2.	Rockingham Fireworks*	W 1-2	Storage capacity for 20,000 lbs. of low explosives.
3.	K.J. Quinn & Company*	SW 1-2	Storage for 44,000 gals. of chemicals and solvents.
4.	Sagamore Industrial Finishes*	SW 4-5	Storage for 17,000 gals. of paints, thinners and finishes.
5.	Hysol Aerospace Industries*	WSW 2-3	Bulk quantities (100,000 lbs.) of nitrogen and freon; unspecified solvents, corrosives, and flammables.
6.	Amesbury Metal Products	SW 4-5	Limited quantities of solvents, oils and paints used or stored.
7.	Advanced Absorber Products	SW 4-5	Limited quantity of solvent used or stored.
8.	NANCO*	SW 4-5	Storage for 90,000 lbs. of industrial gases.
9.	Craig System Division	SW 4-5	Limited quantities of flammables, corrosives, and compressed gases used or stored.
10.	Eastern Manufacturing Corp.	SW 4-5	Limited quantities of solvents, corrosives and ammonia used or stored.

	Facility	Location Direction-Miles	Hazardous Materials Status
11.	Tech Ceram	SW 4-5	Limited quantities of solvents, ammonia and acid used or stored.
12.	Aqua Laboratories	SW 4-5	Limited quantities of flammables and corrosives used or stored.
13.	Vaughn Manufacturing Corp.	SW 4-5	Tank storage (18,000 - 24,000 lbs.) of urethane.
14.	Foss Manufacturing	N 3-4	Drum storage of flammables, corrosives, and oxidizers (1,200 gallons).
15.	Morton Thiokol, Inc.	SW 1-2	Limited quantities of solvents and propane used or stored; bulk storage of 55,000 gals. of polymers.

* Bulk storage of potentially hazardous materials.

TABLE 2.2-2 LIST OF MANUFACTURING FIRMS WITHIN FIVE MILES OF THE SITE

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees
New Hampshire Manufacturers			
Hampton			
J.D. Cahill Co.	Scott Road (N 4-5)	Polyethylene coated paperboard (2649)	40
Foss Manufacturing*	380 Lafayette Road (N 3-4)	Nonwoven textiles (2297)	190
Whites Welding	6 Kershaw Avenue (NNE 4-5)	Welding (3446)	3
Wands Inc.	1 Lafayette Road (N 1-2)	Hydraulic fuel & electronic controls (3622)	17
Rockingham County Newspapers	Depot Square (NNE 3-4)	Newspaper publishing (2711)	12
Adhesive Technologies	3 Merrill 2nd Drive (N 3-4)	Hot melt adhesives/glues (2891, 3423)	40

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees
Carpenter Associates, Inc.	40 Timber Swamp Road (NW 3-4)	Millwork, woodworking (2431, 2434)	25
QA Technology Company, Inc.	4 Merrill 2nd Drive (N 3-4)	Spring contact probes (3825)	19
Hampton Falls			
Golden Eagle Coppersmiths	Lafayette Road (N 1-2)	Copper weathervanes and lanterns (3645)	10
Stillmeadow Glass Works	Lafayette Road (NW 1-2)	Blown glass for labs (3231)	4
Kensington			
None			
North Hampton			
None			

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees
Seabrook			
Hysol Aerospace Industries*	1 Dexter Road (WSW 2-3)	Hot melt adhesives and sealants (2891, 3559)	120
Hale Bros.	Stard Road (W 1-2)	Small chains (3496)	7
House of White Birches	Folly Mill Road (SW 1-2)	Publishing books and magazines (2731)	30
K.J. Quinn & Co.*	34 Folly Mill Road (SW 1-2)	Industrial coating materials (2821)	40
Rockingham Fireworks / New Hampshire Pyro Products, Inc.*	Lafayette Road (W 1-2)	Fireworks (2899)	4
Spherex Inc.	Walton Road (S 1-2)	Light duty wheels (3499)	75

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees
Bailey Corporation*	700 Lafayette Road (WSW 1-2)	Plastic, rubber and metal (3465, 3079)	1200
Withey Cook Associates	248 Lafayette Road (SW 1-2)	Commercial printing (2752)	16
Protective Materials Company, Inc.	Folly Mill Road (WSW 2-3)	Bulletproof materials (3231)	40
D.G. O'Brien Inc.	1 Chase Park (W 1-2)	Electrical connector (3643, 3621)	150
Amesbury Machine Manufacturing	142 Batchelder Road (W 1-2)	Rim clamps (3559)	30
Bocra Industries	Batchelder Road (WSW 2-3)	Special tools and dies (3599)	23

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees
Exeter Instruments	148 Batchelder Road	Medical instruments (3841)	5
Morton Thiokol, Inc.* Chemical Division	Folly Mill Road (WSW 2-3)	Polyurethane elastomers (2821)	<100
South Hampton			
None			
Massachusetts Manufacturers			
Salisbury			
Austin Precision Tool	40 Ferry Street (S 4-5)	Precision parts and gages (3599)	8
Barton Corp.	40 Ferry Street (S 4-5)	Custom shipping boxes and crates (2441)	25

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees
Tucker Machine Corp.	284 Elm St. Rte. 110 (SSW 4-5)	Screw machine products (3451)	20
Vaughn Manufacturing Corp.*	386 Elm Street (SW 4-5)	Stonelined water heaters and tanks, solar heaters (3639, 2442)	100
Elm Knoll Farm	240 Main Street (SW 3-4)	Lumber (2421)	3
Cambridge Air System, Inc.	10 Fanaras Drive (SW 3-4)	Ventilating system components (3144)	35
Orbit Plastics Corp.	Fanaras Drive (SW 3-4)	Thermoformed plastic products (3089)	25
Amesbury			
Advanced Absorber Products*	10 Morrill Street (SW 4-5)	Microwave absorbers and radomes (3679)	21
Amesbury Chair	63 Clinton Street (WSW 4-5)	Chairs (2521)	65

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees
Amesbury Metal Products*	38 Oakland Street (SW 4-5)	Metal stamping, fluorescent lighting fixtures, metal plating (3491)	100
Bartley Machine and Manufacturing	Water Street (SW 4-5)	Machinery parts (3599)	70
Cado Fabricating	144 Elm Street (SW 4-5)	Transit cases, consoles (machine work only) (3444)	30
Cargocaire Engineering	79 Monroe Street (SW 4-5)	Dehumidifiers, heat exchangers (3564)	150
Craig System Division*	10 Industrial Way	Environmental Shelters (3449)	435
Durasol Drug & Chemical	1 Oakland Street (SW 4-5)	Erasers, dental adhesives, cleaners (2844)	20
LeBaron-Bonney Co.	14 Washington (SW 4-5)	Upholstery and top product kits (2842)	55
North Shore Weeklies	16 Millyard	Newspapers and printing	60

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees
	(SW 4-5)	(2711)	

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees
Oakland Industries	11 Oakland Street (SW 4-5)	Sheet metal fabrication (3312)	35
R&G Manufacturing (Amesbury Chair)	63 Clinton Street (SW 4-5)	Chairs, kitchen cabinets (2511, 2514)	120
Sagamore Industrial Finishes*	Rocky Hill Road (SW 4-5)	Industrial finishes (2843)	19
Whittier Press	110 Market Street (SW 4-5)	Commercial printing (2752)	5
Erikson-Hedlund Stamponic Co.	33 Oakland Street (SW 4-5)	Tools, dies (3599)	8

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees
NANCO*	Railroad Avenue (SW 4-5)	Industrial Gas Depot (4226)	20

Name of Firm	Address (Sector)	Type of Manufacturing	Approximate Number of Employees
Tech Ceram*	14 Cedar Street (SW 4-5)	Plastic Products (3089)	45
Aqua Laboratories*	8 Industrial Way (SW 4-5)	Testing Laboratory (8734)	15
Eastern Manufacturing Corp.*	2 Industrial Way (SW 4-5)	Electronic Circuit Boards (3699)	110

* Denotes facility follow up concerning hazardous materials.

TABLE 2.2-3 TABLE OF DISTANCES FOR STORAGE OF LOW EXPLOSIVES (CLASS B)

Pounds Over	Pounds Not Over	Inhabited Buildings Distance (Feet)	Public Rail- Road and Highway Distance (Feet)	Aboveground Magazine (Feet)
0	1,000	75	75	50
1,000	5,000	115	115	75
5,000	10,000	150	150	100
10,000	20,000	190	190	125
20,000	30,000	215	215	145
30,000	40,000	235	235	155
40,000	50,000	250	250	165
50,000	60,000	260	260	175
60,000	70,000	270	270	185
70,000	80,000	280	280	190
80,000	90,000	295	295	195
90,000	100,000	300	300	200
100,000	200,000	375	375	250
200,000	300,000	450	450	300

TABLE 2.2-4 TRAFFIC COUNT, PEASE AIR FORCE BASE 1979

Month	IFR Arrival	IFR Departure	Stg II	IFR Satellite	Over Flight	VFR Service	Total
Jan.	1,270	1,308	26	14	1,099	64	3,781
Feb.	1,431	1,620	25	7	1,179	60	4,322
Mar.	1,347	1,599	30	32	1,584	128	4,720
Apr.	1,303	1,579	31	26	1,510	283	4,732
May	1,429	1,647	46	41	1,623	348	5,134
June	1,340	1,626	86	34	2,660	377	6,123
July	1,171	1,373	32	49	2,470	365	5,460
Aug.	1,533	2,492	27	106	2,415	523	7,096
Sept.	1,113	1,465	48	60	2,413	438	5,537
Oct.	1,450	1,662	33	57	1,481	799	5,482
Nov.	1,195	1,291	21	27	1,322	492	4,348
Dec.	1,006	1,052	23	40	943	813	3,877
TOTAL	15,588	18,714	428	493	20,699	4,690	60,612

IFR Arrival - Any IFR arrival, practice or termination to Pease terminal control area.

IFR Departure - Any IFR departure from Pease terminal control area.

Stage II - VFR A/C landing or departing PAFB requesting spacing.

IFR Satellite - Pertains to instrument approach to satellite airports within the Pease terminal area.

Over Flight - Any VFR A/C requesting advisories and all IFR A/C below 5,000 feet within approximately 40 miles of PAFB (in general, A/C passing through the PAFB control zone).

VFR Service - A/C terminating or originating at the Pease terminal control area requesting advisories.

TABLE 2.2-5 INSTRUMENT APPROACHES AT PEASE AIR FORCE BASE

Type Aircraft	Sept(79)	Nov(79)	Dec(79)	Jan(80)	Feb(80)	Mar(80)	6 Month Total
FB-111A	221	366	298	386	406	413	2,090
KC-135	494	430	382	442	457	373	2,580
C-130	61	83	50	81	38	28	341
C-141	15	1	7	38	13	6	80
C-123, F4, C5A, P3, B57, B52	19	7	19	42	28	35	150
Other*	317	234	282	216	264	277	1,590
TOTAL	1,127	1,162	1,038	1,075	1,206	1,132	6,831

* Other indicates aircraft weighing equal to or less than 12,500 pounds.

TABLE 2.2-6 ANNUAL LANDINGS TO RUNWAY 34 (PEASE AIR FORCE BASE)

Type Aircraft	Total Approaches (6 months)	Annual Approaches	Expected Number of Approaches to Rwy. 34
FB-111A	2,090	4,180	2,352
KC-135	2,580	5,160	2,903
C-130	341	682	384
C-141	80	160	90
C-123, F4, C5A, P3, B57, B52	150	300	169

TABLE 2.2-7 ACCIDENT RATE BY AIRCRAFT TYPE - 1968 - 31 OCT 1979

YEAR	TOTAL HOURS FLOWN	NUMBER DESTROYED	ACCIDENT (DESTROYED) RATE/100,000 HRS
		FB-111A	
1968	0	0	0.0
1969	0	0	0.0
1970	3,973	1	25.2
1971	18,481	0	0.0
1972	23,186	0	0.0
1973	16,935	0	0.0
1974	18,821	0	0.0
1975	17,381	3	17.3
1976	17,822	1	5.6
1977	17,729	2	11.3
1978	16,469	0	0.0
1979	15,021	1	6.7
TOTAL	165,818	8	4.8
		C-130	
1968	593,976	6	1.0
1969	537,126	4	.7
1970	504,113	3	.6
1971	487,137	1	.2
1972	480,989	5	1.0
1973	399,605	1	.3
1974	360,549	3	.8
1975	365,181	2	.5
1976	336,592	0	0.0
1977	334,524	0	0.0
1978	348,168	5	1.4
1979	302,828	0	0.0
TOTAL	5,050,788	30	.6
		KC-135	
1968	502,467	5	1.0
1969	431,849	4	.9
1970	376,930	0	0.0
1971	372,410	2	.5
1972	438,029	1	.2
1973	329,410	1	.3
1974	296,320	1	.3
1975	266,522	1	.4
1976	259,785	2	.8
1977	262,304	2	.8
1978	271,819	0	0.0
1979	227,071	1	.4
TOTAL	4,034,916	20	.5

TABLE 2.2-8 DESTROYED AIRCRAFT BY PHASE OF OPERATION 1968 - 30 NOVEMBER 1979

YEAR	FB-111A	C-130	KC-135
1968		*Landing final	*Initial climb
		*Landing	Cruise
		*Landing roll	*Landing
		*Landing	*Takeoff roll
		*Landing	Descent
		*Landing	
1969		*Cruise	*Landing roll
		*Landing final	*Takeoff roll
		*Cruise	Cruise
		*Initial climb	Cruise
		*Initial climb	
1970	Landing approach	Prolonged climb	*Takeoff roll
		Cruise	
		Cruise	
1971		*Takeoff	Landing initial
			Cruise
1972		Landing	*Landing
		*Go-around	
		*Takeoff	
		*Takeoff	
1973		Prolonged climb	
1974		Initial climb	*Initial climb
		*Landing roll	
		Cruise	
1975	*Night formation (2 A/C)	*Initial climb	*Initial climb
	*Normal cruise	Cruise	
1976	Descent		Descent
			Descent
1977	Normal cruise		*Landing roll
	Normal cruise		Initial climb
1978		*Landing pattern	
		*Landing final	
		Landing pattern	
		Cruise	
		Landing pattern	
1979	*Normal cruise		Takeoff

* Indicates aircraft eliminated when calculating accident rate.

Note: A detailed description of the above accidents is available through Norton Air Force Base.

TABLE 2.2-9 GROSS WEIGHT OF FB-111A AT HIGH FIX (WARNI) (PEASE AIR FORCE BASE)

Minimum FB-111A Weight: 56,500 pounds

Maximum FB-111A Weight: 86,000 pounds

Average FB-111A Weight: 67,849 pounds

Number of FB-111A Weighting More Than 81,800 pounds = 4

Date and Weight of FB-111A Exceeding 81,800 pounds

21 Nov. 1979	86,000 pounds
27 Nov. 1979	83,700 pounds
15 July 1980	82,400 pounds
7 Aug. 1980	83,800 pounds

Annual Estimated Number Arriving at WARNI Weighing More Than 81,800 pounds = 12

Note: Flight Plans Examined (dates)

1 - 30 Nov. 1979

22 May - 31 May 1980

1 - 30 June 1980

1 - 31 July 1980

1 - 21 Aug. 1980

TABLE 2.2-10 PEASE SECTOR PEAK DAY AIR TRAFFIC COUNT[(1)] MAXIMUM AIRCRAFT TAKEOFF WEIGHT LESS THAN 80,000 POUNDS

AIRCRAFT TYPE	WEIGHT (LBS.)	CRUISING SPEED (MPH)	AVERAGE ALTITUDE (Ftx100)	NUMBER OBSERVED
BE99	4,717	254	83.0	20
AC69	9,400	278	250.0	1
PA31	6,500	248	66.6	25
DH6	12,500	210	78.0	10
MO20	2,740	185	60.0	1
LR25	15,000	534	350.0	6
PA2T	5,200	277	76.0	4
C172	2,550	153	70.0	3
PA28	2,325	146	63.3	4
H3	2,134	155	80.0	1
MU2	11,575	365	180.0	5
BE18	4,490	336	50.0	1
C500	4,309	647	90.0	2
AA5	2,400	160	70.0	1
N265	19,615	563	290.0	2
PA32	3,400	180	70.0	1
C337	4,630	195	65.0	2
C210	1,542	356	100.0	1
C206	3,600	169	50.0	2
K200	12,500	320	175.0	1
LR35	15,000	534	316.6	3
C340	5,990	267	190.0	1
BE60	6,775	275	150.0	1
MO21	2,575	169	110.0	1
C421	7,450	242	90.0	1
LR24	13,500	545	280.0	2
A4	24,500	646	155.0	2
F27	45,000	298	150.0	3
A6	60,400	477	230.0	1
T37	6,574	425	250.0	1
BE90	10,100	287	200.0	1
BE20	12,500	320	230.0	2
*L329	---	---	250.0	2
WW24	12,495	320	100.0	1
AC50	9,500	403	60.0	1
C501	11,850	403	70.0	1

* Weight is assumed to be more than 12,500 pounds.

(1) Date of peak air traffic count: July 27, 1979

TABLE 2.2-11 PEASE SECTOR PEAK DAY AIR TRAFFIC COUNT[1] MAXIMUM AIRCRAFT TAKEOFF WEIGHT EQUAL TO OR GREATER THAN 80,000 POUNDS

AIRCRAFT TYPE	WEIGHT(LBS.)	CRUISING SPEED (MPH)	AVERAGE ALTITUDE (Ftx100)	NUMBER OBSERVED
C141	344,900	350	362.7	13
B747	820,000	608	359.3	16
B727	209,500	599	252.0	18
B707	333,600	605	354.0	12
C5	764,500	541	336.6	4
DC10	572,000	573	350.0	10
DC8	350,000	565	318.5	9
IL62	363,760	560	376.6	3
L1011	496,000	500	276.6	3
VC15	335,000	581	390.0	1
P3	135,000	473	230.0	16
C130	155,000	375	260.0	1
DC9	121,000	564	190.0	1

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[1] Date of peak air traffic count: July 27, 1979

TABLE 2.2-12 BACKGROUND DATA – PROPANE SPILL PROBLEM

Parameter		Designation	Value	Units
A.	Propane Characteristics			
	Boiling point at ambient pressure	TB	-43.8[(1)]	°F
	Latent heat of vaporization	L	183.05[(1)]	Btu/lb.
	Density of liquid, @ 60° F	ρL	31.57[(1)]	lb./ft^3
	@ 105°F	ρLa	29.33[(1)]	lb./ft^3
	Density of gas, @ 60°F	ρg	0.118[(1)]	lb./ft^3
	@ 104°F	ρga	0.107[(1)]	lb./ft^3
	Specific heat of liquid, @ 1 atm	C_L	0.592	Btu/lb.-°F
	Gross heat of combustion, @ 60°F	Hc	23434[(1)]	Btu/lb.
	Flammability limits, (by volume)			
	Upper	λfl	0.021[(1)]	
	Lower	λfu	0.095[(1)]	
	Detonability limits, (by volume)			
	Lower	λdl	0.030[(2)]	
	Upper	λdu	0.068[(2)]	
	Flashing fraction, @ 104°F	f	0.478	
	Vapor pressure, @ 100°F	Pv	190	psia
B.	Meteorological Model			
	Wind speed	v		m/sec
	Mean windspeed - lowest windspeed class	v_{min}	0.75	m/sec
	Dispersion parameter -G stability	Cx	0.046[(3)]	$m^{.09}$
	- F ″	Cx	0.062[(3)]	$m^{.09}$
	- E ″	Cx	0.093[(3)]	m.^{09} $m^{0.0g}$
	- D ″	Cx	0.127[(3)]	m.^{09}
	- C ″	Cx	0.192[(3)]	m.^{09}

(1) From Reference 73

(2) From Reference 63

(3) From Reference 66

TABLE 2.2-13 CONCENTRATION AND METEOROLOGICAL DATA FOR PROPANE SPILL

Stability Class	Frequency in Sector (8549 observations)			Peak Onsite Concentration (Continuous Release)	Puff Release X_F (m)	R_F (m)	X_{Dl} (m)	X_{D2} (m)
	WSW	W	SW					
G	1.0075	0.0124	0.0047	0.129	3970	78.4	2275	3380
F	0.0123	0.0096	0.0066	0.070	2860	83.5	1640	2430
E	0.0361	0.0497	0.0298	0.028	1830	59.4	1050	1558
D	0.0253	0.0289	0.0236	0.013	1300	-	745	1110
C	0.0041	0.0048	0.0018	0.004	826	-	473	703

TABLE 2.2-14 **CONTINUOUS RELEASE ANALYSIS ASSUMPTIONS AND PARAMETERS FOR FLAMMABLE VAPOR CLOUDS**

Port Hudson	
Ground level temperature	34°F
Wind speed	8.4 ft/sec
Mass release	1.38×10^5 lb.
Average release rate	96.1 lb./sec
Flashing fraction	0.242
Release volume	31,500 gals
Meteorological conditions	Pasquill Category F
Pipeline pressure	942 psig
Bailey Hypothetical Event	
Ground level temperature	104°F
Wind speed	2.7 ft/sec
Mass release	2.35×10^5 lb.
Average release rate	82.9 lb./sec
Flashing fraction	0.478
Effective release rate	39.6 lb./sec
Release volume	60,000 gals
Meteorological conditions	Pasquill Category G
Propane vapor pressure	190 psia

* Midpoint of lowest wind speed range

TABLE 2.2-15 **PUFF RELEASE ANALYSIS PARAMETER VALUES**

Probability that a release will occur (P1)*	10^{-4} spills/year
Probability ignition will be delayed (P2)**	0.24 delayed ignitions per spill
Probability of ignition at a critical point (P5)	1.0
Probability of unacceptable damage per critical ignition for a deflagration (P6)	1.0
Probability of a detonation occurring per critical ignition, for a detonation (P6')***	0.28
Site Temperature	104°F
Propane Mass Release	2.35×10^5 lb.
Flashing Fraction	0.478
Propane Puff Weight (M)	1.12×10^5 lb.
Propane Vapor density at 104°F (Pga)	0.107 lb./ft^3
Detonability Limits of Propane	3.0 - 6.8% (Ref. 96)

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* Reference 70 gives an upper bound for boiler failures of 10^{-5} per year and Reference 98 gives the failure rate for fixed location chlorine tanks as 10^{-5} per year, excluding seismic events. A value of 10^{-4} per year is conservatively assumed.

** Study of rail car spills (Reference 70) shows that 76 percent of the spills ignited within 100 ft of the release, hence, a value of 0.24 delayed ignitions per spill.

*** Reference 71 suggests a detonation rate giving ignition of 0.28, which is considered conservative.

TABLE 2.2-16 PROBABILITY DATA FOR A WORST CASE DEFLAGRATION

(P2 = .24, P4 = 1, P5 = 1.0, P6 = 1.0) (WSW Sector)				
Stability Class	Frequency	Δ ψ (Degrees)	P3	P2,P3,P4,P5,P6
G	0.0075	5.09	0.45	$0.81x10^{-3}$
F	0.0123	5.28	0.47	$1.39x10^{-3}$
E	0.0361	4.42	0.39	$3.41x10^{-3}$
D		0		
			Total:	$5.61x10^{-3}$

TABLE 2.2-17 **PROBABILITY DATA FOR A WORST CASE DETONATION**

(P5 = .28, P2 = .24)

Sector(s)	Stability Class	Frequency (P2)	P4',P3'	P2,P2',P3,P4',P5'
WSW	G	0.0075	0.43	0.22×10^{-3}
(Direct)	F	0.0123	0.41	0.34×10^{-3}
	E	0.0361	0.27	0.65×10^{-3}
	D	0.0253	0.15	0.26×10^{-3}
Total		0.0253		1.47×10^{-3}
W, SW	G	0.0171	0.32	0.37×10^{-3}
(Adjacent)	F	0.0162	0.31	0.34×10^{-3}
	E	0.0795	0.20	1.07×10^{-3}
	D	0.0525	0.09	0.32×10^{-3}
			Total:	2.10×10^{-3}
ALL			Total:	3.60×10^{-3}

TABLE 2R-1 DIRECTION AND DISTANCE DATA

Release Point	Receptor Point	Release Height (ft)	Release Height (m)	Receptor Height (ft)	Receptor Height (m)	Distance (ft)	Distance (m)	Direction with respect to true north (degrees)
Plant Vent	East Intake	185	56.4	6.5	2.0	352.34	107.3	196
Plant Vent	CR Fire Exit Door	185	56.4	5	1.5	215.31	65.6	67
Plant Vent	Diesel Building Intake	185	56.4	28.5	8.7	246.52	75.1	65
Closest Containment Surface Point	East Intake	6.5	2.0	6.5	2.0	272.09	82.9	196
Closest Containment Surface Point	CR Fire Exit Door	5	1.5	5	1.5	135.06	41.1	67
Closest Containment Surface Point	Diesel Building Intake	28.5	8.7	28.5	8.7	166.27	50.6	65
RWST	West Intake	50	15.2	8.25	2.5	315.3	96.1	7
RWST	CR Fire Exit Door	50	15.2	5	1.5	75.54	23.0	151
RWST	Diesel Building Intake	50	15.2	28.5	8.7	77.97	23.7	127

Release Point	Receptor Point	Release Height (ft)	Release Height (m)	Receptor Height (ft)	Receptor Height (m)	Distance (ft)	Distance (m)	Direction with respect to true north (degrees)
Containment Personnel Hatch	East Intake	9.5	2.9	6.5	2.0	372.69	113.5	210
Containment Personnel Hatch	CR Fire Exit Door	9.5	2.9	5	1.5	149.95	45.7	49
Containment Personnel Hatch	Diesel Building Intake	9.5	2.9	28.5	8.7	181.88	55.4	50
Main Steam Line Closest Point	East Intake	20.58	6.3	6.5	2.0	202.5	61.7	210
Main Steam Line Chase (West) Panel (North)	CR Fire Exit Door	38.38	11.7	5	1.5	112.26	34.2	55
Main Steam Line Chase (West) Panel (North)	Diesel Building Intake	38.38	11.7	28.5	8.7	144.26	43.9	55
Closest MSSV	East Intake	53.16	16.2	6.5	2.0	251.94	76.7	191
Closest ADSV	East Intake	54.5	16.6	6.5	2.0	282.71	86.1	185
Closest MSSV	CR Fire Exit Door	53.16	16.2	5	1.5	115.6	35.2	57

Release Point	Receptor Point	Release Height (ft)	Release Height (m)	Receptor Height (ft)	Receptor Height (m)	Distance (ft)	Distance (m)	Direction with respect to true north (degrees)
Closest ADSV	CR Fire Exit Door	54.5	16.6	5	1.5	125.91	38.3	75
Closest MSSV	Diesel Building Intake	53.16	16.2	28.5	8.7	147.55	44.9	56
Closest ADSV	Diesel Building Intake	54.5	16.6	28.5	8.7	156.05	47.5	71
Primary Auxiliary Building Louver PAH-L6D	West Intake	61	18.6	8.25	2.5	331.74	101.1	22
Primary Auxiliary Building Fan PAH-FN46A	CR Fire Exit Door	88	26.8	5	1.5	122.85	37.4	101
Primary Auxiliary Building Fan PAH-FN46A	Diesel Building Intake	88	26.8	28.5	8.7	146.41	44.6	92
Turbine Building Closest Point	East Intake	6.5	2.0	6.5	2.0	211.77	64.5	234

Release Point	Receptor Point	Release Height (ft)	Release Height (m)	Receptor Height (ft)	Receptor Height (m)	Distance (ft)	Distance (m)	Direction with respect to true north (degrees)
Turbine Building Closest Point	CR Fire Exit Door	5	1.5	5	1.5	117.6	35.8	1
Turbine Building Closest Point	Diesel Building Intake	28.5	8.7	28.5	8.7	102	31.0	54
Waste Process Building SW Corner Roll-Up Door	West Intake	8.25	2.5	8.25	2.5	164.03	49.9	4
Carbon Delay Bed (East)	Diesel Building Intake	41.42	12.6	28.5	8.7	80.5	24.5	144
BWST (West)	Diesel Building Intake	22.67	6.9	28.5	8.7	53.67	16.3	144

Notes:

1. Release heights are calculated as 20 feet less than the reference elevations to account for the plant grade elevation.
2. The closest/limiting MSSV is MSSV-V-40 for the East Intake and MSSV-V-54 for the control room fire exit door and Diesel building intakes. The closest/limiting ADSV off of main steam line MS-4002 for the East Intake and main steam line MS-4003 for the control room fire exit door and Diesel building intakes.
3. Release and receptor points are considered to be at the centerpoint or centerline of all openings.
4. The closest main steam line break point for the East Intake is off of main steam line MS-4002.

TABLE 2R-2 CONTROL ROOM CHI/Qs

This table summarizes the results for CHI/Q factors for the control room intakes for the various accident scenarios. Values are presented for the release point to the unfavorable control room makeup air intake and the unfiltered inleakage point, which is a Diesel Building intake and/or the control room fire exit door. These values are not corrected for Control Room Occupancy Factors, but the control room makeup air intakes do include credit for dilution. Based on the layout of the site and the fact that both makeup air intakes have equal flow rates, the base χ/Q values may be reduced by a factor of 2. These reduced values are listed in the table below.

Some of the event analyses take credit for a factor of 5 reduction on the base χ/Q values to account for buoyant plume rise from the MSSVs and ASDVs in accordance with Section 6 of Regulatory Guide 1.194. This reduction factor is not reflected in the table below.

Release-Receptor Pair	Release Point	Receptor Point	0-2 hour CHI/Q	2-8 hour CHI/Q	8-24 hour CHI/Q	1-4 days CHI/Q	4-30 days CHI/Q
A	Plant Vent	East Intake	2.34E-04	1.85E-04	6.75E-05	4.62E-05	3.87E-05
B	Plant Vent	CR Fire Exit Door	7.54E-04	5.03E-04	2.00E-04	1.45E-04	9.89E-05
C	Plant Vent	Diesel Building Intake	7.01E-04	4.74E-04	1.89E-04	1.37E-04	8.97E-05
D	Closest Containment Surface Point	East Intake	4.40E-04	3.46E-04	1.29E-04	8.40E-05	6.80E-05
E	Closest Containment Surface Point	CR Fire Exit Door	3.08E-03	2.17E-03	8.48E-04	6.31E-04	4.64E-04
F	Closest Containment Surface Point	Diesel Building Intake	2.06E-03	1.48E-03	5.79E-04	4.29E-04	3.11E-04
G	RWST	West Intake	3.54E-04	2.75E-04	9.70E-05	6.90E-05	4.37E-05

Release-Receptor Pair	Release Point	Receptor Point	0-2 hour CHI/Q	2-8 hour CHI/Q	8-24 hour CHI/Q	1-4 days CHI/Q	4-30 days CHI/Q
H	RWST	CR Fire Exit Door	7.52E-03	3.85E-03	1.26E-03	9.29E-04	7.23E-04
I	RWST	Diesel Building Intake	5.06E-03	2.85E-03	9.00E-04	7.17E-04	6.17E-04
J	Containment Personnel Hatch	East Intake	2.84E-04	2.48E-04	1.04E-04	6.50E-05	5.10E-05
K	Containment Personnel Hatch	CR Fire Exit Door	2.84E-03	2.30E-03	8.67E-04	5.87E-04	3.70E-04
L	Containment Personnel Hatch	Diesel Building Intake	1.97E-03	1.60E-03	5.99E-04	4.04E-04	2.58E-04
M	Main Steam Line Closest Point	East Intake	8.70E-04	7.85E-04	3.22E-04	2.02E-04	1.61E-04
N	Main Steam Line Chase (West) Panel (North)	CR Fire Exit Door	4.55E-03	3.72E-03	1.38E-03	9.67E-04	6.35E-04
O	Main Steam Line Chase (West) Panel (North)	Diesel Building Intake	3.11E-03	2.50E-03	9.37E-04	6.53E-04	4.29E-04
P	Closest MSSV	East Intake	5.45E-04	4.50E-04	1.56E-04	9.85E-05	8.00E-05
Q	Closest ASDV	East Intake	4.44E-04	3.38E-04	1.16E-04	7.30E-05	6.05E-05

Release-Receptor Pair	Release Point	Receptor Point	0-2 hour CHI/Q	2-8 hour CHI/Q	8-24 hour CHI/Q	1-4 days CHI/Q	4-30 days CHI/Q
R	Closest MSSV	CR Fire Exit Door	4.11E-03	3.31E-03	1.24E-03	8.72E-04	5.86E-04
S	Closest ASDV	CR Fire Exit Door	3.49E-03	2.79E-03	1.02E-03	7.54E-04	5.45E-04
T	Closest MSSV	Diesel Building Intake	2.89E-03	2.39E-03	8.87E-04	6.17E-04	4.11E-04
U	Closest ASDV	Diesel Building Intake	2.64E-03	2.11E-03	7.82E-04	5.71E-04	4.07E-04
V	Primary Auxiliary Building Louver PAH-L6D	West Intake	3.21E-04	2.68E-04	1.02E-04	6.75E-05	3.72E-05
W	Primary Auxiliary Building Fan PAH-FN46A	CR Fire Exit Door	2.91E-03	1.98E-03	6.61E-04	5.09E-04	4.37E-04
X	Primary Auxiliary Building Fan PAH-FN46A	Diesel Building Intake	2.63E-03	1.81E-03	6.48E-04	4.86E-04	3.95E-04
Y	Turbine Building Closest Point	East Intake	8.40E-04	7.65E-04	3.44E-04	2.41E-04	1.91E-04
Z	Turbine Building Closest Point	CR Fire Exit Door	4.49E-03	3.22E-03	1.19E-03	8.27E-04	5.99E-04

Release-Receptor Pair	Release Point	Receptor Point	0-2 hour CHI/Q	2-8 hour CHI/Q	8-24 hour CHI/Q	1-4 days CHI/Q	4-30 days CHI/Q
AA	Turbine Building Closest Point	Diesel Building Intake	5.95E-03	4.80E-03	1.79E-03	1.24E-03	8.00E-04
BB	Waste Process Building SW Corner Roll-Up Door	West Intake	1.18E-03	8.85E-04	3.25E-04	2.28E-04	1.47E-04
CC	Carbon Delay Bed (East)	Diesel Building Intake	8.57E-03	4.46E-03	1.43E-03	1.11E-03	8.37E-04
DD	BWST (West)	Diesel Building Intake	1.86E-02	9.65E-03	3.08E-03	2.39E-03	1.84E-03

TABLE 2R-3 RELEASE-RECEPTOR POINT PAIRS ASSUMED FOR AST ANALYSIS EVENTS

Event	Filtered Makeup	Unfiltered Inleakage Through Diesel Building	Unfiltered Inleakage Through CR Fire Exit Door
LOCA			
Containment Leakage CEVA Release	A	C	B
Containment Leakage CEVA Bypass	D	F	E
ECCS Leakage CEVA Release	A	C	B
ECCS Leakage CEVA Bypass	D	F	E
RWST Backleakage	G	I	H
Containment Purge	A	N/A	B
FHA (bounding for Containment and FSB)	J	L	K
MSLB			
Break Release	M	O	N
MSSV/ASDV Release	P (prior to 2.5 hours, also applies plume rise factor of 5 reduction) Q (after 2.5 hours)	T (prior to 2.5 hours, also applies plume rise factor of 5 reduction) U (after 2.5 hours)	R (prior to 2.5 hours, also applies plume rise factor of 5 reduction) S (after 2.5 hours)
SGTR	P (prior to 0.5 hours for the iodine spike – also applies plume rise factor of 5 reduction; entire transient for the noble gas release) Q (after 0.5 hours for the iodine spike)	T (prior to 0.5 hours for the iodine spike – also applies plume rise factor of 5 reduction; entire transient for the noble gas release) U (after 0.5 hours for the iodine spike)	R (prior to 0.5 hours for the iodine spike – also applies plume rise factor of 5 reduction; entire transient for the noble gas release) S (after 0.5 hours for the iodine spike)

Event	Filtered Makeup	Unfiltered Inleakage Through Diesel Building	Unfiltered Inleakage Through CR Fire Exit Door
Locked Rotor	P (prior to 2.5 hours, also applies plume rise factor of 5 reduction) Q (after 2.5 hours)	T (prior to 2.5 hours, also applies plume rise factor of 5 reduction) U (after 2.5 hours)	R (prior to 2.5 hours, also applies plume rise factor of 5 reduction) S (after 2.5 hours)
RCCA Ejection			
Containment Leakage CEVA Release	A	C	B
Containment Leakage CEVA Bypass	D	F	E
Secondary Side Release	P (prior to 2.5 hours, also applies plume rise factor of 5 reduction) Q (after 2.5 hours)	T (prior to 2.5 hours, also applies plume rise factor of 5 reduction) U (after 2.5 hours)	R (prior to 2.5 hours, also applies plume rise factor of 5 reduction) S (after 2.5 hours)
Small Line Break			
Break Release	V	X	W
Condenser Release	Y	AA	Z
Radioactive Gaseous Waste System Failure	BB	CC	N/A*
Radioactive Liquid Waste System Failure	BB	DD	N/A*

*It is conservative for these release points to assume that all unfiltered Control Room inleakage is through the Diesel Building (i.e., no unfiltered inleakage through the Control Room Fire Exit door).

TABLE 2.3-1 OFFSITE METEOROLOGICAL INSTRUMENTATION INFORMATION

a. – Boston NWS

STATION LOCATION BOSTON, MASSACHUSETTS

						Elevation Above Sea Level	Elevation Above Ground									
Location	Occupied from	Occupied to	Airline distance and direction from previous location	Latitude North	Latitude West	Ground at temperature site	Wind instruments	Extreme thermometers	Psychrometer	Telepsychrometer	Tipping bucket rain gage	Weighing Rain Gage	8" Rain Gage	Hygrothermometer	*	Remarks
City																
Old State House, corner State & Devonshire Sts.	10/20/70	1/09/71		42º21′	71º04′	16										Ground elevation approximate.
103 Court Street	1/10/71	8/12/75	600 ft. NW	42º21′	71º04′	40										Ground elevation approximate.
Equitable Building Corner Milk & Devonshire Streets	8/12/75	10/01/84	1200 ft. SE	42º21′	71º04′	12	172	156	156				162			
Old U.S. Post Office and Courthouse Milk, Devonshire, Congress & Water Streets East Tower	10/01/84	6/07/29	300 ft. NE	42º21′	71º04′	17	188	115	115			154	174 154			8 inch rain gage moved from bad exposure atop east tower to west tower, 154 feet above ground on 7/1/91. Marvin Weighing Rain and Snow Gage installed
Young's Hotel Building Corner City Hall Avenue and Court Street	6/07/29	9/29/33	700 ft. NW	42º21′	71º04′	40	165	106	106		96		96			Anemometer atop City Hall Annex, across City Hall Avenue.
New U.S. Post Office and Courthouse Same site as old	9/29/33	6/06/64	700 ft. SE	42º21′	71º04′	20	360	337	336		329		328			Observation Program transferred to Airport 1/1/36.
Airport																
U.S. Army Hanger No. 1 Boston Airport East Boston	10/15/26	4/01/27		42º22′	71º02′	3										Pibal only.
Section F, Army Base South Boston	4/01/27	11/01/27	1-¾mi. S	42º21′	71º02′		143									Pibal only.
Shack 25 feet South of Commercial Hanger Boston AP, East Boston	11/01/27	7/01/29	1-¾mi. N	42º21′	71º02′	2	22		4							Pibal only

* Requests for information concerning solar radiation data or instrumentation should be made to the Director, National Climatic Center, Federal Building, Asheville, NC 28801

STATION LOCATION BOSTON, MASSACHUSETTS

Location	Occupied from	Occupied to	Airline distance and direction from previous location	Latitude North	Latitude West	Sea Level: Ground at temperature site	Elevation Above Ground: Wind instruments	Extreme thermometers	Psychrometer	Telepsychrometer	Tipping bucket rain gage	Weighing Rain Gage	8" Rain Gage	Hygrothermometer		Remarks
Shack 200 feet SW of East Coast Hanger Boston AP, East Boston	7/01/29	5/01/30	1/8 mi. SW	42º22′	71º02′	12	24		4							Pibal only to 2/16/30.
Administration Building Boston Municipal airport East Boston	5/01/30	11/01/45	3/8 mi. NW	42º22′	71º02′	12	50	31	31		a3	b3	3			a– Added 1/1/36. b – Added 2/1/38. Official synoptic records began 1/1/36.
Administration Building Boston Municipal Airport East Boston	11/01/45	11/22/51	Same	42º22′	71º02′	12	*62	*33	*33		#32	#32	#32			* - Installed on 30 foot instrument tower on roof 9/17/37. # - Gages moved to roof 3/10/44.
Gate No. 11, Boutwell Building, Logan Int'l. Airport, East Boston	11/22/51	12/05/63	5/8 mi. E	42º22′	71º01′	15	X33	20	20		19	19	18			x – 34 feet to 7/20/54 and 75 feet to 8/23/57.
General Aviation Admin. Building, West Wing, Logan International AP	12/05/63	Present	5/8 mi. W	42º22′	71º02′	d15	22	e33 f6	e33 f5		33 f5	33 f5	33 f5	c4		Instrument relocations completed 12/11/63. c – commissioned on field site 4/1/64. d – 12 FT TO 4/1/64. e – Standby status after 4/1/64. f – Effective 8/5/71.

b. Portland NWS

STATION LOCATION PORTLAND, MAINE

Location	Occupied from	Occupied to	Airline distance and direction from previous location	Latitude North	Latitude West	Ground at temperature site	Wind instruments	Extreme thermometers	Psychrometer	Telepsychrometer	Tipping bucket rain gage	Weighing Rain Gage	8" Rain Gage	Hygrothermometer		Remarks
Fort Preble	1-1820	12-1836		43º39′	70º14′	53										Surgeon General Station.
Fort Preble	10-1840	8-1845		43º39′	70º14′											Surgeon General Station.
Fort Preble	1-1849	12-1853		43º39′	70º14′											Surgeon General Station.
Portland	1856	1859		43º39′	70º15′											Cooperative Station.
Fort Preble	1865	1871		43º39′	70º14′											Cooperative Station.
City																
4 Exchange Street	7/15/71	9/30/73		43º39′	70º15′	30	?	40					7			
Boyd's Block, Middle & Exchange Streets	9/30/73	12/01/74	450 ft. NW	43º39′	70º15′	51	?	50					7			
Custom House, Fore St.	12/01/74	7/01/85	450 ft. E	43º39′	70º15′	32	82	28					71			
First National Bank 57 Exchange Street	7/01/85	12/04/40	350 ft. WNW	43º39′	70º15′	47	117*	81	#81		Ø75		77			Ø – 74 feet 1/94 to 4/97 * - 89 ft 5/22/93 to 11/28/99 # - Added January 1889.

STATION LOCATION — PORTLAND, MAINE

Location	Occupied from	Occupied to	Airline distance and direction from previous location	Latitude North	Latitude West	Elevation Above Sea Level: Ground at temperature site	Elevation Above Ground: Wind instruments	Extreme thermometers	Psychrometer	Telepsychrometer	Tipping bucket rain gage	Weighing Rain Gage	8" Rain Gage	Hygrothermometer		Remarks
Airport																
Administration Building Portland City Airport General Aviation Terminal effective Oct. 1968 Portland International Jetport, Sept. 1969	12/03/39	Present	2.75 miles West of City Office	43°39′	70°19′	d43	a20 f20	e6	e6		b3	6	3	c4 f5		a – 36 ft to 6/41; 61 ft to 5/43; 43 ft to 8/48; and 55 ft to 10/6/64. b – 24 ft to 6/48 c – commissioned 1200 ft. ESE of thermometer 2/2/65. d – 61 ft to 2/2/65 and 47 ft to 12/10/69. e – Standby status after 2/2/65. f – moved 850′ SE 12/10/69

c. Concord NWS

STATION LOCATION — CONCORD, NEW HAMPSHIRE

Location	Occupied from	Occupied to	Airline distance and direction from previous location	Latitude North	Latitude West	Ground at temperature site	Wind instruments	Extreme thermometers	Psychrometer	Telepsychrometer	Tipping bucket rain gage	Weighing Rain Gage	8" Rain Gage	Hygrothermometer		Remarks
COOPERATIVE																
Number and identity of observers unknown	1-1828	9/30/56						-					-			
Hon. Wm L. Foster Winter & State Streets	10/01/56	8/13/97		43°13′	71°33′	*280		-					-			*Approximate
Prof. Wm. W. Flint St. Paul's School	8/14/97	10/31/02	2.5mi WSW	43°12′	71°35′	*350										*Approximate
City																
Smith Block, 28 North Main Street	11/01/02	7/31/33	0.3 mi. SE	43°12′	71°32′	272	80	71	70		62		62			First order station. Exposures fair.
Patriot Building 4 Park Street	8/01/33	12/33/37	¼ mi. NNW	43°12′	71°32′	276		61	60				55			Second order station.
First National Bankl Bldg., 18 N. Main St.	12/23/37	5/01/41	¼ mi. SSE	43°12′	71°32′	270	72	63	62		56		56			First order station re_opened.
AIRPORT																
NE Airlines, Inc. Old Hanger	10/27/33	3/28/39		43°12′	71°31′	339										On call station. No instruments
1st Floor, Admin. Bldg., Municipal Airport	3/01/39	11/19/42		43°12′	71°31′	339	37	5	5				3			Observations by CAA.

STATION LOCATION CONCORD, NEW HAMPSHIRE

						Sea Level	Elevation Above Ground									
Location	Occupied from	Occupied to	Airline distance and direction from previous location	Latitude North	Latitude West	Ground at temperature site	Wind instruments	Extreme thermometers	Psychrometer	Telepsychrometer	Tipping bucket rain gage	Weighing Rain Gage	8" Rain Gage	Hygrothermometer		Remarks
2nd Floor, Admin. Bldg., Municipal Airport	5/01/41	8/08/62	1.5 mi. E of City Office	43º12′	71º31′	339	47	5	5		3	4	3			Semi-rural locations. Exposures good to excellent.
1st Floor, Admin. Bldg., Municipal Airport	8/08/62	Present		43º12′	71º30′	b342	20	c5	%5		3	4	3	a4		a – commissioned 1600′ E of thermometer 3/15/65. b – 339′ to 3/15/65. c - Standby status after 3/15/65, discontinued 3/16/66. % - Standby equipment

d. Pease AFB

STATION NO. ON SUMMARY	STATION NAME	LATITUDE	LONGITUDE	STATION ELEV. (FT)	CALL SIGN	WMO NUMBER
0474	PEASE AFB NH/PORTSMOUTH	N 43 05	W 070 49	111	KPSM	

STATION LOCATION AND INSTRUMENTATION HISTORY

Number of Location	Geographical Location & Name	Type of Station	At This Location		Latitude	Longitude	Elevation Above MSL		OBS PER DAY
			From	To			Station (Ft)	Hgt Barometer	
1	Pease AFB, Portsmouth NH	AFB	Apr 56	Feb 57	N 43 05	W 070 46	104	N/A	24
2	No change	AFB	Mar 57	22 Feb 60	No chge	W 070 49	111	88 ft.	24
3	No change	AFB	23 Feb 60	Dec 70	No chge	No chge	No chge	127 ft.	24

SURFACE WIND EQUIPMENT INFORMATION

Number of location	Date of Change	Location	Type of Transmitter	Type of Recorder	Ht Above Ground	Remarks, Additional Equipment or Reason for Change
1	Apr 56 to 24 Apr 56	Located 50 ft. S of the weather station.	AN/GMQ-11	ML204B	15 ft.	
2	25 Apr 56 to Feb 47	Located on the ground	AN/GMQ-1	N/A	N/A	
3	Mar 57 to Feb 58	Located 750 ft. W of centerline of Rnwy 16/34.	AN/GMQ-11	RO-2	13 ft.	
4	Mar 58 to Feb 59	Located 500 ft. off center at N end of Rnwy 16	No chge	No chge	No chge	
5	Mar 59 to 22 Feb 60	Located 3350 ft. WnW of weather station	No chge	No chge	No chge	
6	23 Feb 60 to Feb 62	Located 1000 ft. from touchdown pt on W side of Rnwy 16.	AN/GMQ-11	RO-2	15 ft.	
7	Mar 62 to Feb 63	Located 500 ft. W of Rnwy 16/34 centerline, 3700 ft. S of N end of Rnwy	No chge	No chge	13 ft	
8	Mar 63 to 27 Mar 69	1. Located 1500 ft. S of N end of Rnwy 16, 500 ft E of center-line of the Rnwy.	No chge	No chge	No chge	
		2. Located 750 ft N of S end of Rnwy 34, 500 ft E of center-line of the Rnwy.	No chge.		No chge	
9	28 Mar 69 to Sep 70	1. No change	No chge	RO-362	No chge	
		2. No change	No chge		No chge	
10	Oct 70 to Dec 70	1. No change	AN/GMQ-20	No chge	No chge	
		2. No change	No chge		No chge	

TABLE 2.3-2 **MEAN NUMBER OF DAYS WITH THUNDERSTORMS**

	Boston	Portland	Concord	Pease AFB
Jan	*	*	*	0.1
Feb	*	*	*	0
Mar	1	*	*	0.1
Apr	1	1	1	0.9
May	2	2	2	2.3
Jun	4	4	5	4.1
Jul	5	4	6	5.5
Aug	4	4	4	3.8
Sep	2	2	2	1.4
Oct	1	1	1	0.6
Nov	*	*	*	0.4
Dec	*	*	*	0
Annual	19	18	20	19.0
Years	1936 – 1977	1941 – 1977	1942 – 1977	Apr. 1956 - 1970

References: 8, 9, 10, 11
* Less than one half

TABLE 2.3-3 ESTIMATED FREQUENCY OF CLOUD-TO-GROUND LIGHTNING – NUMBER PER YEAR (REFERENCE 12)

Period	Height of Object Above Grade (ft)			
	50	100	200	500
Dec – Feb	0.001	0.002	0.003	0.007
Mar – May	0.022	0.055	0.099	0.231
Jun – Aug	0.089	0.224	0.402	0.938
Sep – Nov	0.016	0.040	0.072	0.168
Annual	0.127	0.318	0.570	1.330

TABLE 2.3-4 NUMBER OF DAYS WITH HAIL (REFERENCE 14)

	Boston	Portland	Concord
Jan	0	0	1
Feb	0	0	0
Mar	1	2	2
Apr	3	4	3
May	5	4	9
Jun	5	3	3
Jul	8	6	4
Aug	3	6	2
Sep	1	2	1
Oct	0	6	2
Nov	2	0	1
Dec	0	0	1
Total	28	33	29
Average Per Year	0.7	0.83	0.83
Years of Data	1904 – 1943	1904 – 1943	1904 – 1933; 1939 - 1943

TABLE 2.3-5 **FASTEST MILE WIND SPEED (MPH)**

	Boston	**Portland**	**Concord**
Jan	66	50	44
Feb	61	58	42
Mar	73	76	71
Apr	63	57	52
May	55	49	48
Jun	46	45	38
Jul	52	44	45
Aug	52	69	56
Sep	87	62	61
Oct	63	45	39
Nov	80	76	72
Dec	73	62	52
Maximum	87	76	72
Years	1916 – 1978	1941 – 1978	1938 – 1978

References: (8, 18, 19), (9, 20), (1, 10)

TABLE 2.3-6 **FASTEST-MILE EXTREME WIND SPEEDS FOR SEABROOK AREA**

Return Interval (years)	Annual Probability of Exceedance	Wind Speed (mph) 10 Meters Above Grade	Wind Speed (mph) 30 Meters Above Grade
10	0.1	61	72
25	0.04	72	84
50	0.02	81	94
100	0.01	90	105
200	0.005	98	115
400	0.0025	107	126
2000	0.0005	131	154

Derived from data in References, 50, 51

TABLE 2.3-7 **AVERAGE FREQUENCY OF OCCURRENCE (PERCENT OF HOURS) OF FREEZING RAIN AT PORTSMOUTH, NEW HAMPSHIRE (REFERENCE 24)**

Month	Percent of Hours
Nov	0.2
Dec	1.0
Jan	0.9
Feb	0.5
Mar	0.3
Apr	0.0
Annual	0.3
Years	1956 - 1961

TABLE 2.3-8 EPISODES WITH METEROLOGICAL CONDITIONS IN THE SITE AREA UNFAVORABLE FOR ATMOSPHERIC DISPERSION (REFERENCE 29)

Number Episodes in 5 years	Minimum Episode Duration (Days)	Maximum Mixing Height (Feet)	Maximum Wind Speed (mph)
0	2	1640	4.5
1	2	1640	9.0
2	2	1640	13.4
0	2	3280	4.5
3	2	3280	9.0
15	2	3280	13.4
0	5	1640	9.0
0	5	1640	13.4
0	5	3280	9.0
1	5	3280	13.4

TABLE 2.3-9 FREQUENCY OF OCCURRENCE OF SUMMERTIME 4-HOUR AVERAGE WET BULB TEMPERATURES

Four-Hour Average Wet Bulb Temperature (°F)	Frequency of Occurrence at Temperature in 25 Years (Summer)	Cumulative Frequency of Occurrence At or Above Temperature in 25 Years (Summer)
81	4	4
80	20	24
79	51	75
78	112	187
77	199	386
76	348	734
75	541	1,275
74	759	2,034
73	1,115	3,149
72	1,327	4,476
71	1,554	6,030
70	1,934	7,964
69	2,184	10,148
68	2,407	12,555
67	2,770	15,325
66	2,999	18,324
65	3,260	21,584

Data Base: Pease Air Force Base Hourly Observations
Summer Periods (June 1 through September 15)
for the Years 1956-1974 and 1976-1981.

TABLE 2.3-10 FREQUENCY OF OCCURRENCE OF 9-HOUR AVERAGE WET BULB TEMPERATURES FOR NIGHT-TIME HOURS DURING THE PERIOD JULY 16 THROUGH JULY 31

Nine-Hour Average Wet Bulb Temperature (°F)	Frequency of Occurrence at Temperature in 25 Years	Cumulative Frequency of Occurrence At or Above Temperature in 25 Years
76	7	7
75	2	9
74	15	24
73	42	66
72	63	129
71	56	185
70	86	271
69	117	388
68	111	499
67	95	594
66	149	743
65	221	964
64	236	1,200
63	191	1,391
62	150	1,541
61	164	1,705
60	170	1,875
59	170	2,045
58	203	2,248
57	122	2,370
56	80	2,450
55	83	2,533
54	68	2,601
53	59	2,660
52	13	2,673
51	12	2,685
50	16	2,701
49	16	2,717
48	7	2,724
47	2	2,726

Data Base: Pease Air Force Base Nighttime Hourly Observations Running
Nine-Hour Averages Ending in the Hours 0300 –0900 LST
Summer Period July 16 through July 31
Years 1956-1974 and 1976-1981

TABLE 2.3-11 FREQUENCY OF OCCURRENCE OF PERIODS OF 24-HOUR AVERAGE DRY BULB TEMPERATURES OF LESS THAN OR EQUAL TO 15°F BY LENGTH OF PERIOD

Episode Length (Whole Days)*	Number of Occurrences In 25 Years of Record
1	69
2	64
3	34
4	10
5	4
6	1
7	4
8	0
9	0
10	0
11	1
12	0
13	0
14	0
15	0
16	1`

Data Base: Pease Air Force Base Hourly Observations
April 1, 1956 – December 31, 1974 and
January 1, 1976 – December 31, 1981
Excluding the Summer Months June through August

*Fractional days discarded.

TABLE 2.3-12 MONTHLY AVERAGE TEMPERATURES (°F)

	Boston	Portland	Concord	Portsmouth
Jan	29.2	21.5	20.6	22.9
Feb	30.4	22.9	22.6	23.9
Mar	38.1	31.8	32.3	32.1
Apr	48.6	42.7	44.2	42.5
May	58.6	52.7	55.1	53.5
Jun	68.0	62.2	64.7	63.1
Jul	73.3	68.0	69.7	68.1
Aug	71.3	66.4	67.2	66.1
Sep	64.5	58.7	59.5	58.6
Oct	55.4	49.1	49.3	49.2
Nov	45.2	38.6	38.0	39.3
Dec	33.0	25.7	24.8	25.8
Annual	51.3	45.0	45.6	45.4
Years of Data	1941-1970	1941-1970	1941-1970	1954-1967

References : 8, 9, 10, 24

TABLE 2.3-13 MONTHLY MEAN OF DAILY MAXIMUM TEMPERATURES (°F)

	Boston	Portland	Concord	Portsmouth
Jan	36	31	31	32
Feb	38	33	34	35
Mar	45	41	42	42
Apr	56	53	57	53
May	67	64	69	66
Jun	77	73	78	75
Jul	81	79	83	80
Aug	79	78	80	78
Sep	72	70	72	70
Oct	63	60	62	61
Nov	52	48	48	49
Dec	39	35	35	35
Annual	58.7	55.3	57.5	56.4
Years of Data	1941-1970	1941-1970	1941-1970	1954-1967

References : 8, 9, 10, 24

TABLE 2.3-14 MONTHLY MEAN OF DAILY MAXIMUM TEMPERATURES (°F)

	Boston	Portland	Concord	Portsmouth
Jan	23	12	10	13
Feb	23	13	11	13
Mar	32	23	22	22
Apr	41	33	32	32
May	50	42	42	41
Jun	59	51	52	51
Jul	65	57	57	56
Aug	63	55	54	54
Sep	57	47	47	47
Oct	48	38	36	37
Nov	39	30	28	30
Dec	27	16	15	17
Annual	43.8	34.7	33.7	34.4
Years of Data	1941-1970	1941-1970	1941-1970	1954-1967

References : 8, 9, 10, 24

TABLE 2.3-15 EXTREME HIGHEST TEMPERATURE (°F)

	Boston	Portland	Concord	Portsmouth
Jan	72 (1950)	65 (1906)	72 (1876)	58 (1966)
Feb	68 (1957)	64 (1957)	68 (1880)	64 (1957)
Mar	86 (1945)	86 (1946)	85 (1977)	76 (1962)
Apr	94 (1976)	89 (1927)	95 (1976)	92 (1962)
May	97 (1880)	96 (1937)	98 (1911)	94 (1964)
Jun	100 (1952)	97 (1941)	101 (1919)	96 (1956)
Jul	104 (1911)	103 (1911)	102 (1966)	99 (1963)
Aug	102 (1975)	103 (1975)	101 (1975)	98 (1955)
Sep	102 (1881)	96 (1939)	98 (1953)	92 (1965)
Oct	90 (1963)	88 (1963)	92 (1879)	88 (1963)
Nov	83 (1950)	74 (1974)	80 (1950)	76 (1959)
Dec	70 (1966)	65 (1911)	65 (1932)	60 (1966)
Record High	104 (1911)	103 (1911, 1975)	102 (1966)	99 (1963)
Years of Data	1872-1978	1872-1978	1871-1978	1954-1967

References : (8, 17, 18), (9, 17, 19), (1, 10, 17), (24)

TABLE 2.3-16 EXTREME LOWEST TEMPERATURE (°F)

	Boston	Portland	Concord	Portsmouth
Jan	-13 (1882)	-26 (1971)	-35 (1878)	-23 (1957)
Feb	-18 (1934)	-39 (1943)	-37 (1943)	-15 (1962)
Mar	-8 (1872)	-21 (1950)	-16 (1967)	-8 (1967)
Apr	11 (1874)	8 (1954)	7 (1874)	10 (1967)
May	31 (1882)	23 (1956)	21 (1966)	22 (1967)
Jun	41 (1945)	33 (1944)	30 (1972)	35 (1967)
Jul	50 (1879)	40 (1965)	35 (1965)	40 (1956)
Aug	46 (1940)	33 (1965)	29 (1965)	33 (1965)
Sep	34 (1914)	23 (1941)	20 (1941)	26 (1962)
Oct	25 (1936)	15 (1976)	10 (1972)	14 (1966)
Nov	-2 (1875)	-6 (1875)	-17 (1875)	11 (1957)
Dec	-17 (1933)	-21 (1963)	-24 (1875)	-12 (1962)
Record Low	-18 (1934)	-39 (1943)	-37 (1943)	-23 (1957)
Years of Data	1872-1978	1872-1978	1871-1978	1954-1967

References : (8, 17, 18), (9, 17, 19), (1, 10, 17), (24)

TABLE 2.3-17 MEAN NUMBER OF DAYS WITH MINIMUM TEMPERATURE 0 (°F) OR BELOW

	Boston	Portland	Concord	Portsmouth
Jan	1	7	12	4
Feb	*	5	8	5
Mar	0	1	1	*
Apr	0	0	0	0
May	0	0	0	0
Jun	0	0	0	0
Jul	0	0	0	0
Aug	0	0	0	0
Sep	0	0	0	0
Oct	0	0	0	0
Nov	0	0	*	0
Dec	*	3	6	2
Years of Data	1965-1977	1941-1977	1966-1977	1954-1967

*Less than one half

References : 8, 9, 10, 24

TABLE 2.3-18 HOTTEST CONTIGUOUS 24-HOURS IN ASSOCIATION WITH THE HOTTEST ONE-HOUR TEMPERATURE* OBSERVED DURING 1957 THROUGH 1981 AT PEASE AFB

Year	Date	Hour	Temperature °F
1964	June 30	Hr 15	89
		16	89
		17	89
		18	85
		19	81
		20	80
		21	77
		22	76
		23	76
	July 1	Hr 00	74
		1	76
		2	75
		3	75
		4	74
		5	73
		6	76
		7	80
		8	88
		9	92
		10	93
		11	96
		12	98
		13	101*
		14	100

TABLE 2.3-19 FIVE WARMEST AND FIVE COLDEST 24-HOUR PERIODS OBSERVED DURING 1957 THROUGH 1981 AT PEASE AFB

FIVE COLDEST 24-HOUR PERIODS						FIVE WARMEST 24-HOUR PERIODS					
Average	-8.08	-7.12	-5.50	-2.70	-2.50	Average	86.62	85.87	85.25	84.25	83.91
Year Period	1968	1957	1980	1967	1981	Year Period	1975	1977	1964	1978	1981
Ends	Jan 9	Jan 15	Dec 26	Feb 13	Jan 5	Ends	Aug 3	Jul 21	Jul 19	Jul 22	Jul 9
Hour						Hour					
00						00					
01						01					
02						02					
03						03					
04						04	74				
05						05	77				
06			-2		-4	06	82				
07			-5		-2	07	85				
08			-7		-4	08	90				
09			-7		-4	09	92				
10			-7	0	-2	10	97				
11	-6		-7	1	-2	11	99			88	
12	-5		-5	2	1	12	100			90	
13	-4		-4	2	2	13	100		93	91	
14	-4		-4	3	3	14	100		94	93	
15	-4		-4	3	3	15	98		94	93	
16	-5		-5	3	2	16	97	94	94	93	
17	-6		-5	2	0	17	92	92	92	91	
18	-7		-7	0	0	18	87	89	89	86	
19	-8		-7	-1	-2	19	84	87	87	85	87
20	-10		-7	-1	-2	20	82	85	85	84	86
21	-10		-7	-2	-5	21	80	83	84	82	82
22	-10	-4	-7	-3	-7	22	78	82	84	82	80
23	-10	-7	-6	-4	-7	23	77	80	82	82	80
00	-10	-8	-5	-5	-7	00	80	79	81	82	79
01	-9	-10	-5	-6	-5	01	77	79	80	80	78
02	-9	-11	-5	-7	-5	02	75	78	79	79	77
03	-10	-13	-5	-8	-5	03	76	77	79	79	75
04	-9	-14	-5	-8	-4	04		77	78	79	74
05	-10	-15	-4	-8	-4	05		77	77	78	75
06	-10	-15		-9		06		77	76	78	77
07	-12	-16-		-9		07		80	78	79	79
08	-10	14		-7		08		84	80	81	80
09	-9	-12		-3		09		87	84	82	82
10	-7	-8				10		91	90	85	85
11		-5				11		95	92		90
12		-1				12		96	94		89
13		0				13		96			93
14		1				14		98			95
15		0				15		98			94
16		-3				16					94
17		-4				17					93
18		-4				18					90
19		-4				19					
20		-2				20					
21		-2				21					
22						22					
23						23					

TABLE 2.3-20 MEAN MONTHLY RELATIVE HUMIDITY (%) AT PEASE AFB, NEW HAMPSHIRE (REFERENCE 11)

Jan	65.9
Feb	64.7
Mar	65.0
Apr	64.9
May	65.7
Jun	70.9
Jul	72.2
Aug	72.5
Sep	74.4
Oct	70.4
Nov	71.6
Dec	69.0
Annual	68.9
Years	Apr. 1956-1970

TABLE 2.3-21 MEAN NUMBER OF DAYS WITH PRECIPITATION 0.01 INCH OR MORE*

	Boston	Portland	Concord
Jan	12	11	11
Feb	11	10	10
Mar	12	11	11
Apr	11	12	11
May	11	13	12
Jun	11	11	11
Jul	9	9	10
Aug	10	9	10
Sep	9	8	9
Oct	9	9	8
Nov	11	12	11
Dec	12	12	11
Annual	128	127	125
Years of Data	1952 - 1977	1941 – 1977	1942 - 1977

References : 8, 9, 10
*Portsmouth Annual 129 days (Reference 24)

TABLE 2.3-22 MEAN MONTHLY PRECIPITATION (INCHES OF WATER)

	Boston	Portland	Concord	Portsmouth
Jan	3.7	3.4	2.7	4.2
Feb	3.5	3.5	2.5	4.0
Mar	4.0	3.6	2.8	3.4
Apr	3.5	3.3	2.9	3.6
May	3.5	3.3	3.0	2.8
Jun	3.2	3.1	3.4	2.7
Jul	2.7	2.6	3.1	3.4
Aug	3.5	2.6	2.9	2.7
Sep	3.2	3.1	3.1	3.8
Oct	3.0	3.3	2.7	4.1
Nov	4.5	4.9	4.0	4.6
Dec	4.2	4.1	3.3	3.5
Annual	42.5	40.8	36.2	42.6
Years of Data	1941-1970	1941-1970	1941-1970	1954-1967

References : 8, 9, 10, 24

TABLE 2.3-23 PRECIPITATION EXTREMES: MAXIMUM 24-HOUR TOTAL (INCHES OF WATER)

	Boston		Portland		Concord		Portsmouth	
Jan	3.3	(1881)	3.6	(1977)	2.1	(1888)	2.6	(1958)
Feb	4.5	(1886)	3.2	(1965)	2.1	(1951)	3.4	(1965)
Mar	4.1	(1968)	3.7	(1937)	2.6	(1936)	1.8	(1964)
Apr	3.2	(1921)	5.3	(1973)	3.0	(1923)	1.7	(1962)
May	5.7	(1954)	4.9	(1916)	3.1	(1922)	1.8	(1960)
Jun	5.4	(1875)	5.6	(1967)	4.5	(1944)	2.4	(1955)
Jul	6.0	(1921)	4.3	(1939)	5.1	(1887)	2.5	(1961)
Aug	8.4	(1955)	4.2	(1946)	5.3	(1908)	2.3	(1954)
Sep	5.6	(1954)	7.5	(1954)	6.0	(1932)	6.6	(1954)
Oct	4.9	(1895)	7.7	(1962)	4.2	(1962)	5.6	(1962)
Nov	5.4	(1876)	3.8	(1877)	4.0	(1927)	2.8	(1963)
Dec	4.2	(1969)	3.8	(1969)	3.3	(1969)	2.0	(1962)
Years	1871-1978		1871-1978		1871-1978		1954-1967	

References : (8, 17, 18), (9, 19), (1, 10), (24)

TABLE 2.3-24 PRECIPITATION EXTREMES: MAXIMUM MONTHLY TOTAL (INCHES OF WATER)

	Boston		Portland		Concord		Portsmouth	
Jan	9.5	(1958)	12.3	(1935)	6.3	(1978)	13.8	(1958)
Feb	7.1	(1969)	9.3	(1900)	5.9	(1896)	5.8	(1965)
Mar	11.0	(1953)	10.0	(1953)	9.8	(1936)	6.2	(1956)
Apr	9.1	(1904)	9.9	(1973)	7.4	(1904)	6.5	(1961)
May	13.4	(1954)	7.7	(1948)	8.3	(1954)	6.4	(1967)
Jun	9.1	(1931)	10.9	(1917)	10.1	(1954)	6.3	(1959)
Jul	11.7	(1921)	10.8	(1915)	10.3	(1915)	5.4	(1959)
Aug	17.1	(1955)	8.3	(1946)	9.0	(1892)	6.7	(1955)
Sep	10.9	(1933)	9.8	(1954)	11.0	(1888)	9.1	(1954)
Oct	8.8	(1877)	12.3	(1962)	8.8	(1962)	10.8	(1962)
Nov	11.0	(1876)	9.8	(1963)	7.6	(1937)	9.7	(1963)
Dec	9.7	(1969)	9.7	(1969)	7.6	(1936)	6.4	(1954)
Years	1871-1978		1871-1978		1871-1978		1954-1967	

References : (8, 17, 18), (9, 19), (1, 10), (24)

TABLE 2.3-25 MAXIMUM RECORDED SHORT PERIOD RAINFALL (INCHES OF WATER) (REFERENCE 30)

	Boston	Portland	Concord
Time Period (Minutes)			
5	0.56	0.51	0.66
10	0.95	0.78	1.12
15	1.25	1.09	1.6
30	1.63	1.49	2.53
Years of Data	1896-1961	1896-1961	1905-1932; 1938-1961
(Hours)			
1	2.10	2.11	2.71
2	2.85	3.4	2.73
3	4.05	4.51	3.56
6	5.46	5.84	3.82
12	6.74	7.09	5.53
Years of Data	1892-1961	1893-1961	1902-1961

TABLE 2.3-26 PRECIPITATION EXTREMES: MINIMUM MONTHLY TOTAL (INCHES OF WATER)

	Boston		Portland		Concord		Portsmouth	
Jan	0.9	(1970)	0.8	(1970)	0.4	(1970)	0.9	(1955)
Feb	0.5	(1877)	0.4	(1872)	0.4	(1877)	1.3	(1957)
Mar	T	(1915)*	0.1	(1915)	T	(1915)*	1.7	(1965)
Apr	0.9	(1892)	0.7	(1941)	0.4	(1941)	1.4	(1966)
May	0.3	(1944)	0.5	(1965)	0.3	(1899)	1.0	(1964)
Jun	0.3	(1912)	0.5	(1908)	0.1	(1913)	0.8	(1964)
Jul	0.5	(1952)	0.6	(1965)	0.9	(1910)	1.3	(1955)
Aug	0.4	(1883)	0.3	(1947)	0.4	(1882)	1.4	(1956)
Sep	0.2	(1914)	0.3	(1948)	0.2	(1914)	1.5	(1964)
Oct	0.1	(1924)	0.1	(1924)	0.1	(1924)	1.9	(1963)
Nov	0.6	(1917)	0.6	(1939)	0.5	(1939)	2.4	(1965)
Dec	0.7	(1935)	0.9	(1874)	0.6	(1943)	1.0	(1955)
Years	1871-1978		1871-1978		1871-1978		1954-1967	

*T = Trace, an amount too small to measure (less than 0.01 inch)

References : (8, 17, 18), (9, 19), (1, 10), (24)

TABLE 2.3-27 MEAN MONTHLY SNOWFALL (INCHES OF SNOW)

	Boston	Portland	Concord	Portsmouth
Jan	12.2	18.1	17.1	17.7
Feb	11.8	19.6	15.3	18.9
Mar	8.1	13.9	11.6	16.3
Apr	0.7	3.1	2.2	1.9
May	T*	0.2	0.2	T*
Jun	0	0	0	0
Jul	0	0	0	0
Aug	0	0	0	0
Sep	0	T*	0	0
Oct	T*	0.3	0.1	T*
Nov	1.2	3.3	3.9	1.8
Dec	8.1	16.0	14.3	15.6
Annual	42.1	74.5	64.8	72.2
Years of Data	1938-1978	1938-1978	1938-1978	1954-1967

*T = Trace, less than 0.1 inches

References : 8, 9, 10, 24

TABLE 2.3-28 SNOWFALL EXTREMES: MAXIMUM 24-HOUR TOTAL (INCHES OF SNOW)

	Boston		Portland		Concord		Portsmouth	
Jan	21.0	(1978)	23.3	(1935)	19.0	(1944)	15.0	(1966)
Feb	23.6	(1978)	21.5	(1969)	15.0	(1929)	15.0	(1966)
Mar	17.7	(1960)	19.8	(1939)	13.6	(1959)	15.0	(1956)
Apr	9.1	(1917)	15.0	(1906)	18.3	(1933)	8.0	(1956)
May	0.5	(1977)	7.0	(1945)	5.0	(1945)	T	(1963)*
Jun	0.0		0.0		0.0		0.0	
Jul	0.0		0.0		0.0		0.0	
Aug	0.0		0.0		0.0		0.0	
Sep	0.0		T	(1959)*	0.0		0.0	
Oct	0.5	(1884)	3.6	(1969)	2.1	(1969)	T	(1963)*
Nov	12.0	(1898)	11.2	(1898)	13.3	(1938)	5.2	(1961)
Dec	13.0	(1960)	22.8	(1970)	14.6	(1946)	21.6	(1954)
Years	1872-1978		1882-1978		1871-1978		1954-1967	

*T = Trace (less than 0.1 inches)

References : (8, 17, 18), (9, 19), (1, 10), (24)

TABLE 2.3-29 SNOWFALL EXTREMES: MAXIMUM MONTHLY TOTAL (INCHES OF SNOW)

	Boston		Portland		Concord		Portsmouth	
Jan	35.9	(1978)	59.0	(1935)	46.7	(1935)	47.6	(1966)
Feb	41.3	(1969)	61.2	(1969)	59.0	(1893)	38.4	(1967)
Mar	33.0	(1916)	46.6	(1956)	38.3	(1956)	53.9	(1956)
Apr	28.3	(1874)	20.5	(1906)	35.0	(1874)	9.7	(1956)
May	0.5	(1977)	7.0	(1945)	5.0	(1945)	T	(1963)*
Jun	0.0		0.0		0.0		0.0	
Jul	0.0		0.0		0.0		0.0	
Aug	0.0		0.0		0.0		0.0	
Sep	0.0		T	(1959)*	0.0		0.0	
Oct	0.5	(1884)	3.8	(1969)	3.0	(1884)	T	(1963)*
Nov	17.8	(1898)	24.3	(1921)	25.0	(1873)	6.4	(1961)
Dec	27.9	(1970)	54.8	(1970)	43.0	(1876)	42.5	(1956)
Years	1872-1978		1882-1978		1871-1978		1954-1967	

*T = Trace (less than 0.1 inches)

References : (8, 17, 18), (9, 19), (1, 10), (24)

TABLE 2.3-30 MEAN NUMBER OF DAYS WITH HEAVY FOG*

	Boston	Portland	Concord
Jan	2	2	2
Feb	2	2	2
Mar	2	4	3
Apr	2	3	2
May	3	6	3
Jun	2	6	4
Jul	2	7	6
Aug	2	6	7
Sep	2	6	9
Oct	2	5	7
Nov	2	4	4
Dec	1	2	3
Annual	23	52	51
Years of Data	1936-1977	1941 – 1977	1942 - 1977

*Heavy fog = visibility of ¼ mile or less

References : 8, 9, 10

TABLE 2.3-31 ANNUAL FREQUENCY OF FOG AT PEASE AFB (REFERENCE 24)

Month	Percent of Hours
Jan	13.5
Feb	12.3
Mar	13.3
Apr	16.6
May	13.9
Jun	18.1
Jul	15.3
Aug	12.2
Sep	16.9
Oct	19.0
Nov	17.0
Dec	14.2
Annual	15.2
Years of Data	1956-1961

TABLE 2.3-32 MEAN NUMBER OF HOURS PER MONTH WITH VISIBILITY LESS THAN 0.5 MILES AT PEASE AFB (REFERENCE 11)

Jan	15
Feb	18
Mar	15
Apr	10
May	14
Jun	12
Jul	17
Aug	13
Sep	19
Oct	20
Nov	16
Dec	18
Annual	187
Years of Data	Apr. 1956-1970

TABLE 2.3-33 – FREQUENCY AND PERSISTENCE OF FOG AT PORTLAND (REFERENCE 32)

	Frequency	Persistence Summary (Number of Occurrences By Hours) *													
Month	**(Percent of Obs.)**	**3**	**6**	**9**	**12**	**15**	**18**	**21**	**24**	**27**	**30**	**33**	**36-39**	**42-45**	**45**
Jan	10	24	11	12	5	5	3	6	3	1	0	0	1	1	0
Feb	12	15	7	11	6	5	3	2	5	3	2	0	3	1	0
Mar	17	19	9	13	11	5	11	5	1	1	1	0	3	2	5
Apr	15	29	19	8	15	6	5	3	4	0	3	1	2	1	1
May	21	26	25	13	10	13	8	6	7	5	2	2	3	0	2
Jun	28	44	34	20	17	13	5	12	3	4	1	1	1	3	5
Jul	22	42	28	28	13	13	8	4	2	2	0	1	3	1	3
Aug	21	30	23	33	14	13	11	1	7	0	0	2	2	0	3
Sep	25	37	25	19	17	12	5	11	5	3	4	0	4	1	2
Oct	19	32	19	14	11	10	7	2	3	2	4	1	5	1	2
Nov	18	24	26	14	13	12	6	1	3	3	1	2	1	1	2
Dec	16	18	9	9	14	13	8	3	3	3	1	0	4	1	1
Annual	**19**	**326**	**225**	**192**	**147**	**120**	**80**	**54**	**48**	**26**	**18**	**8**	**33**	**14**	**28**

Years of Data	1968-1977
Reference	(29a)

* Number of occurrences are based on observations made once every 3 hours and each observation was assumed to persist for 3 hours.

TABLE 2.3-34 PRE-CONSTRUCTION SEABROOK METEOROLOGICAL MEASUREMENT SYSTEM

30 Foot Level	
Winds	
11/71 – 11/72	Six-bladed Bendix Aerovane with Bendix Model 141-2 dual recorder.
11/72 – 6/74	Bendix P/N 2414914 3-cup anemometer and P/N 2416970 vane system with Bendix Model 141-2 Dual strip chart recorder. Starting speed: less than 1 mph.
Ambient Air Temperature	
11/71 – 6/74	REC platinum temperature sensor, 400A REC resistance bridge, and Esterline-Angus multipoint recorder.
Dew Point	
3/72 – 6/74	Foxboro Dewcel H103AZ, Dewcel Weatherhood, REC 400A resistance bridge, Esterline-Angus multipoint recorder.
130 Foot Level	
Winds	
11/72 – 6/74	Bendix P/N 2414914 3-cup anemometer and P/N 2416970 vane system with Bendix Model 141-2 Dual strip chart recorder. Starting speed: less than 1 mph.
Delta T Temperature between 30 feet and 130 feet	
11/71 – 6/74	REC platinum temperature sensor, 400D differential bridge, 421 BX-2X differential chassis, Esterline-Angus multipoint recorder.

TABLE 2.3-35 **METEOROLOGICAL DATA RECOVERY**

PRE-CONSTRUCTION PROGRAM			
Parameter	Possible Hours	Useable Hours	Recovery Rate
30 Foot Wind Direction*	8784	8782	100.0%
30 Foot Wind Speed*	8784	8684	98.9
30 Foot Air Temperature*	8784	8727	99.4
30 Foot Dew Point+	8760	8266	94.3
130-30 Foot Delta T*	8784	8628	98.2

PRE-OPERATIONAL PROGRAM		
	Recovery Date	
Parameters	Apr. 79 - Mar. 80	Jun. 80 - May 81
43 Foot Wind Speed	98.8%	99.9%
209 Foot Wind Speed	98.6%	99.9%
43 Foot Wind Direction	98.5%	99.4%
209 Foot Wind Direction	98.8%	99.9%
43 Foot Temperature	98.8%	99.9%
43-150 Foot Delta Temperature	98.1%	96.9%
43-209 Foot Delta Temperature	98.6%	99.7%
Composite (43' WS, 43' WD, 43'-150' DT)	97.7%	96.4%
Composite (209' WS, 209' WD, 43'-209' DT)	98.3%	99.6%

* Period November 1971 - October 1972

\+ Period April 1972 - March 1973

TABLE 2.3-36 – METEOROLOGICAL INSTRUMENTATION SPECIFICATIONS FOR THE PRE-OPERATIONAL MONITORING PROGRAM

Parameters	System Accuracy Root-Sum-Squared Time Averaged	Sensors				Translators		Analog Recorder		A/D Convertor	
		Manufacturer & Model	Range	Accuracy	Threshold or Sensitivity	Manufacturer & Model	Accuracy	Manufacturer & Model	Accuracy	Manufacturer & Model	Accuracy
Wind Speed	<± 0.5 mph	Climatronics F460 Transmitter	0 to 100 mph	± 0.15 mph or 1%	0. 58 mph Threshold	Climatronics 100078	± 0.2%	Esterline Angus L11S2S 4 ½" Chart	± 0.25%	Mod Comp 1400 Analog Input Subsystem	± 0.05%
Wind Direction	<± 5.0°	Climatronics F460 Transmitter	0° to 540°	± 3°	0.58 mph Threshold	Climatronics 100077	± 0.05%				
Temperature and Delta Temp.	Temp: <± 0.9°F Delta T: <± 0.18°F	Teledyne Geotech 327 Asp. Shield Rosemont 78 Platinum Sensors Rosemont 414L Temp Bridge	Temp: -30° to +110°F Delta T: -10° to +18°F	Sensor: ± 0.47°F @ 0°C ± 0.95°F @ 100°C Bridge: ±0.1% of Span	Temp: ± 0.2°F Maximum Radiation Effect	Climatronics 100142 100143	± 0.05%	Esterline Angus E1124E 8 Channel Multipoint 10" Chart	± 0.25%		
Dew Point	<± 0.9°F	Gen. Eastern 1200 APS [(a)]	-30° to +110°F	± 0.36°F	N/A	Climatronics 100089	± 0.05%				
Precipitation	± 0.01 inch (Instantaneous)	Belfort 5-405H Precip.	N/A	± 1% to ± 6% of Rainfall Rate	± 0.01 inch Sensitivity	Climatronics 100157	± 0.05%				
Solar Radiation	<± 0.1 Cal/cm^2-min	Eppley 8-48 Pyranometer	0 to 2 Cal/cm^2-min	± 2% to ± 5%	75 mV per Cal/cm^2-min Sensitivity	Climatronics 100144	± 0.05%				

(a) The General Eastern dew point system was replaced in May 1981 with a Climatronics Model DP-10 lithium chloride dew point system with a range from -30°F to 110°F and an accuracy of ± 0.9°F.

TABLE 2.3-37 METEOROLOGICAL INSTRUMENTATION SPECIFICATIONS FOR THE OPERATIONAL MONITORING PROGRAM (PRIMARY SYSTEM)

VARIABLE	RANGE	SYSTEM PERFORMANCE SPECIFICATIONS
Wind Speed	0 to 100 mph	≤ ±0.5 mph for speeds Less than 5 mph; ≤ ±10% for speeds greater than 5 mph, starting speed < 1.0 mph; distance constant ≤ 2 meters
Wind Direction	0° to 540°	≤ ± 5°; starting speed < 1.0 mph; damping ratio ≥ 0.4; delay distance ≤ 2 meters
Delta-Temp and Temperature	Delta-Temp: -10° to +18°F Temp: -30° to +110°F	Delta-Temp: ≤ ±0.3°F per 164 feet Temp: ≤ ±0.9°F
Precip.	0 to 99 in/15-min	N/A
Solar Radiation	0 to 2 Langley/min	N/A

NOTES:

1. The system performance requirements listed for wind speed, wind direction and delta-temp are those delineated in Revision 3 of Regulatory Guide 1.97 (See Section 7.5 for additional information); the system performance requirements listed for temperature are delineated in Revision 0 to Regulatory Guide 1.23. All performance requirements are applicable to the digital system only.

2. The wind speed distance constant and wind direction damping ration and delay distance performance requirements are applicable to the sensors only. The constants built into the wind translators may dampen the sensors' responses; however, the resulting dampened signals are still appropriate for determining average wind speed and direction.

TABLE 2.3-38 **SEABROOK SECTOR DEPENDENT ACCIDENT DILUTION FACTORS FOR THE EXCLUSION RADIUS**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-39 **SEABROOK SECTOR DEPENDENT ACCIDENT DILUTION FACTORS FOR THE LOW POPULATION ZONE**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-40 **SEABROOK OVERALL-SITE ACCIDENT DILUTION FACTOR PROBABILITY DISTRIBUTION -EXCLUSION RADIUS CONCENTRATION CHI/Q VALUES (SEC/M3)**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-41 **SEABROOK OVERALL-SITE ACCIDENT DILUTION FACTOR PROBABILITY DISTRIBUTION -EXCLUSION RADIUS EFFECTIVE GAMMA CHI/Q VALUES (SEC/M3)**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-42 **SEABROOK MAXIMUM SECTOR ACCIDENT DILUTION FACTOR PROBABILITY DISTRIBUTION-EXCLUSION RADIUS CONCENTRATION CHI/Q VALUES (SEC/M3)**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-43 **SEABROOK MAXIMUM SECTOR ACCIDENT DILUTION FACTOR PROBABILITY DISTRIBUTION -EXCLUSION RADIUS EFFECTIVE GAMMA CHI/Q VALUES (SEC/M3)**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-44 **SEABROOK OVERALL-SITE ACCIDENT DILUTION FACTOR PROBABILITY DISTRIBUTION -LOW POPULATION ZONE CONCENTRATION CHI/Q VALUES (SEC/M3)**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-45 **SEABROOK OVERALL-SITE ACCIDENT DILUTION FACTOR PROBABILITY DISTRIBUTION -LOW POPULATION ZONE EFFECTIVE GAMMA CHI/Q VALUES (SEC/M3)**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-46 **SEABROOK MAXIMUM SECTOR ACCIDENT DILUTION FACTOR PROBABILITY DISTRIBUTION -LOW POPULATION ZONE CONCENTRATION CHI/Q VALUES (SEC/M3)**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-47 **SEABROOK MAXIMUM SECTOR ACCIDENT DILUTION FACTOR PROBABILITY DISTRIBUTION -LOW POPULATION ZONE EFFECTIVE GAMMA CHI/Q VALUES (SEC/M3)**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-48 SUMMARY OF DILUTION FACTORS AT THE EXCLUSION RADIUS (SEC/M^3) 914 METERS, APR 79 – MAR 80 ONSITE METEOROLOGY

	Time Interval	Maximum (ESE) Sector Values [(a)]	Overall-Site Values [(b)]
I. Concentration CHI/Q Values			
A. Conservative Estimates	0-1 Hour	2.67×10^{-4}	2.32×10^{-4}
	1-2 Hours	1.88×10^{-4}	1.72×10^{-4}
	2-8 Hours	1.02×10^{-4}	9.35×10^{-5}
	8-24 Hours	2.58×10^{-5}	2.64×10^{-5}
	1-4 Days	1.43×10^{-5}	1.49×10^{-5}
	4-30 Days	7.78×10^{-6}	7.57×10^{-6}
B. Realistic Estimates	0-1 Hour	3.53×10^{-5}	3.78×10^{-5}
	1-2 Hours	2.66×10^{-5}	2.83×10^{-5}
	2-8 Hours	1.44×10^{-5}	2.26×10^{-5}
	8-24 Hours	5.97×10^{-6}	1.06×10^{-5}
	1-4 Days	5.21×10^{-6}	7.45×10^{-6}
	4-30 Days	5.74×10^{-6}	5.81×10^{-6}
II. Effective Gamma CHI/Q Values			
A. Conservative Estimates	0-1 Hour	2.98×10^{-5}	3.00×10^{-5}
	1-2 Hours	2.05×10^{-5}	2.13×10^{-5}
	2-8 Hours	1.14×10^{-5}	1.12×10^{-5}
	8-24 Hours	6.02×10^{-6}	6.21×10^{-6}
	1-4 Days	3.71×10^{-6}	3.74×10^{-6}
	4-30 Days	2.37×10^{-6}	2.31×10^{-6}
B. Realistic Estimates	0-1 Hour	6.19×10^{-6}	7.23×10^{-6}
	1-2 Hours	4.75×10^{-6}	5.73×10^{-6}
	2-8 Hours	2.66×10^{-6}	4.30×10^{-6}
	8-24 Hours	1.91×10^{-6}	3.39×10^{-6}
	1-4 Days	1.48×10^{-6}	2.21×10^{-6}
	4-30 Days	1.61×10^{-6}	1.63×10^{-6}

(a) The maximum sector conservative CHI/Q values represent the ESE sector's values which are exceeded 0.5% of the total time; the maximum sector realistic CHI/Q values represent the ESE sector's median values.

(b) The overall-site conservative CHI/Q values represent the overall-site values which are exceeded 5% of the total time; the overall-site realistic CHI/Q values represent the overall-site median values.

TABLE 2.3-49 SUMMARY OF DILUTION FACTORS AT THE LOW POPULATION ZONE (SEC/M^3) 2012 METERS, APR 79 – MAR 80 ONSITE METEOROLOGY

			Maximum (ESE) Sector Values [(a)]	Overall-Site Values [(b)]
I.	Concentration CHI/Q Values			
	A. Conservative Estimates	0-1 Hour	1.31×10^{-4}	1.10×10^{-4}
		1-2 Hours	9.17×10^{-5}	8.31×10^{-5}
		2-8 Hours	4.82×10^{-5}	4.49×10^{-5}
		8-24 Hours	7.21×10^{-6}	7.50×10^{-6}
		1-4 Days	4.25×10^{-6}	4.32×10^{-6}
		4-30 Days	2.25×10^{-6}	2.20×10^{-6}
	B. Realistic Estimates	0-1 Hour	1.25×10^{-5}	1.35×10^{-5}
		1-2 Hours	9.68×10^{-6}	1.08×10^{-5}
		2-8 Hours	5.54×10^{-6}	8.53×10^{-6}
		8-24 Hours	1.80×10^{-6}	3.25×10^{-6}
		1-4 Days	1.52×10^{-6}	2.23×10^{-6}
		4-30 Days	1.70×10^{-6}	1.71×10^{-6}
II.	Effective Gamma CHI/Q Values			
	A. Conservative Estimates	0-1 Hour	1.15×10^{-5}	1.20×10^{-5}
		1-2 Hours	8.19×10^{-6}	8.26×10^{-6}
		2-8 Hours	4.43×10^{-6}	4.39×10^{-6}
		8-24 Hours	2.33×10^{-6}	2.43×10^{-6}
		1-4 Days	1.44×10^{-6}	1.45×10^{-6}
		4-30 Days	9.05×10^{-7}	8.81×10^{-7}
	B. Realistic Estimates	0-1 Hour	2.35×10^{-6}	2.77×10^{-6}
		1-2 Hours	1.82×10^{-6}	2.19×10^{-6}
		2-8 Hours	9.99×10^{-7}	1.66×10^{-6}
		8-24 Hours	7.20×10^{-7}	1.30×10^{-6}
		1-4 Days	5.54×10^{-7}	8.53×10^{-7}
		4-30 Days	6.15×10^{-7}	$6.21 \times 10-^{7}$

(a) The maximum sector conservative CHI/Q values represent the ESE sector's values which are exceeded 0.5% of the total time; the maximum sector realistic CHI/Q values represent the ESE sector's median values.

(b) The overall-site conservative CHI/Q values represent the overall-site values which are exceeded 5% of the total time; the overall-site realistic CHI/Q values represent the overall-site median values.

TABLE 2.3-50 **SEABROOK ANNUAL AVERAGE CHI/Q BEFORE DEPLETION (SEC/M3) PRIMARY VENT STACK RELEASE**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-51 **SEABROOK ANNUAL AVERAGE CHI/Q AFTER DEPLETION (SEC/M3) PRIMARY VENT STACK RELEASE**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-52 SEABROOK ANNUAL AVERAGE DEPOSITION RATES (1/M2) PRIMARY VENT STACK RELEASE

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-53 **SEABROOK ANNUAL AVERAGE EFFECTIVE GAMMA CHI/Q (SEC/M3) PRIMARY VENT STACK RELEASE**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-54 **SEABROOK ANNUAL AVERAGE CHI/Q BEFORE DEPLETION (SEC/M3) TURBINE BUILDING RELEASE**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-55 **SEABROOK ANNUAL AVERAGE CHI/Q AFTER DEPLETION (SEC/M3) TURBINE BUILDING RELEASE**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-56 **SEABROOK ANNUAL AVERAGE DEPLETION RATES (1/M2) TURBINE BUILDING RELEASE**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-57 **SEABROOK ANNUAL AVERAGE EFFECTIVE GAMMA CHI/Q (SEC/M3) TURBINE BUILDING RELEASE**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.3-58 ESTIMATED FREQUENCY OF TIBL FORMATION AND SEA BREEZE CONDITIONS AT THE SEABROOK SITE APRIL 1979 – SEPTEMBER 1979

		TIBL Formation			Sea Breeze Conditions		
Month	No. of Good Hourly Obs.	No. of Hours	No. of Days	% of Good Hourly Obs.	No. of Hours	No. of Days	% of Good Hourly Obs.
April	687	67	15	9.8	42	12	6.1
May	660	67	13	10.2	26	8	4.0
June	718	133	22	18.5	79	21	11.0
July	735	117	22	15.9	92	22	12.5
August	740	80	16	10.8	67	15	9.1
September	720	63	12	8.8	45	11	6.3
Total – (Apr-Sept)	4260	527	100	12.4	351	89	8.2

TABLE 2.3-59 ANNUAL AVERAGE TIBL TERRAIN CORRECTION FACTORS PRIMARY VENT STACK RELEASE CHI/Q (BEFORE DEPLETION)

Downwind Sector	Distance From Release Point (Miles)								
	No. OBS	.25	.50	.75	1.00	1.50	2.00	2.50	3.00
N	386	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NNE	525	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NE	670	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ENE	763	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E	891	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ESE	1530	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	858	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSE	334	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
S	328	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSW	221	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SW	348	1.00	1.00	1.00	1.01	1.01	1.00	1.01	1.00
WSW	316	.99	1.02	1.07	1.07	1.05	1.03	1.03	1.01
W	385	.97	1.03	1.07	1.07	1.04	1.02	1.02	1.00
WNW	351	.99	1.04	1.08	1.09	1.07	1.07	1.02	1.02
NW	411	1.00	1.10	1.19	1.17	1.09	1.07	1.07	1.06
NNW	309	1.00	1.00	1.02	1.02	1.02	1.02	1.02	1.01
Average	8626	1.00	1.01	1.02	1.02	1.02	1.01	1.01	1.01

Downwind Sector	Distance From Release Point (Miles)								
	No. OBS	3.50	4.00	4.50	5.00	7.50	10.00	15.01	20.00
N	386	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NNE	525	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NE	670	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ENE	763	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E	891	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ESE	1530	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	858	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSE	334	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
S	328	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSW	221	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SW	348	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
WSW	316	1.01	1.01	1.01	1.01	1.01	1.01	1.00	1.00
W	385	1.00	1.00	1.00	1.00	1.00	1.00	1.00	.99
WNW	351	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.01
NW	411	1.04	1.04	1.04	1.04	1.04	1.03	1.03	1.02
NNW	309	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
Average	8626	1.01	1.01	1.00	1.00	1.00	1.00	1.00	1.00

TABLE 2.3-60 ANNUAL AVERAGE TIBL TERRAIN CORRECTION FACTORS PRIMARY VENT STACK RELEASE CHI/Q (AFTER DEPLETION)

Downwind Sector	Distance From Release Point (Miles)								
	No. OBS	.25	.50	.75	1.00	1.50	2.00	2.50	3.00
N	386	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NNE	525	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NE	670	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ENE	763	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E	891	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ESE	1530	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	858	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSE	334	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
S	328	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSW	221	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SW	348	1.00	1.00	1.00	1.01	1.01	1.00	1.00	1.00
WSW	316	.99	1.03	1.07	1.07	1.05	1.03	1.03	1.01
W	385	.98	1.03	1.07	1.07	1.04	1.02	1.02	1.00
WNW	351	.99	1.04	1.09	1.09	1.07	1.07	1.02	1.02
NW	411	1.00	1.11	1.20	1.17	1.09	1.07	1.07	1.06
NNW	309	1.00	1.00	1.02	1.02	1.02	1.02	1.02	1.01
Average	8626	1.00	1.01	1.02	1.02	1.02	1.01	1.01	1.01

Downwind Sector	Distance From Release Point (Miles)								
	No. OBS	3.50	4.00	4.50	5.00	7.50	10.00	15.01	20.00
N	386	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NNE	525	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NE	670	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ENE	763	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E	891	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ESE	1530	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	858	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSE	334	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
S	328	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSW	221	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SW	348	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
WSW	316	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
W	385	1.00	1.00	1.00	1.00	1.01	1.01	1.00	1.00
WNW	351	1.02	1.02	1.02	1.02	1.03	1.03	1.02	1.02
NW	411	1.04	1.04	1.04	1.04	1.04	1.04	1.03	1.03
NNW	309	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
Average	8626	1.01	1.01	1.01	1.01	1.01	1.00	1.00	1.00

TABLE 2.3-61 ANNUAL AVERAGE TIBL TERRAIN CORRECTION FACTORS PRIMARY VENT STACK RELEASE DEPOSITION RATES

Downwind	Distance From Release Point (Miles)								
Sector	No. OBS	.25	.50	.75	1.00	1.50	2.00	2.50	3.00
N	386	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NNE	525	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NE	670	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ENE	763	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E	891	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ESE	1530	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	858	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSE	334	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
S	328	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSW	221	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SW	348	1.00	1.00	1.00	1.01	1.01	1.01	1.01	1.01
WSW	316	1.00	1.02	1.06	1.07	1.06	1.05	1.05	1.02
W	385	.98	1.03	1.07	1.08	1.06	1.04	1.04	1.02
WNW	351	.99	1.04	1.10	1.11	1.10	1.10	1.04	1.04
NW	411	1.00	1.13	1.24	1.22	1.14	1.12	1.11	1.10
NNW	309	1.00	1.01	1.02	1.03	1.03	1.03	1.03	1.03
Average	8626	1.00	1.01	1.02	1.02	1.02	1.02	1.01	1.01

Downwind	Distance From Release Point (Miles)								
Sector	No. OBS	3.50	4.00	4.50	5.00	7.50	10.00	15.01	20.00
N	386	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NNE	525	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NE	670	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ENE	763	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E	891	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ESE	1530	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	858	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSE	334	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
S	328	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSW	221	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SW	348	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
WSW	316	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
W	385	1.01	1.01	1.01	1.02	1.02	1.02	1.02	1.01
WNW	351	1.05	1.05	1.05	1.05	1.06	1.06	1.06	1.05
NW	411	1.08	1.08	1.08	1.08	1.08	1.08	1.07	1.07
NNW	309	1.02	1.03	1.02	1.02	1.02	1.03	1.02	1.02
Average	8626	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01

TABLE 2.3-62 ANNUAL AVERAGE TIBL TERRAIN CORRECTION FACTORS PRIMARY VENT STACK RELEASE EFFECTIVE GAMMA CHI/Q

Downwind		Distance From Release Point (Miles)							
Sector	**No. OBS**	**.25**	**.50**	**.75**	**1.00**	**1.50**	**2.00**	**2.50**	**3.00**
N	386	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NNE	525	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NE	670	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ENE	763	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E	891	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ESE	1530	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	858	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSE	334	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
S	328	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSW	221	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SW	348	1.00	1.00	1.01	1.01	1.01	1.01	1.01	1.01
WSW	316	1.01	1.03	1.05	1.05	1.05	1.05	1.05	1.03
W	385	1.02	1.06	1.08	1.08	1.08	1.08	1.08	1.06
WNW	351	1.02	1.07	1.11	1.12	1.13	1.13	1.08	1.07
NW	411	1.04	1.12	1.17	1.17	1.14	1.14	1.14	1.13
NNW	309	1.00	1.01	1.02	1.03	1.03	1.03	1.03	1.03
Average	8626	1.00	1.01	1.02	1.02	1.02	1.02	1.02	1.02

Downwind		Distance From Release Point (Miles)							
Sector	**No. OBS**	**3.50**	**4.00**	**4.50**	**5.00**	**7.50**	**10.00**	**15.01**	**20.00**
N	386	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NNE	525	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
NE	670	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ENE	763	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
E	891	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ESE	1530	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SE	858	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSE	334	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
S	328	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SSW	221	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SW	348	1.01	1.01	1.01	1.01	1.01	1.01	1.01	1.01
WSW	316	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.02
W	385	1.05	1.06	1.04	1.04	1.05	1.05	1.05	1.05
WNW	351	1.08	1.08	1.08	1.09	1.09	1.10	1.10	1.09
NW	411	1.11	1.11	1.11	1.11	1.11	1.11	1.10	1.10
NNW	309	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
Average	8626	1.02	1.02	1.02	1.02	1.02	1.01	1.01	1.01

TABLE 2.4-1 **TIDAL FLOOD ELEVATIONS BOSTON, MASSACHUSETTS TO PORTLAND, MAINE**

	TIDAL ELEVATIONS (FT. MSL)		
STORM	BOSTON (OBSERVED)	NEW HAMPSHIRE (ESTIMATED)	PORTLAND (OBSERVED)
9-21-38*	6.4	6.5	6.8
9-14-44*	6.6	5.4	5.0
11-30-44	8.8	8.4	8.7
11-20-45	7.9	8.0	8.7
8-31-54*	8.2	7.7°	7.9
12-29-59	9.3	8.4	8.5
1-20-61	9.3	8.3	8.3
11-30-63	7.4	7.5	7.9
2-7-78	10.3	9.1+	9.6

*Hurricane +Record High °Record Hurricane High

TABLE 2.4-2 ANNUAL FREQUENCY OF OCCURRENCE FOR TIDES* IN EXCESS OF MHW

Portsmouth Navy Yard, Maine

Height Above MHW	Average Annual Occurrence
1 Foot	107 times
2 Feet	12 times
3 Feet	0.51 times
3.5 Feet	0.17 times

* Astronomical tide combined with surge

TABLE 2.4-3 TIDES EXCEEDING MHW AT PORTSMOUTH NAVY YARD, MAINE

Feet in Excess of MHW	Number of Occurrences
2.0	54
2.1	42
2.2	40
2.3	18
2.4	18
2.5	14
2.6	10
2.7	3
2.8	2
2.9	5
3.0	2
3.1	1
3.2	1
3.3	2
3.4	0
3.5	1
3.6	1
3.7	0
3.8	0
3.9	1 (11-30-44 storm)

TABLE 2.4-4 COMPARISON OF HAMPTON HARBOR TIDAL PARAMETERS

	Hampton Harbor
Mean Tidal Range	8.3 feet
Spring Tidal Range	9.5 feet
Highest Predicted Astronomical Tide*	10.8 feet MLW
Mean High Water (MHW)	8.3 feet MLW
Mean Sea Level (MSL)	4.15 feet MLW
Mean Low Water (MLW)	0.00 feet MWL
Lowest Predicted Astronomical Tide*	-2.2 feet MLW

* Based on Portland, Maine tidal information and converted to Hampton Harbor.

TABLE 2.4-5 PREDICTED ASTRONOMICAL TIDES FOR HAMPTON HARBOR

Year	Highest Tide of Year Feet MLW	Number of Times High Tide of 10.6 Feet MLW is Exceeded
1978	10.6	0
1977	10.7	4
1976	10.7	6
1975	10.6	0
1974	10.5	0
1973	10.6	0
1972	10.6	0
1971	10.6	0
1970	10.3	0
1969	10.4	0
1968	10.5	0
1967	10.5	0
1966	10.3	0
1965	10.4	0
1964	10.6	0
1963	10.6	0
1962	10.4	0
1961	10.7	1
1960	10.8	4
1959	10.8	7
1958	10.7	1
1957	10.6	0
1956	10.6	0
1955	10.7	2
1954	10.6	0

Reference: 34

TABLE 2.4-6 OPEN COAST PMH STORM SURGE RESULTS

Run No.	Radius of Maximum Winds R(Nautical Miles)	Translational Velocity V_T (Knots)	Maximum Open Coast Stillwater Elevation		Wind Stress Coefficients X10^{-6}	
			Feet Above MLW	Feet Above MSL	Constant	Constant Multiplier
1	30	37	16.23	12.08*	1.1	1.6
2	56	37	16.48	12.33*	1.1	1.6
3	30	52	16.36	12.21*	1.1	1.6
4	56	52	16.59	12.44*	1.1	1.6
5	56	52	17.5	13.4**	1.1	1.6
6	56	52	18.6	14.5**	1.1	2.5

* Includes storm surge and astronomical tide of +10.6 feet MLW.

** Includes storm surge, astronomical tide of +10.6 feet (MLW) and initial surge of 0.9 feet (sea-level anomaly).

TABLE 2.4-7 **HAMPTON HARBOR SURGE, CASE NO. 1 - COEFFICIENT OF DISCHARGE = 0.55**

Surge Hydrograph in an Enclosed Bay Due to Inlet Flow

Time in Hours	Open Coast Surge (HO) in Feet*	Surge in Bay (H) in Feet*
0.00	0.000	0.000
0.20	0.200	0.076
0.40	0.500	0.225
0.60	0.800	0.424
0.80	1.000	0.641
1.00	1.300	0.874
1.20	1.600	1.133
1.40	2.000	1.426
1.60	2.400	1.759
1.79	2.800	2.122
2.00	3.700	2.585
2.20	4.100	3.119
2.40	4.800	3.685
2.59	5.600	4.336
2.80	6.000	4.999
3.00	6.600	5.641
3.20	7.600	6.372
3.40	8.000	7.119
3.59	8.700	7.828
3.80	9.300	8.533
4.00	10.000	9.172
4.19	10.800	9.802
4.40	11.600	10.447
4.60	12.600	11.133
4.80	13.400	11.843
5.00	14.400	12.574
5.19	15.400	13.345
5.40	16.000	14.100
5.60	16.300	14.771
5.80	16.600	15.351
6.00	16.400	15.798
6.19	16.200	16.059
6.40	15.600	15.941
6.60	14.800	16.624
6.80	14.000	15.218
7.00	13.400	14.770
7.19	12.800	14.300
7.39	11.800	13.793
7.60	11.000	13.248
7.80	10.200	12.679
8.00	9.500	12.089
8.20	9.000	11.486

* Feet above MLW

TABLE 2.4-8 HAMPTON HARBOR SURGE CASE NO. 2 – COEFFICIENT OF DISCHARGE = 0.60

SURGE HYDROGRAPH IN AN ENCLOSED BAY DUE TO INLET FLOW

TIME IN HOURS	OPEN COAST SURGE (HO) IN FEET*	SURGE IN BAY (H) IN FEET*
0.00	0.000	0.000
0.20	0.200	0.081
0.40	0.500	0.240
0.60	0.800	0.450
0.80	1.000	0.676
1.00	1.300	0.917
1.20	1.600	1.183
1.40	2.000	1.485
1.60	2.400	1.827
1.79	2.800	2.200
2.00	3.700	2.679
2.20	4.100	3.229
2.40	4.800	3.808
2.59	5.600	4.474
2.80	6.000	5.145
3.00	6.600	5.786
3.20	7.600	6.524
3.40	8.000	7.271
3.59	8.700	7.972
3.80	9.300	8.662
4.00	10.000	9.283
4.19	10.800	9.912
4.40	11.600	10.563
4.60	12.600	11.261
4.80	13.400	11.984
5.00	14.400	12.731
5.19	15.400	13.518
5.40	16.000	14.287
5.60	16.300	14.963
5.80	16.600	15.539
6.00	16.400	15.966
6.19	16.200	16.163
6.40	15.600	15.987
6.60	14.800	15.634
6.80	14.000	15.193
7.00	13.400	14.709
7.19	12.800	14.207
7.39	11.800	13.664
7.60	11.000	13.080
7.80	10.200	12.470
8.00	9.500	11.836
8.20	9.000	11.186

*Feet Above MLW

TABLE 2.4-9 HAMPTON HARBOR SURGE CASE NO. 2 – COEFFICIENT OF DISCHARGE = 0.65

SURGE HYDROGRAPH IN AN ENCLOSED BAY DUE TO INLET FLOW

TIME IN HOURS	OPEN COAST SURGE (HO) IN FEET*	SURGE IN BAY (H) IN FEET*
0.00	0.000	0.000
0.20	0.200	0.087
0.40	0.500	0.254
0.60	0.800	0.474
0.80	1.000	0.708
1.00	1.300	0.956
1.20	1.600	1.228
1.40	2.000	1.537
1.60	2.400	1.887
1.79	2.800	2.267
2.00	3.700	2.760
2.20	4.100	3.325
2.40	4.800	3.914
2.59	5.600	4.593
2.80	6.000	5.269
3.00	6.600	5.907
3.20	7.600	6.650
3.40	8.000	7.394
3.59	8.700	8.087
3.80	9.300	8.755
4.00	10.000	9.368
4.19	10.800	10.000
4.40	11.600	10.659
4.60	12.600	11.369
4.80	13.400	12.106
5.00	14.400	12.866
5.19	15.400	13.670
5.40	16.000	14.450
5.60	16.300	15.130
5.80	16.600	15.699
6.00	16.400	16.104
6.19	16.200	16.229
6.40	15.600	16.988
6.60	14.800	15.616
6.80	14.000	15.144
7.00	13.400	14.630
7.19	12.800	14.099
7.39	11.800	13.526
7.60	11.000	12.907
7.80	10.200	12.258
8.00	9.500	11.585
8.20	9.000	10.896

*Feet Above MLW

TABLE 2.4-10 EFFECTIVE FETCHES IN HAMPTON HARBOR DURING COMBINED PMH – SPF EVENT

TIME HRS	WIND DIRECTION	WIND SPEED FPS	EFFECTIVE FETCH LENGTH FT.	AVERAGE WATER DEPTH FT.	MAXIMUM WAVE HT. FT.	SIGNIFICANT WAVE HEIGHT FT.	GENERATED WAVE PER. SEC
-1.4	N44°E	143.6	11,800	8.2	6.4	4.2	3.7
-1.0	N74°E	155.4	10,750	13.0	8.6	5.7	4.3
- .80	N85°E	157.3	10,460	15.3	9.0	5.9	4.4
- .60	S85°E	159.3	10,160	16.2	9.6	6.3	4.5
- .40	S75°W	163.9	10,120	15.4	9.6	6.3	4.5
- .20	S64°E	167.1	11,400	16.6	10.3	6.8	4.7
0	S58°E	168.4	12,300	17.0	10.6	7.0	4.7
+ .5	S52°E	152.8	12,600	16.4	9.7	6.4	4.6
+1.0	S40°E	124.0	12,200	10.6	6.7	4.4	3.8
+1.6	S34°E	104.5	11,800	9.1	5.5	3.6	3.5

Time ‘0’ corresponds to arrival of peak stillwater level at site.

TABLE 2.4-11 WAVE PERIOD ANALYSIS FOR HAMPTON HARBOR DURING COMBINED PMH-SPF EVENT

Time Hrs.	Fetch Direction	Diffraction Coefficient at Site	Diffraction Wave Height Ft.	Maximum Wave Height Ft.	Significant Wave Height Ft.	Regenerated Wave per Ft.
-1.0	N74°E	0.2	3.2	8.0*		4.3
-0.8	N85°E	0.3	5.2	8.5*		4.7
-0.6	S85°E	0.75	13.6	9.8*		5.4
-0.4	S75°W	0.45	8.4	10.7*		5.2
-0.2	S64°E	0.2	3.8	10.5	6.9	4.8
0	S58°E	0.17	3.6	10.9	7.2	4.8
+0.6	S50°E	0.14	2.8	8.0	5.3	4.2

* Waves controlled by available water depth

TABLE 2.4-12 **DESIGN BASIS WAVES AND COINCIDENT STILLWATER LEVEL ON CRITICAL SECTIONS OF PLANT**

SECTION	STILLWATER LEVEL Ft.—MLW	DESIGN WAVE	
		HGT., FT.	PERIOD, SEC.
1	19.7	2.0	4.8
4	19.7	5.8	4.8
5	19.7	7.9	4.8
6	19.7	7.9	4.8
7	19.7	3.9	4.8
8	18.1	2.1	4.3

TABLE 2.4-13 FLOW PATHWAY DISCHARGES - (CFS)

Water Elev. Behind Seawall (ft msl)	Flow Pathways					
	1	2	3	4	5	All Combined
20.6	86	251	263	0	0	600
20.7	113	332	348	0	0	793
20.8	142	423	440	0	0	1006
20.9	173	525	540	0	5	1243
21.0	210	635	647	5	10	1506
21.1	248	753	759	10	15	1786

TABLE 2.4-14 REVETMENT STONE SIZES

Revetment A

Class	Weight	Thickness, Ft.
Armor Stone*	1.5 T to 3.0 T	6
A Layer	300 lbs to 600 lbs	3
B Layer	15 lbs to 30 lbs	1.2

Revetment B

Class	Weight	Thickness, Ft.
B Layer	15 lbs to 30 lbs	1 – 2.5

Revetment C

Class	Weight	Thickness, Ft.
Armor Stone*	0.5 T to 1.0 T	4.8
A Layer	50 lbs to 200 lbs	2.2

* K_D = 3.0, Density of Rock = 165 lbs/cu. ft.

TABLE 2.4-15 WAVE FORCES ON VERTICAL SEA WALL SOUTH OF CONTAINMENT BUILDING NO. 1

<table>
<tr><th colspan="3">WAVE CONDITIONS / WAVE FORCES</th><th>BREAKING WAVE (MINIKIN METHOD)</th><th>BROKEN WAVE (WALL SEAWARD OF SHORELINE)</th></tr>
<tr><td rowspan="2">STATIC FORCES</td><td colspan="2">Pressure (psf)</td><td>804</td><td>905</td></tr>
<tr><td colspan="2">Thrust (lbs/ft of wall</td><td>5,047</td><td>6,398</td></tr>
<tr><td rowspan="4">DYNAMIC FORCES</td><td rowspan="2">Pressure (psf)</td><td>10% slope</td><td>9,136</td><td rowspan="2">381</td></tr>
<tr><td>5% slope</td><td>10,097</td></tr>
<tr><td rowspan="2">Thrust (lbs/ft of wall)</td><td>10% slope</td><td>24,089</td><td rowspan="2">2,111</td></tr>
<tr><td>5% slope</td><td>26,622</td></tr>
</table>

H = 7.9 ft. (Wave Height)

T = 4.8 sec. (Wave Period)

d_s = 8.6 ft. (Depth from stiliwater level to toe of vertical wall)

TABLE 2.4-16 WAVE FORCES ON RETAINING WALL NORTH SIDE OF SITE

WAVE FORCES \ WAVE CONDITIONS		NONBREAKING WAVES (Sainflou Method)
STATIC FORCES	Pressure (psf)	490
	Thrust (lbs/ft of wall	1,862
DYNAMIC FORCES	Pressure (psf)	104
	Thrust (lbs/ft of wall	1,078

H = 2.0 ft. (Wave Height)

T = 4.8 sec. (Wave Period)

d_s = 7.6 ft. (Depth from stiliwater level to toe of vertical wall)

TABLE 2.4-17 DRILLED WELL SUMMARY SHEET – SEABROOK STATION

Well No.	Mag. Grid Location Plant Grid Location N. Coord.	E. Coord.	Ground[1] Elev.	Depth (Feet)	Bottom Elev.	Inflow Depth(s)	Inflow Elev. (s)	Est. Yield (GPM)	Test[2] Yield (GPM)	Soil Depth (Ft)	Casing Depth (Ft)	Hole Diam. (In.)
1	MG 23698 PG 13143	79683 7000	22.50	143	-120.5	130	-107.5	80	70.8	6	21	6.0
2	MG 23466 PG 13029	79325 6589	16.00	205	-189	100 130 160	-84 –114 –144	15 20 45	90.0	20	42	6.5
3	MG 23480 PG 12910	79765 7013	13.00	175	-162	170	-157	80	100.2	27?	27	6.5
4	MG 23874 PG 13339	79589 6964	17.50	205	-187.5	?	?	12	---	21?	21	6.5
5	MG 21338 PG 12012	75974 2752	40.67	310	-269.3	160 160+	-119	15 5	27	32	43	6.5
6	MG 21035 PG 11405	77027 3664	31. 86	295	-263.1	85 265	-53 –233	2 to 3 25	33.3	11	21	6.5
7	MG 20676 PG 11083	76962 3494	36.76	400	-363.2	?	?	1	---	45+	68	6.5
8	MG 19665 PG 10428.2	75937 2212.3	43.51	400	-356.5	340	-296	45	40	62	92	6.0

Well No.	Mag. Grid Location / Plant Grid Location N. Coord.	E. Coord.	Ground[1] Elev.	Depth (Feet)	Bottom Elev.	Inflow Depth(s)	Inflow Elev. (s)	Est. Yield (GPM)	Test[2] Yield (GPM)	Soil Depth (Ft)	Casing Depth (Ft)	Hole Diam. (In.)
9	MG19653 PG 10565.6	75446 1739.7	45.16	400	-354.8	220±	-175	2	---	78	127	6.0
10	MG 19644 PG 10269.9	76394 2641.0	39.89	400	-360.1	150± 150±	-110	2.0 1.5	---	8	30	6.0
11	PG 14968.2	7130.7	19.24	246	-220.8	75 115 135 230	-55.8 –95.8 –115.8 –210.8	2 3 5 10	---	41	51	6.0
12	PG 14973.2	7147.8	18.39	41	-22.6	?	?	1.5	---	41	Set screen @ 25.1	
13	PG 13671.3	6515.3	21.97	240	-218	68 102	-46 –80	7 5	---	34	41	6.0
14	PG 12761.5	7465.4	12.51	200	-187.5	60 80 125 140	-47.5 –67.5 –112.5 -127.5	0.5 12+ 10+ 10+	---	6	21	6.0
15	MG 23665 PG 13176	79467 6784	17.75	200	-182.3	115 152	-97.3 -134.3	---	---	33	35	6.5

1. Top of Casing
2. 48-Hour Specific Capacity Pump Test

Note: Wells 4, 13, and 14 for observational purposes only. Wells 7, 9,10, 11 and 12 not developed due to insufficient water.

TABLE 2.4-18 RECORDS OF SELECTED WELLS AND TEST HOLES IN SOUTHEASTERN NEW HAMPSHIRE

Well no.	Location	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well	Diameter of well (inches)	Water-bearing material: Character	Water-bearing material: Geologic unit	Water level: Depth	Water level: Date	Type of pump	Use	Remarks
							SEABROOK							
1	W16-9	Town of Seabrook	1956	100	54	Dr	24	Sand and gravel	Ice-contact deposits	5.76	4-25-56	T	PS	Reported yield 450 gpm. T 47.
2	W16-9	do.	1956	105	49	Dr	24	do.	do.	5	-56	T	PS	Reported yield 350 gpm.
3	W16-9	L. R. Matthews	1930	105	110	Dr	6	-	Bedrock	35	-30	F	D	
4	W16-9	R. E. Bergeron	1952	100	26.5	Dg	36	Sand and gravel	Ice-contact deposits	17.92	5-9-56	J	D	
5	W16-9	Joseph Neves	1900	63	12.4	Dg	30	-	Till	3.00	5-9-56	S	D	Not in use in 1956.
6	X16-7	Parkman Clinic	-	45	13.3	Dg	36	Sand	Outwash and shore deposits	3.93	5-9-56	S	D	
7	X15-1	Lloyd Property	1900	63	22.0	Dg	36	do.	do.	16.08	4-25-56	S	D	
8	X16-8	Town of Seabrook	1955	14	15.0	Dg	96	do.	Beach deposits	9.26	4-25-56	None	PS	Fire protection well. Reported yield 60 gpm
9	X15-1	Carroll F. Randall	1946	65	150	Dr	6	-	Bedrock	-	-	J	D	
10	X16-7	T. L. Boyd	1930	25	9.0	Dg	18	Sand	Outwash and shore deposits	2.35	5-9-56	S	D	
11	X16-7	Dearbon Academy Assoc.	1900	58	10.8	Dg	36	do.	do.	7.15	5-9-56	None	U	
12	W16-9	Town of Seabrook	1955	45	16.5	Dn	2 ½	-	-	-	-	None	T	
13	W16-9	do.	1955	47	28.7	Dn	2 ½	-	-	4	-55	None	T	
14	W16-9	do.	1955	50	43.0	Dn	2 ½	-	-	+2	-55	None	T	
15	W16-9	do.	1955	54	45.0	Dn	2 ½	-	-	1.9	-55	None	T	
16	X16-7	do.	1955	45	94.3	Dn	2 ½	-	-	2.8	-55	None	T	
17	W16-9	do.	1955	40	33.5	Dn	2 ½	-	-	+2.8	-55	None	T	Reported natural flow 7 gpm.
18	X16-7	do.	1955	43	37.3	Dn	2 ½	-	-	9.3	-55	None	T	
19	X15-1	do.	1955	48	41.5	Dn	2 ½	-	-	2	-55	None	T	
20	X15-1	do.	1955	18	53.5	Dn	2 ½	-	-	4.3	-55	None	T	
21	W16-9	do.	1955	100	54.8	Dn	2 ½	-	-	6.7	-55	None	T	At same location as Seabrook 1.
22	W16-9	do.	1955	50	41.0	Dn	2 ½	-	-	Flowing	-55	None	T	Reported natural flow 6 gpm.
23	X15-1	do.	1955	60	61.3	Dn	2 ½	-	-	2	-55	None	T	
24	W16-9	do.	1955	65	38.9	Dn	2 ½	-	-	+4	-55	None	T	
25	W16-9	do.	1955	70	52.7	Dn	2 ½	-	-	2.8	-55	None	T	

Well no.	Location	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well	Diameter of well (inches)	Water-bearing material		Water Level		Type of pump	Use	Remarks
								Character	Geologic unit	Depth	Date			
							SOUTH HAMPTON							
1	W16-7	Guy E. Kenerson	1938	188	75	Dr	6	-	Bedrock	-	-	F	D	Reported yield 7 gpm.
2	W16-7	do.	1900	190	19.0	Dg	36	Sand and gravel	Ice-contact deposits	4.92	5-14-56	None	U	
3	W15-1	R. E. Lowry	1935	87	53	Dr	6	-	Bedrock	-	-	F	D	
4	W16-8	Edith M. Spurr	1945	250	200	Dr	6	-	do.	17	-45	J	D	Reported yield 12 gpm.
5	W16-7	Albert E. Gray	1948	130	123	Dr	6	-	do.	Flowing	-48	S	D	Reported yield 10 gpm. T 50.
6	W16-7	Edmund Roy	1955	110	19.8	Dg	24	Sand	Outwash and shore deposits	4.33	5-18-56	S	D	
7	W16-8	Adam J. Mazur	1900	185	13.0	Dg	36	-	Till	5.30	5-18-56	S	D	Not in use in 1956.
							NORTH HAMPTON							
1	X17-8	Paul Kelley	1954	110	138	Dr	8	-	Bedrock	20	-54	J	D	Reported yield 3 gpm.
2	X17-7	Lora Booker	1900	100	42.3	Dg	36	-	Till	35.31	4-13-56	L	D	Not in use in 1956.
3	X16-1	Charles Black	1900	70	23.8	Dg	36	-	do.	17.61	4-12-56	S	D	
4	X16-1	K. D. Bowers	1956	105	105	Dr	6	-	Bedrock	12	-56	J	D	Reported yield 4 gpm.
5	X16-1	R. A. Wright	1935	100	32.9	Dg	24	Sand and gravel	Ice-contact deposits	25.22	4-12-56	L	D	
6	X16-2	Wallace P. Hale	1954	122	100	Dr	8	-	Bedrock	45	-54	J	D	
7	X16-2	Hampton Water Works	1919	65	22	Dg	240	Sand and gravel	Ice-contact deposits	4.07	4-11-56	C	PS	Reported yield 450 gpm.
8	X16-2	do.	1919-1937	65	42	Dg-Dr	240-18	do.	do.	3.27	4-11-56	T	PS	Reported yield 450 gpm; 18-inch casing Installed inside 240-inch dug well in 1937.
9	X16-2	Hinckle Property	1900	30	18.5	Dg	36	-	Till	3.11	4-17-56	S	D	
10	X16-2	Mrs. J. Marshall	1953	83	175	Dr	6	-	Bedrock	Flowing	-53	J	D	Reported yield 8 gpm.
11	X16-1	Mrs. Irving Marsten	1948	85	74	Dr	6	Sand and gravel	Ice-contact deposits	32	-48	F	D	Reported yield 20 gpm.
12	X16-1	F. S. Snow	1947	95	179	Dr	6	-	Bedrock	23	-47	J	D	Reported yield 5 ½ gpm. T 55.
13	X16-1	Kenneth S. Ellingwood	1947	65	50	Dr	6	-	do.	12	-47	J	D	Reported yield 6 gpm.
14	X16-1	Abraham Lampert	1948	108	170	Dr	6	-	do.	26	-48	J	D	L. Reported yield 10 gpm. T 48.
							HAMPTON							
1	W16-3	Charles Mathews	1900	142	28.0	Dg	42	-	Till	18.82	12-8-53	S	U	T 51
2	X16-5	Otis Garland	1900	47	30.0	Dg	36	Sand and gravel	Ice-contact deposits	27.95	12-11-53	L	U	T 51
3	X16-5	Hampton Water Works	1937	75	54	Dr	18	do.	do.	8	-37	T	PS	Reported yield 460 gpm. T 52.
4	X16-1	Mrs. O. D. Colvin	1900	100	15.0	Dg	36	-	Till	5.89	4-11-56	S	D	
5	X16-4	Robert F. Walker	1952	60	32	Dg	42	Sand	Ice-contact deposits	7.04	4-12-56	S	D	
6	X16-5	Hampton Water Works	1956	75	45.0	Dn	2 ½	Sand and gravel	do.	1.77	4-11-56	None	O	Reported yield 100 gpm.
7	X16-5	do.	1950	45	54	Dr	36	do.	do.	2	-50	T	PS	Reported yield 720 gpm.
8	X16-4	Godfrey Dearbon	1926	85	19.0	Dg	24	do.	do.	4.05	4-17-56	S	D	
9	X16-4	Ernest Woodburn	1900	60	14.0	Dg	24	-	Till	4.18	4-19-56	S	D	
10	X16-3	Deborah G. Bryer	1937	125	160	Dr	6	-	Bedrock	36	-37	F	D	Reported yield 15 gpm.
11	X16-1	Edwin L. Batchelder	1940	70	232	Dr	6	-	do.	11	-40	T	D	Reported yield 4 gpm.
12	X16-5	Gordon Yeaton	1913	77	90	Dr	6	-	do.	20	-13	J	D	Reported yield 5 ½ gpm.

Well no.	Location	Owner or user	Year completed	Altitude of land-surface datum (feet)	Depth (feet)	Type of well	Diameter of well (inches)	Water-bearing material		Water Level		Type of pump	Use	Remarks
								Character	Geologic Unit	Depth	Date			
							HAMPTON FALLS							
1	W16-9	J. M. Goodwin	1900	85	8.5	Dg	48	Sand	Ice-contact deposits	1.91	12-4-53	S	D	T 49
2	X16-7	R. P. Merrill	1945	68	20.0	Dg	18	do.	Outwash and shore deposits	11.45	4-17-56	S	D	
3	X16-7	E. J. Payne	1955	67	101	Dr	6	-	Bedrock	9	-55	J	D	Reported yield 16 gpm.
4	W16-6	Oscar McKenney	1900	90	25.3	Dg	28	-	Till	4.47	4-19-56	S	U	
5	W16-6	do.	1951	90	95	Dg	6	-	Bedrock	-	-	J	D	Reported yield 7 ½ gpm.
6	W16-6	Mark Kelly	1900	112	38.2	Dg	42	Sand and gravel	Ice-contact deposits	21.00	4-17-56	F	D	
7	W16-6	Ralph M. Farley	1954	60	120	Dr	6	-	Bedrock	5	-54	J	D	Reported yield 25 gpm.
8	W16-6	Donald Merchant	1955	65	17	Dg	48	Sand and gravel	Ice-contact deposits	15	8- -55	S	D	
9	W16-3	Alfred L. Binnette	1900	115	21.0	Dg	36	-	Till	5.65	4-19-56	S	D	
10	W16-6	V. L. Yeaton	1947	103	100	Dr	6	-	Bedrock	19	-47	F	D	L. Reported yield 2 ½ gpm.
11	W16-6	J. W. Elton	1942	110	150	Dr	6	-	do.	45	-42	J	D	T. Reported yield 45 gpm. Additional use, orchard.
12	X16-4	Eugene Whittemore	1948	65	140	Dr	6	-	do.	13	-48	J	D	Reported yield 25 gpm.
13	X16-7	C. M. Wellington	1948	60	120	Dr	6	-	do.	8	-48	F	D	Reported yield 15 gpm.
14	X16-7	Nicholas A. Natale	1947	30	94	Dr	6	-	do.	15	-47	J	D	Reported yield 20 gpm.
15	W16-6	William H. Coburn	1952	115	250	Dr	6	-	do.	-	-	L	D	Reported yield 35 gpm.
							KENSINGTON							
1	W16-4	Gordon Swift	1953	217	13.0	Dg	40	-	Till	9.56	7-13-54	None	U	
2	W16-4	Betsy J. Monahan	1900	270	25.0	Dg	30	-	do.	10.52	7-13-54	None	U	
3	W16-5	J. W. York	1953	75	108	Dr	6	-	Bedrock	-	-	J	D	Reported yield 6 gpm.
4	W16-5	F. E. Toothacre	1926	107	84	Dr	6	-	do.	22	-26	J	D	Reported yield 2 ½ gpm.
5	W16-4	Charles Matthews	1954	225	120	Dr	6	-	Till and Bedrock	28	-54	L	D	Reported yield 5 gpm.
6	W16-4	C. R. Hutchinson	1952	250	220	Dr	6	-	do.	30	-52	J	D	Reported yield 20 gpm.
7	W16-5	Kensington School	1952	128	50	Dr	6	Sand and gravel	Ice contact deposits	17	-52	J	PS	Reported yield 30 gpm.
8	W16-5	Mrs. Alice E. Bragg	1931	123	60	Dr	6	do.	Ice contact deposits and Bedrock	-	-	L	D	Reported yield 20 gpm.
9	W16-4	Amos S. Gove	1900	223	25.0	Dg	36	-	Till	7.53	5-21-56	H	D	
10	W16-8	A. Mertinooke	1915	170	23.0	Dg	36	-	do.	10.95	5-21-56	S	D	T 52.
11	W16-8	Leavitt Brown	1910	90	23.5	Dg	36	Sand and gravel	Ice-contact deposits	6.15	5-21-56	S	D	

RECORDS OF SELECTED WELLS AND

TEST HOLES IN SOUTHEASTERN NEW HAMPSHIRE

Owner or user: Name of present owner or agency responsible for installation or operation of well.

Year completed: Year when well was completed, if known. Wells completed prior to 1900 are not specifically dated unless exact year is known.

Altitude: Altitude expressed in feet and tenths, or in feet, tenths, and hundredths are instrumentally determined; those in whole feet are interpolated from topographic maps. Datum is mean sea level.

Depth: Depths expressed in feet and tenths are measured; those in whole feet are reported. Depths are below land-surface datum.

Type of well and diameter of well: Dg, dug; Dn, Driven; Dr, drilled; Dg-Dr, dug and drilled.

Water-bearing material: For explanation of geologic units from which water is drawn, see table 1 and accompanying test.

Water level: Water levels expressed in feet and tenths, or in feet, tenths, and hundredths are measured; those in whole feet are reported. Depths are below land-surface datum, except when proceeded by + indicating they are above land- surface datum.

Type of pump: C, centrifugal pump; F, force pump; H, hand drawn; J, jet pump; L, lift pump; 5, suction; Sb, submersible pump; T, turbine pump.

Use: C, use in cemetery; D, domestic or domestic and farm; I, Industrial or commercial; Ir, irrigation; 0, well installed as an observation or test well; PS, public supply; S, use for stock only; T, test hole or test well, now abandoned and casing removed; U, unused.

Remarks: Other available data are indicated as follows: D, destroyed; dd, drawdown; gpm, gallons per minute; T, temperature in degrees Fahrenheit.

SEABROOK UPDATED FSAR

TABLE 2.4-19

BORING LOGS OF SELECTED WELLS AND TEST HOLES

	Thickness (Feet)	Depth (Feet)
SEABROOK 14. W16-9. Alt. 50 ft. Lat. 42°53'29". Long. 70°52'41".		
Outwash and shore deposits:		
Peat	1.7	1.7
Sand, light brown; some gravel, fine	7.3	9.0
Marine deposits:		
Clay, hard, brown	4.0	13.0
Sand, fine, brown	1.3	14.3
Sand, fine, and clay, gray; changing to clay, gray	8.2	22.5
Clay, soft, gray	18.5	41.0
Till:		
Sand and gravel, sharp, and clay, gray	2.0	43.0
Refusal		43.0
SEABROOK 15. W16-9. Alt. 54 ft. Lat. 42°53'34". Long. 70°52'35".		
Outwash and shore deposits:		
Sand and gravel, brown	14.0	14.0
Marine deposits:		
Sand, fine, and clay, gray	9.8	23.8
Sand, fine, and clay, gray; changing to clay	10.2	34.0
Till:		
Sand and gravel, sharp, and clay, blue	10.3	44.3
Unreported	0.7	45.0
Refusal		45.0
SEABROOK 16. X16-7. Alt. 45 ft. Lat. 42°53'37". Long. 70°51'54".		
Outwash and shore deposits:		
Gravel, small	8.0	8.0
Sand, fine, brown	5.0	13.0
Sand, fine, and clay, brown	5.3	18.3
Sand and clay, red-brown	1.5	19.8
Marine deposits:		
Clay, light gray, and sand, fine	12.2	32.0
Clay, dark brown	3.5	35.5
Sand, medium-fine, brown	1.5	37.0
Sand, fine, and clay, gray	5.0	42.0
Sand, fine, and clay in layers, gray	28.0	70.0
Till:		
Sand, gravel, sharp, and clay, gray	7.9	77.9
Gravel, sharp, gray, and boulders; some clay	9.6	87.5
Sand and gravel, sharp, and clay, gray	6.8	94.3
Refusal		94.3
SEABROOK 17. W16-9. Alt. 40 ft. Lat. 42°53'01". Long. 70°52'48".		
Outwash and shore deposits:		
Sand and gravel, light brown	3.5	3.5
Marine deposits:		
Clay, gray	18.2	21.7
Sand, fine, and clay, gray	11.8	33.5
SEABROOK 18. X16-7. Alt. 43 ft. Lat. 42°52'50". Long. 70°51'48".		
Outwash and shore deposits:		
Sand, fine, brown	10.1	10.1
Marine deposits:		
Sand, fine, brown, and clay, gray	5.2	15.3
Clay, gray	14.8	30.1
Clay, gray, and sand	7.2	37.3
Refusal		37.3
SEABROOK 19. X15-1. Alt. 48 ft. Lat. 42°52'07". Long. 70°51'35".		
Outwash and shore deposits:		
Loam	1.0	1.0
Sand, brown	2.0	3.0
Sand and gravel	3.0	6.0
SEABROOK 17.--Continued		
Marine deposits:		
Sand, fine, and clay, brown	2.0	8.0
Sand, gray, changing to sand, fine, and clay	14.6	22.6
Clay, hard, brown	3.4	26.0
Ice-contact deposits:		
Sand, medium, gray; some gravel, fine	15.0	41.0
Till:		
Sand, gravel, and clay, gray	2.5	43.5
Refusal		43.5
SEABROOK 20. X15-1. Alt. 18 ft. Lat. 42°52'19". Long. 70°50'37"		
Outwash and shore deposits:		
Sand, medium-coarse	10.0	10.0
Sand and gravel; cemented layer at 19 feet	9.0	19.0
Marine deposits:		
Sand, fine, and clay, gray	28.5	47.5
Till:		
Sand, fine, and gravel, gray	6.0	53.5
SEABROOK 21. W16-9. Alt. 100 ft. Lat. 42°53'42". Long. 70°54'44".		
Ice-contact deposits:		
Sand and gravel	23.3	23.3
Sand and gravel, fine	10.6	33.9
Sand, coarse, and gravel	5.0	38.9
Sand and gravel, fine	10.2	49.1
Till:		
Sand and gravel, some clay	5.7	54.8
Refusal		54.8
SEABROOK 22. W16-9. Alt. 50 ft. Lat. 42°53'52". Long. 70°54'07".		
Marine deposits:		
Clay, brown	8.0	8.0
Clay, gray	27.9	35.9
Ice-contact deposits:		
Sand and gravel, blue	5.1	41.0
SEABROOK 23. X15-1. Alt. 60 ft. Lat. 42°52'29". Long. 70°51'18".		
Ice-contact deposits:		
Sand and gravel, brown	7.1	7.1
Sand, fine, brown	5.2	12.3
Sand, fine to medium, tight, brown	44.0	56.3
Till:		
Sand, fine to medium, and clay	5.0	61.3
Bedrock		61.3
SEABROOK 24. W16-9. Alt. 65 ft. Lat. 42°53'58". Long. 70°54'31".		
Marine deposits:		
Clay	7.1	7.1
Clay, gray	10.8	17.9
Clay, gray, and sand, fine	16.6	34.5
Ice-contact deposits:		
Gravel, blue, sand, fine, and clay, gray	4.4	38.9
SEABROOK 25. W16-9. Alt. 70 ft. Lat. 42°53'33". Long. 70°54'28".		
Outwash and shore deposits:		
Sand, fine, brown	19.5	19.5
Marine deposits:		
Sand, fine; a little clay, brown	10.3	29.8
Ice-contact deposits:		
Sand, fine, brown	10.7	40.5
Till:		
Sand, gravel, and clay, gray	12.2	52.7
Refusal		52.7
SOUTH HAMPTON 1. W16-7. Alt. 188 ft. Lat. 42°52'56". Long. 70°57'52".		
Unconsolidated deposits, undifferentiated:		
Sand, fine, yellow, and gravel	40	40
Bedrock	35	75
SOUTH HAMPTON 3. W15-1. Alt. 87 ft. Lat. 42°52'25". Long. 70°57'41".		
Marine deposits:		
Silt and clay	52	52
Bedrock	1	53
SOUTH HAMPTON 4. W16-8. Alt. 250 ft. Lat. 42°53'52". Long. 70°56'06".		
Till:		
Clay and boulders	100	100
Bedrock	100	200
SOUTH HAMPTON 5. W16-7. Alt. 130 ft. Lat. 42°53'29". Long. 70°58'56".		
Till:		
Gravel and clay	56	56
Bedrock	67	123
HAMPTON 3. X16-5. Lat. 42°57'29". Long. 70°49'35". Alt. 75 ft.		
Ice-contact deposits:		
Sand and gravel	9.0	9.0
Clay and sand, fine	0.5	9.5
Sand and gravel	48.5	58.0
Refusal		58.0
HAMPTON 7. X16-5. Lat. 42°56'31". Long. 70°48'46". Alt. 45 ft.		
Ice-contact deposits:		
Sand and gravel	54	54
HAMPTON 10. W16-3. Lat. 42°57'43". Long. 70°53'12". Alt. 125 ft.		
Unconsolidated deposits, undifferentiated	60	60
Bedrock:		
Gneiss	100	160
HAMPTON 11. X16-1. Lat. 42°57'32". Long. 70°51'55". Alt. 70 ft.		
Till:		
Sand, gravel, and clay	30	30
Bedrock	202	232
HAMPTON 12. X16-5. Lat. 42°56'42". Long. 70°49'07". Alt. 77 ft.		
Ice-contact deposits:		
Sand	30	30
Bedrock:		
Gneiss	60	90
HAMPTON FALLS 3. X16-7. Alt. 67 ft. Lat. 42°54'58". Long. 70°51'48".		
Ice-contact deposits:		
Sand	35	35
Bedrock	66	101
HAMPTON FALLS 5. W16-6. Alt. 90 ft. Lat. 42°55'28". Long. 70°52'47".		
Till	35	35
Bedrock	60	95
HAMPTON FALLS 7. W16-6. Alt. 60 ft. Lat. 42°55'07". Long. 70°53'35".		
Outwash and shore deposits:		
Sand	30	30
Till	30	60
Bedrock	60	120
HAMPTON FALLS 8. W16-6. Alt. 65 ft. Lat. 42°56'08". Long. 70°54'42".		
Ice-contact deposits:		
Sand and gravel	17	17
Bedrock		17
HAMPTON FALLS 10. W16-6. Alt. 103 ft. Lat. 42°57'27". Long. 70°54'18".		
Till:		
Gravel	11	11
Bedrock	89	100
HAMPTON FALLS 11. W16-6. Alt. 110 ft. Lat. 42°55'48". Long. 70°54'23".		
Till:		
Sand and gravel	6	6
Clay, yellow; gravel and rocks	33	39
Clay, blue; gravel and rocks	38	77
Bedrock	73	150
HAMPTON FALLS 15. W16-6. Alt. 115 ft. Lat. 42°55'32". Long. 70°53'57".		
Till	120	120
Bedrock	130	250
NORTH HAMPTON 1. X17-8. Alt. 110 ft. Lat. 43°00'02". Long. 70°48'41".		
Outwash and shore deposits:		
Gravel	20	20
Marine deposits:		
Clay and silt, gray	60	80
Bedrock	58	138
NORTH HAMPTON 4. X16-1. Alt. 105 ft. Lat. 42°57'56". Long. 70°50'21".		
Ice-contact deposits:		
Sand and gravel, silty	40	40
Bedrock	65	105
NORTH HAMPTON 6. X16-2. Alt. 122 ft. Lat. 42°59'22". Long. 70°49'16".		
Unconsolidated deposits, undifferentiated:		
Gravel	45	45
Clay	29	74
Not recorded	6	80
Bedrock	20	100
NORTH HAMPTON 8. X16-2. Alt. 65 ft. Lat. 42°57'32". Long. 70°49'24".		
Unconsolidated deposits, undifferentiated	7	7
Ice-contact deposits:		
Sand and gravel	35	42
NORTH HAMPTON 10. X16-2. Alt. 83 ft. Lat. 42°45'26". Long. 70°49'49".		
Unconsolidated deposits, undifferentiated	1	1
Bedrock:		
Rock	174	175
NORTH HAMPTON 11. X16-1. Alt. 85 ft. Lat. 42°57'23". Long. 70°50'42".		
Ice-contact deposits:		
Sand and gravel	74	74
NORTH HAMPTON 12. X16-1. Alt. 95 ft. Lat. 42°58'17". Long. 70°50'43".		
Unconsolidated deposits, undifferentiated:		
Gravel and bouldery material	29	29
Bedrock	150	179
NORTH HAMPTON 13. X16-1. Alt. 65 ft. Lat. 42°50'27". Long. 70°50'11".		
Unconsolidated deposits, undifferentiated:		
Clay and boulders	10	10
Bedrock	40	50
NORTH HAMPTON 14. X16-1. Alt. 108 ft. Lat. 42°52'51". Long. 70°50'10".		
Ice-contact deposits:		
Sand and boulders	20	20
Bedrock	150	170
NORTH HAMPTON 15. X16-2. Alt. 85 ft. Lat. 42°53'07". Long. 70°49'26".		
Till	19	19
Bedrock	53	72
NORTH HAMPTON 16. X16-2. Alt. 85 ft. Lat. 42°57'36". Long. 70°53'20".		
Outwash and shore deposits:		
Sand and gravel	12	12
Marine deposits:		
Clay and gravel	7	19
Refusal		19
NORTH HAMPTON 17. X16-2. Alt. 85 ft. Lat. 42°59'33". Long. 70°53'24".		
Outwash and shore deposits:		
Sand and gravel	6	6
Marine deposits:		
Clay	19	25
Refusal		25
NORTH HAMPTON 18. X16-2. Alt. 87 ft. Lat. 42°5?'42". Long. 70°53'28".		
Outwash and shore deposits:		
Sand and gravel	12	12
Till:		
Clay, sand, and gravel	17	29
Refusal		29
NORTH HAMPTON 19. X16-2. Alt. 95 ft. Lat. 42°59'46". Long. 70°53'31".		
Outwash and shore deposits:		
Sand and gravel	12.3	12.3
Marine deposits:		
Clay	5.5	17.8
Till:		
Clay, sand, gravel, and disintegrated bedrock	15.0	32.8
Refusal		32.8
NORTH HAMPTON 20. X16-2. Alt. 105 ft. Lat. 42°59'54". Long. 70°53'31".		
Outwash and shore deposits:		
Sand	12.3	12.3
Marine deposits:		
Clay	5.0	17.3
Clay and gravel	4.5	21.8
Refusal		21.8
NORTH HAMPTON 21. X16-2. Alt. 95 ft. Lat. 42°59'52". Long. 70°53'16".		
Ice-contact deposits:		
Clay and gravel	11.3	11.3
Till:		
Sand, gravel, and broken ledge	6.9	18.2
Refusal		18.2
SEABROOK 9. X15-1. Alt. 65 ft. Lat. 42°52'14". Long. 70°51'49".		
Ice-contact deposits:		
Gravel	12	12
Bedrock	138	150
SEABROOK 12. W16-9. Alt. 45 ft. Lat. 42°53'26". Long. 70°52'36".		
Outwash and shore deposits:		
Loam and subsoil	4.0	4.0
Sand, coarse, brown	0.5	4.5
Sand and clay, light brown	6.0	10.5
Marine deposits:		
Clay, hard, gray	5.2	15.7
Clay, gray, and broken stones	0.8	16.5
Bedrock		16.5
SEABROOK 13. W16-9. Alt. 47 ft. Lat. 42°53'27". Long. 70°52'39".		
Outwash and shore deposits:		
Loam	0.5	0.5
Sand, coarse; some gravel, fine	4.0	4.5
Sand and clay, gray	1.2	5.7
Sand and gravel, light brown	2.8	8.5
Marine deposits:		
Clay, brown	2.0	10.5
Sand, fine, and clay, gray	14.5	25.0
Till:		
Sand, gravel, and clay, gray	3.7	28.7
Refusal		28.7

TABLE 2.4-20 SUMMARY OF CHEMICAL ANALYSES OF GROUNDWATER SEACOAST REGION

Characteristic or Constituent	Seacoast Values Range PPM	U.S. Public Health Service Drinking Water Standards PPM
Silica	6.6 – 18	--
Iron	.01 – 3	.3
Manganese	00 - .04	.05
Calcium	1.4 – 39	--
Magnesium	.5 – 15	125.
Sodium	2.5 – 28	--
Potassium	0.6 – 11.0	--
Bicarbonate	4. – 110.	--
Sulfate	1.6 – 54	250
Chloride	1.2 – 96	250
Fluoride	0 – 1.0	.7 – 1.2
Nitrate	0.05 – 26	45
Dissolved solids	36 – 197	500
Hardness	13 – 188	--
pH	5.6 – 8.5	--
Color	Generally free of color in objectional amounts	15

Reference: Report on the Water Supply of Southeastern New Hampshire prepared by Southeastern New Hampshire Regional Planning Commission, August, 1972.

TABLE 2.4-21 GALLONS OF WATER PUMPED ANNUALLY FOR DOMESTIC, INDUSTRIAL AND COMMERCIAL USES FROM SEABROOK

Year	Municipal Water Supply
1960	56,433,660 gallons
1961	63,417,190 gallons
1962	71,399,710 gallons
1963	93,947,720 gallons
1964	105,581,720 gallons
1965	114,037,320 gallons
1966	111,838,520 gallons
1967	97,317,820 gallons
1968	139,859,380 gallons
1969	133,115,780 gallons
1970	150,915,940 gallons
1971	221,141,340 gallons
1972	256,128,900 gallons
1973	265,492,380 gallons
1974	227,106,080 gallons
1975	235,177,950 gallons
1976	239,772,680 gallons
1977	362,904,375 gallons
1978	381,636,800 gallons

Reference: Comprehensive Town Plan for Seabrook, New Hampshire by Hans Klunder and personal communications with the Seabrook Water Department

Note: Values for the years 1973 through 1976 are due to faulty meters (Reference 30).

TABLE 2.4-22 **PAST, PRESENT AND PROJECTED WATER USE SOUTHEASTERN NEW HAMPSHIRE REGION AND SALISBURY, MASSACHUSETTS***

Community	1964	1971	1980	1990	2000	2010	2020
Exeter	0.5		1.4	1.7	2.3	2.6	3.3
Hampton	1.0		1.6	1.9	2.2	2.8	3.2
Hampton Falls	--	--	--	0.3	0.7	1.3	2.2
Kensington	--	--	0.1	0.5	0.8	1.3	2.3
North Hampton			0.4	1.1	2.0	2.9	3.6
Rye			0.9	1.3	2.0	3.2	4.8
Salisbury (Mass.)		0.7	2.2	4.0	--	--	--
Seabrook	0.3	0.6	1.2	1.8	2.4	3.1	3.7
South Hampton	--	--	--	--	0.1	0.4	1.3
Stratham	--	--	--	0.3	0.9	2.1	3.7

*These figures are for groundwater and surface water requirements in million gallons per day.

References:

Water Supply by The Southeastern New Hampshire Regional Planning Commission, August 31, 1972.

Water Supply and Sewerage Planning in Central Merrimack Valley Region by Metcalf & Eddy, Inc.

Engineering Investigation of New and Existing Sources of Water Supply for the Town of Seabrook, New Hampshire by Coffin & Richardson, November 1979.

TABLE 2.4-23 **SUMMARY OF FIELD PERMEABILITY FOR GLACIAL AND BEDROCK MATERIALS IN THE SEABROOK AREA**

Type of Material	Number of Samples	Permeability in gpd/sq. ft. Range	Mean
Outwash	6	17—130	50
Marine (silty phase)	2	0.3 – 0.6	0.4
Till	21	0.3 - 25	5
Bedrock	9	1 – 51*	4

*Large fracture, not used in Mean

Reference: Groundwater Hydrology for the Proposed Seabrook Nuclear Station, by Weston Geophysical Research, Inc., 1969.

TABLE 2.5-1 **K-AR AGE DATES FOR ROCK SAMPLES FROM SEABROOK STATION SITE STUDIES**

(Reference: Figure 2.5-8)

A. Samples from Site Excavations, Site Borings or Borings Along Cooling Water Tunnels Adjacent to the Site

Rock Unit	Rock Types	Location	Material Dated	K-Ar Age (millions of years)
Diabase dike d5	Diabase	Trench W Excavation, Unit II	Whole Rock	212±9
Diabase dike d12	Sheared Diabase	Trench W Excavation, Unit II, along Fault CII-1	Whole Rock	213±14
Diabase dike	Bleached (Tan) Diabase	Tunnel Boring ADT-16	Whole Rock	213±10
Diabase dike	Diabase	Tunnel Boring ADT-16D	Whole Rock	221±9
Diabase dike	Diabase	Tunnel Boring F-4	Whole Rock	224±10
Diabase dike	Diabase	Site Boring B-42	Whole Rock	225±10
Diabase dike d12	Diabase	Trench W Excavation, Unit II	Whole Rock	236±13
Diabase dike d1	Diabase	Fuel Storage Bldg. Excavation, Unit I	Whole Rock	255±13
Diabase dike d3	Diabase	Equipment Vault Excavation, Unit I	Whole Rock	295±14
Newburyport	Welded Quartz Diorite Breccia	Fuel Storage Bldg. Excavation, Unit I along Fault CI-2	Sericite	246±13
Kittery	Schist	Site Boring B-4	Biotite	254±9
Kittery	Sheared Quartzite	Tunnel Boring AIT-39	Sericite	261±10

Rock Unit	Rock Types	Location	Material Dated	K-Ar Age (millions of years)
Kittery	Sheared Chlorite Phyllite	Reactor Pit Excavation, Unit II	Micas	269±11
Newburyport	Biotite Diorite	Site Boring B-9	Biotite	284±9
Newburyport	Quartz Diorite	Site Boring B-2	Biotite	294±9
Undetermined	Hornblende Diorite	Reactor Pit Excavation, Unit II	Chlorite	1181±119
B. Samples From Outcrops and Borings for the Investigation of the Scotland Road Fault				
Diabase Dike	Diabase	Boring SRF-5	Whole Rock	199±9
Newburyport	Mylonitized Schist	Boring SRF-8	Sericite-Feldspar	248±9
Newburyport	Mylonitized Quartz-Muscovite Schist	Boring SRF-2	Whole Rock	256±10
Newburyport	Muscovite Mylonite	Boring SRF-3	Whole Rock	269±10
Newburyport	Altered Granodiorite	Boring SRF-5	Whole Rock	272±10
Newburyport	Granodiorite	Parker Street, Little River Area, Newburyport, MA	Chloritized Bioitite	294±20
Undetermined	Schist	Highfield Road, Abandoned RR Grade, Newbury, MA, South of Scotland Road Fault	Chlorite-Amphibole	304±15
Undetermined	Diorite	Boring SRF-1	Amphibole	324±14
Newburyport	Diorite	Interstate Rt. 95 at Scotland Road, Newbury, MA	Amphibole	422±17

C. Samples from Outcrops for the Investigation of the Portsmouth Fault

Rock Unit	Rock Types	Location	Material Dated	K-Ar Age (millions of years)
Kittery	Feldspathic Quartzite	U.S. Rt. 1 Bypass, Greenland Road, Portsmouth, NH	Mica-Quartz	262±11
Kittery	Quartzite	Towle Road, Exeter-Hampton Expressway, Hampton, NH	Chloritized Biotite	268±10
Rye	Feldspathic Gneiss	U.S. Rt. 1 Bypass, Lafayette Road, Portsmouth, NH	Muscovite	294±10
Kittery	Feldspathic Quartzite	Winnicut Rd., NH Rt. 151, Hampton, NH	Amphibole	308±14

TABLE 2.5-2 **SUMMARY OF DATA FOR FAULTS IN SITE EXCAVATIONS**

This table records for each fault the:

- Number,
- Location (See Table 2.5-4 for abbreviations),
- Length with a "+" added if both ends of a fault are not visible on the site,
- Range of strike and dip with important deviations noted,
- Trend and plunge of slickensides, if present, with multiple sets noted,
- Movement sense determined from offsets, slickensides,
- Amount of displacement reported as computed net slip (NS) if determinable or as measured horizontal separation (HS), or dip separation (DS),
- Ratio of amounts of strike-slip movement to dip-slip movement based on slickensides and/or cross-cutting relationships,
- Summary of cross-cutting relationships,
- Range of weathering along a fault:

Sl -	slight -	minor or very minor rock decomposition
Mod -	moderate -	some significant decomposition
Sev -	severe -	much or most of rock softened and decomposed
Ext -	extreme -	rock completely decomposed,

- Mineralization,
- Remarks concerning other significant observable data or comments on data already listed.

Set No. 1 NNW - Striking, NE - Dipping

Fault No.	Location	Length (Ft)	Width (Unmineralized) & Fault Character	Strike, Dip	Slickensides Trend, Plunge	Movement Sense	Displacement	Movement Component Ratio Str. Slip/Dip Slip	Crosscutting Relationships	Weathering	Mineralization	Remarks
EI-1	From CWT opp. ESFPCI to SWT SE of CI	203	1/16 in discrete fracture	N20°-30°W, 50°-55°N; N end N35°E, 45°SE	None	Normal, E side down	NS=29-41 in	—	Displaces Nqd; cross-cut by dikes d1 and d3; displaced by fault CI-2B	Sl to sev	Quartz, Calcite	Quartz is locally vuggy with unbroken prismatic crystals. Visible dying out with depth in profile near S end of fault.
NI-1	From SE corner of the AB to NW corner of the TFI	257	1/16 in discrete fracture	N20°-45°W, 55°-65° NE	S80°-85°E, 60°-65° and N85°E, 52°	Normal, E side down	NS=10-14 in	0.23-0.48	Displaces Nqd, dikes d5 and d6; apparently cross-cut by dike d3; displaced by fault NI-4	C to mod	Quartz, Calcite	Quartz is locally vuggy with unbroken prismatic crystals.
NI-2	From SE corner of the AB to just S of CBI	125	1/16 in discrete fracture	N15°-20°W, 55°-60° NE	N75°E, 50°	Normal, E side down	NS=10 in	0.08	Displaces Nqd and dike d5, but not dike d6.	Sl to mod	Quartz, Calcite	Quartz is locally vuggy with unbroken prismatic crystals on fault surface. Fault ends to N against NI-1.
NI-3	From SW corner TBI to CBI	135	1/16 in discrete fracture	N25°W, 71°E	S70°-90°E, 50°-64°	Normal, E side down	NS=3/4 in	0.47-1.0	Displaces Nqd and dike d6	Sl	Quartz, minor Calcite	Visible dying out with depth in profile near S end of fault.
T-1	NW corner of TFI	109	1/16 in discrete fracture	N20°-27°W, 55°-63° NE	S70°-90°E, 54°-63°	Normal, E side down	NS=22 in	0.45-1.0	Displaces Nqd and diabase dike d3	Clean to Sl	Quartz, minor Calcite	Calcite mineralization contains angular pieces of Nqd - a fused breccia.
T-3	N end of TFI	60	1/8-1/16 in discrete fracture	N15°-20°W, 55°-60°E; S end N0°E, 90°	S85°E, 47°	Normal, E side down	None visible	0.41	Displaces Nqd, apparently cross-cut by dike d3	Clean to Sl	Patchy Quartz and Calcite	No displaced features seen; movement apparently minute.
T-3A	Just N of TFI	42	1/16 in discrete fracture	N20°W, 90°	None	—	—	—	None seen	Clean to Sl	Calcite	Feature may not be a fault, but it is mineralized with calcite and is on strike with T-3 and NI-2.
W-1	From W side of DI to just W of WPB	222	Mostly 1/16 in small segments open to 1/4 in; discrete fracture	N12°-30°W, 60°-65°E; N40°W strike in d5	S60°-90°E, 55°-65°	Normal, E side down	NS=13-27 in	0.50-1.1	Displaces Nqd, dike d3 and apparently dike d5	Clean to Sl	Calcite and patchy Quartz	Calcite mineralization forms the matrix at a fused breccia containing pieces of dike d5. Fault changes strike and character in dike d5. Quartz is slickensided

Set No. 1 NNW - Striking, NE - Dipping

Fault No.	Location	Length (Ft)	Width (Unmineralized) & Fault Character	Strike, Dip	Slickensides Trend, Plunge	Movement Sense	Displacement	Movement Component Ratio Str. Slip/Dip Slip	Crosscutting Relationships	Weathering	Mineralization	Remarks
DI-2	From N end of DI to center of DI	45	1/16 in discrete fracture	N30°-50°W 46°-90°E	N45°E, 44°	Normal, E side down	HS=2 in	0.88	Displaces Nqd, dikelet d5	Sl to mod	Minor Calcite	Calcite mineralization forms the matrix of a fused breccia containing pieces of dikelet d5
W-2	NW corner WPB	58	1/16 in discrete fracture	N25°W, 54°NE; at S end N20°E, 50°SE	N80°E, 49°	Normal, E side down	NS=5 in	0.28	Displaces Nqd, dike d3	Sl	Quartz, Calcite	
W-2A	From S side of DI to just N of WPB	45	1/8 - 1/16 in discrete fracture	N24°W, 63°E		Normal, E side down	NS=5 in	——	Displaces Nqd and S contact of dike d5, but not N contact	Sl	Calcite	Ends with dike d5. On strike with but not connected with W-2.
W-3	From S end of CBI to center of WPB	158	1/16 in discrete fracture	N10°-25°W, 50°-63°E; at S end N0°-5°W, 65°E	S72°-90°E, 45°-55°	Normal, E side down	None visible	0.45-0.90	Displaces Nqd, dike d3, but not dike d5	Sl	Calcite	Ends at S contact of dike d5.
W-4	From just NE of WPB to E side of WPB	102	1/16 in discrete fracture	N15°-35°W, 54°-64°E	S58°W, 58°	Normal, E side down	NS=5-14 in	0.31-0.55	Displaces Nqd, but not dike d3	Sl	Quartz, Calcite	Ends at NI-4. Passes through dike d3 as quartz vein; that dike's contacts are irregular near this fault, but not displaced.
W-5	From center of DI to N half of WPB	124	1/16 in discrete fracture	N10°-35°W, 53°-64°E	S75°E, 32°	Normal, E side down	NS=3 in	0.47	Displaces Nqd, and apparently dike d5	Clean to Sl	Calcite, Quartz	Calcite mineralization locally consists of undisturbed prismatic crystals, and forms the matrix of a fused breccia containing pieces of dike d5. A small aphophysis of dike 5d was channeled along the fused calcite vein which represents this vault within dike d5.

W-6	From N end of WPB to just S of DI	65	1/16 in discrete fracture	N7°-28°W, 50°-66°E	S80°E, 51°	Normal, E side down	DS-6 in	0.44	Displaces Nqd	Clean to Sl	Calcite	

Set No. 1 NNW - Striking, NE - Dipping

Fault No.	Location	Length (Ft)	Width (Unmineralized) & Fault Character	Strike, Dip	Slickensides Trend, Plunge	Movement Sense	Displacement	Movement Component Ratio Str. Slip/Dip Slip	Crosscutting Relationships	Weathering	Mineralization	Remarks
RII-1	SW of AB	187	1/4 in discrete fracture or locally a 3 in zone	N10°-25°W, 65°-80°E	N65°E, 58°	Normal, E side down	HS=6 in	0.88	Displaces Nqd; ends to S against dike d5	Clean to Mod	Minor Calcite	The longest of a group of 4 faults on strike with each other. Has minor dip-reversal near S end.
RII-1A	SW of AB	47	1/4 in discrete fracture to 3 in zone	N15°-25°W, 77°E	____	Normal, E side down	HS=3 in	____	Displaces Nqd; ends to N against A-1	Mod	Minor Calcite	
RII-1B	SW of AB	14	1/4 in discrete fracture	N33°W, 76°E	____	Normal, E side down	VS=5 in	____	Displaces Nqd	Sl to mod	Quartz	
RII-1C	SW of AB	25	1/4 in discrete fracture	N29°W, 65°E	____	Normal, E side down	None visible	____	Displaces Nqd?	Sl	Minor Calcite	May not be a fault. Ends to the N just S of dike d5.
RII-2	SW corner of AB	37	1/4 - 1/2 in discrete fracture or zone	N20°W, 70°E	N60°W, 70°E	Normal, E side down	NS=1.5 in	0.16	Displaces Nqd	Sl	None	
HI-1	NE corner of WPB	34	1/4 in discrete fracture	N10°W, 64°W; N end N35°E, 75°-90°W	N80°W, 58° N65°W, 90°	Reverse, E side down	NS=13 in	0.36	Displaces Nqd	Sl to sev	Calcite	On strike with W-2. Occurs among several E-dipping normal faults. Reverse motion is consistent with normal movement sense on E-dipping faults.

Set No. 2 NE - Striking, NW - Dipping

Fault No.	Location	Length (Ft)	Width (Unmineralized) & Fault Character	Strike, Dip	Slickensides Trend, Plunge	Movement Sense	Displacement	Movement Component Ratio Str. Slip/Dip Slip	Crosscutting Relationships	Weathering	Mineralization	Remarks
CI-2	From E wall of CP to SWT S of WPB	575	2-12 in zone	N20°-58°E, 30°-41°N	N32°-60°W, 34°-40°	Normal, NW side down	4 in-15 ft	0.0-0.41	Displaces Nqd, dike d20 and apparently dike d1; ends against dike d1	Mod-Sl with some sev and loc ext	None	Contains fused breccia.
CI-2A	From E wall of CP to SE of EHI	198	2-6 in zone	N35°-47°E, 35°-40°N	None	Normal, NW side down	NS=5 ft 2 in	0.05-0.10	Displaces Nqd; ends against dike d1	Mod to sev	None	
CI-2B	From E wall of CP to SE of EHI	144	2-6 in zone	N35°E, 36°N	None	Normal, NW side down	NS-4 ft 7 in	0.05-0.10	Displaced Nqd; ends against dike d1	Mod to sev	None	
CI-2C	From IS to W wall of CP	238+	2-6 in zone	N30°-35°E, 37°-50°N; in Sk on CP floor; N5°W, 22°W	N44°-50°W, 30°-39°	Normal, NW side down	NS=6-11 ft	0.19	Displaces Nqd, Sk, and apparently dike d1	Sl, loc mod, sev and ext	None	
CI-2D	N end of CP	77	2-6 in zone	N15°-46°E, 25°-45°N	N41°W, 24°	Normal, NW side down	NS=7 ft	0.05	Displaces Nqd, Sk, and apparently dike d1	Sl, loc mod, sev and ext	None	Ends to W within Sk xenolith; ends to E within dike d1, displaces one dike contact but not the other.
NI-4	From S of CBI to SE corner of CBI	128	1/8-6 in	N29°-40°E, 38°-42°N	None	Normal, NW side down	NS=5 ft 6 in	____	Displaces Nqd, NI-1; cross-cut by dike d5; displaced by T-1	Mod, loc sev	Minor quartz	Quartz is locally druzy with undisturbed, prismatic crystals on fault surface.
SIII-1	W wall DI to NE quad CII	130	1/16 in discrete fracture to 2 in zone	N12°-14°E, 36°N; in Sk on CII floor N8°W, 48°W	None	Normal, NW side down	NS=1 ft 10 in	0.19	Displaces Nqd, and apparently Sk; cross-cut by dike d5;	Sl-mod with loc sev	None	Ends to W within Sk xenolith.
CP-1	W wall CP	10	1/8-1/16 in discrete fracture	N35°E, 38°N	None	Normal, NW side down	DS=1 ft	____	Displaces Nqd	Sl	Minor quartz	Cross-cut by a NE-striking, steep S-dipping joint. In profile, 44 ft long
TII-1	W wall of SCLTII SW portion TBII	12	1/16 in discrete fracture	N35°E, 38°N	None	Normal, NW side down	NS=6 in	____	Displaces Nqd	Sl	Minor quartz	In profile about 35 ft long; except for displacement is indistinguishable from joints.
DII-1	W wall DII	20	1/16 in discrete fracture	N35°E, 33°N	None	Normal, NW side down	NS=11 in	____	Displaces Nqd	Sl to sev	None	In profile about 15 ft long; except for displacement is indistinguishable from joints.

Set No. 3 NE - Striking, SE - Dipping

Fault No.	Location	Length (Ft)	Width (Unmineralized) & Fault Character	Strike, Dip	Slickensides Trend, Plunge	Movement Sense	Displacement	Movement Component Ratio Str. Slip/Dip Slip	Crosscutting Relationships	Weathering	Mineralization	Remarks
CI-1	From EFPBI to WPB	390	1/8 in discrete fracture to 4 ft zone	N Segment N35°E 45°S; Middle Segment N 10°-20°W, 50°-80°E S Segment N20°-35°E, 50°-80°E	None	Normal, SE side down	NS=19 in	____	Displaces Nqd, dikelets d4; cross-cut by dikes d21 and apparently by d5	Sl to sev	Quartz, Calcite	Significant differences in fault width, character, and strike occur along this fault's length.
CI-1A	From E of TBI to EFPBI	175	1/16-1/2 in, discrete fracture or fractures	N22°W, 57°NE; S end N43°E, 56°S	N65°E, 42°	Normal, SE side down	NS=3/4 in	0.05	Displaces Nqd, cross-cut by dike d7	Sl to mod	Quartz, Calcite	En echelon with CI-1 and CI-1B.
CI-1B	From E of TBI to CWT	190	1/8 to 1/4 in, discrete fracture or fractures	N25°E, 60°SE; N end N15°-20°W, 62°NE	None	Normal, SE side down	____	____	Displaces Nqd?	Sl to mod	Quartz Calcite	No displacement apparent.
CT-1A	From FII to SWT S of PII	128	1/8 in discrete fracture to 3 in zone	N30°-45°E, 60°-80°S; locally N60°-65°E, 90°	S65°E, 76°	Normal, SE side down	NS=2 in	0.38	Displaces Nqd, Sk	Sl with loc mod to sev	None	Splays off CT-1 to W, Ends to E at FII-1.
CT-3A	W end CT	64+	1/16 in discrete fracture to 3 in zone	N45°-72°E, 72°S	S85°E, 45°	Normal, SE side down	____	1.5	Displaces Nqd	Sl to mod	Minor Calcite	Silkensided surface but no displacement visible.
CT-3B	W half CT	135+	1/16 in discrete fracture to 1 1/2 in zone	N45°-60°E, 71°S-70°N	S85°E, 70°-73°	Normal, SE side down	NS=5 in	1.5	Displaces Nqd	C to mod	Clacite, Minor Chlorite (?)	May join CT-3A to W.
A-2	S end of TBII W of HB	35	less than 1/2 in	N35°E, 75°S	S60°E, 60°	Normal, SE side down	____	____	Displaces Nqd?	Sl to mod	Calcite	No displacement apparent; on strike with A-2A.
A-2A	S end of TBII E of HB	53	less than 1/2 in	N40°E, 65°S	S25°E, 60°	Normal, SE side down	NS=5 in	0.33	Displaces Nqd and a calcite vein	Sl to mod	Calcite	
SP-1	NE side of SP	35	1/16 in discrete fracture	N34°-42°E, 59°-67°S	S0°E, 63° (vague)	Normal, SE side down	DS=4 in	0.58	Displaces Nqd	Sl	Calcite, Quartz	Generally a closed, tight or fused quartz fracture.
TW-1	TWII	17	1/16 in discrete fracture	N47°E, 72°-90°S	None	Normal, SE side down	NS=1 in	____	Displaces Nqd, Sk, dike d5	Mod	None	Displacement visible at only one contract of dike d5.

CI-1D	From NE quad of CI to CWT	285	1/8 in discrete fracture	N40°E, 67-81°S	None	Normal, SE side down	DS=4 in	____	Displaces Nqd	Sl to Mod, loc sev	Quartz	Splays off CI-1 to W.

Set No. 4 NE - Striking, Vertical

Fault No.	Location	Length (Ft)	Width (Unmineralized) & Fault Character	Strike, Dip	Slickensides Trend, Plunge	Movement Sense	Displacement	Movement Component Ratio Str. Slip/Dip Slip	Crosscutting Relationships	Weathering	Mineralization	Remarks
SI-1	N end of ESFPCI	54	1/16 in discrete fracture	N37°-40°E, 70°N-90°	None	Normal, NW side down	HS=1 ft 10 in	High	Displaces Nqd; cross-cut by dike d4	Sl to mod, loc sev	Minor Calcite	Locally tightly fused.
DI-3	W portion of DI	44	1/16 in discrete fracture	N30°E, 87°E-90°	None	Normal, SE side down	NS=5 in	____	Displaces Nqd; cuts into but not across d5 and does not displace d5	Clean to Sl	Calcite	Changes to calcite vein(s) to E before ending. Calcite forms matrix of a fused breccia containing small angular pieces of country rock.
A-1	From center of AB to just S of TBII	400	2-5 in wide zone	N40°-45°E, 80°N-90°	None	Left-lateral?	____	____	Displaces Nqd, Sk(?)	Mod, loc sev	Calcite, Quartz	Quartz and calcite crystals in vugs within fault are undisturbed. Ends to W against fault CII-2, and may cross-cut a portion of that fault.
A-1A	From W of TBII to E side of TBII	294+	1/4 - 2 in wide zone or 0-18 in wide fused breccia	N30°E, 80°NW-90°	None	None measurable	____	____	Displaces Nqd, diabase?	Clean to sev	Calcite	Consists generally of a vein of fused breccia with a matrix of calcite containing angular pieces of country rock. Contains pods of diabase 1-3 in across at N end.

Set No. 5 ENE-Striking, S-Dipping

Fault No.	Location	Length (Ft)	Width (Unmineralized) & Fault Character	Strike, Dip	Slickensides Trend, Plunge	Movement Sense	Displacement	Movement Component Ratio Str. Slip/Dip Slip	Crosscutting Relationships	Weathering	Mineralization	Remarks
CT-1	SWT N of CT to area W of SWT	342+	1/8 in discrete fracture to 4-6 in zone	N70°-85°E, 71°S-80°N	N90°E, 6°-16°	Left Lateral Normal, S side down	NS=8 in	13	Displaces Nqd, Sk	Mod to Sl, loc sev	Calcite	Ends to E just beyond PII-IA, displacing that fault slightly.
CT-2	S of CT to W end of CT	255+	2-12 in wide zone	N75°-90°E, 77°-87°S	S80°E, 35°; N85°E, 19°; N90°W, 3°	Left Lateral Normal, S side down	NS=1-7 in	3.0	Displaces Nqd, dike d1	Mod to sev	Calcite	Fault plane forms S wall of CT for some distance. Minor bleaching associated.

Set No. 6 WNW- Steep Dipping

Fault No.	Location	Length (Ft)	Width (Unmineralized) & Fault Character	Strike, Dip	Slickensides Trend, Plunge	Movement Sense	Displacement	Movement Component Ratio Str. Slip/Dip Slip	Crosscutting Relationships	Weathering	Mineralization	Remarks
CII-1	From TWII to area SE of CII	500+	1 1/2 in zone to 14 ft diffuse zone	N80°-90°W, 80°-85°N	N65°W, 44°; N75°E, 44°	Left Lateral Reverse, N side up; Left Lateral Normal, N side down	NS=6-12 ft	1.5-11	Displaces Sk, hd, dikes d5, d11, d12, and d13; partially cross-cut by dike. d3	Sl to sev, loc ext	Chlorite, Quartz, Minor Pyrite, Calcite, Graphite (?)	Dike 5d is displaced considerably less than the other three. Small Quartz-lined vugs with unsheared crystal occur within the fault. Cross-cuts and may displace EII-1. Overlying till is undisturbed.
CII-2	From TWII to E wall of RPII	324+	1 in to 3 ft zone	N80°-90°W, 72°N-85°S	N49°W, 41°; S73°E, 23°; N60°E, 29°	Left Lateral Reverse, N side up; Left Lateral Normal, N side down; Right Lateral	HS=4-12 ft	1.1-2.5	Displaces Sk, dikes d11, d12, and d13; cross-cut by dike d5	Sl to sev, loc ext	Chlorite, Minor Quartz, Pyrite	Acts as a conduit for a portion of dike d5. Ends to the E against fault EII-1. Overlying till is undisturbed.
CII-2A	From E side of CII to area SE of CII	181	1 in to 2 ft zone	N64°-80°W, 70°-90°N	None	Left Lateral Reverse?	Small	----	Displaces Sk; cross-cut by dike d3	Sl, loc mod	Minor Pyrite, Chlorite	On strike with fault CII-2. Splays into EII-2, and for about 20 ft is indistinguishable from fault.
CII-3	From N side of CBII to area SE of CII	288	1/8 in discrete fracture to 4-6 ft diffuse zone	N70°-80°W, 60°N-77°S	S80°W, 17°s	Left Lateral Reverse	Small	6.0	Displaces Sk; Nqd	Sl, loc mod	Minor Quartz, Calcite Chlorite	Mostly a zone of closely-spaced, tight joints.
FII-1	From just NW of FII to E end of CT	188	1/8 in discrete fracture to 6 ft, diffuse zone	N55°-80°W, 80°S-80°N	None	Left Lateral	Small	____	Displaces Sk; cross-cut by dike d1	Sl, loc mod	Chlorite, Minor Calcite	

Set No. 4 NE - Striking, Vertical

Fault No.	Location	Length (Ft)	Width (Unmineralized) & Fault Character	Strike, Dip	Slickensides Trend, Plunge	Movement Sense	Displacement	Movement Component Ratio Str. Slip/Dip Slip	Crosscutting Relationships	Weathering	Mineralization	Remarks
PII-1	From N end of DII to W side of FII	381	1/16in discrete fracture to 6ft, diffuse zone	N65°-88°W, 75°N-75°S	N90°W, 5°	Left Lateral	HS=5 in	25.0	Displaces Sk, Nqd	C to mod, loc sev	Calcite, Chlorite, Minor Quartz, Pyrite	Contains stringers of Nqd which appear to have been injected lit-par-lit, post-faulting. Calcite locally forms the matrix of a fused breccia which contains angular fragments of Sk.
NII-1	From NW corner of CBII to S wall of EVII	189+	1/8in discrete fracture to 1/2-8in zone	N65°-75°W, 72°S-80°N	N62°W, 49°	Right Lateral Reverse?	NS=2 ft 6 in	9.0	Displaces Sk	C to Sl, loc mod	Minor Calcite, Chlorite	Calcite locally forms matrix of a fused breccia which contains angular fragments of Sk. Movement sense suggested by slickensides is opposite to that observed for other faults in this set.
NII-2	From NW to SE in CBII	122+	1/2in to 1ft zone	N75°W-N85°E, 55°-90°N	None	Left Lateral	HS=6 in	____	Displaces Sk	C to Sl	Minor Chlorite	May join NII-1 to NW.
PII-1A	From SWT S of FII to E end of CT	89	1/4 discrete fracture to 6 ft diffuse zone	N75°-88°N, 77°-90°N	None	Left Lateral?	Small	____	Displaces Sk, Nqd; cross-cut by dike d1.	Mod to Sl	Chlorite, Minor Pyrite	On strike with PII-1.

Set No. 4 NE - Striking, Vertical

Fault No.	Location	Length (Ft)	Width (Unmineralized) & Fault Character	Strike, Dip	Slickensides Trend, Plunge	Movement Sense	Displacement	Movement Component Ratio Str. Slip/Dip Slip	Crosscutting Relationships	Weathering	Mineralization	Remarks
EII-1	From SE corner of TBII to E end of CT	378	1/16-1 in zone in Nqd and db; 2-8 in zone in Sk	N25°-66°W, 30°-65°SW	S75°W, 40°; N65°W, 12°	Left-Lateral Reverse, SW side up; Right-Lateral Normal, SW side down	NS=5-6ft	Very high; .047-1.2	Displaces Sk, hd and Nqd; apparently cuts dikes d1 and d5	Mod to sev, loc ext	Chlorite, Minor Pyrite	A particularly wary, bumpy surface. Fault has apparently experienced two ancient movements. Displaced by CII-1.
EII-1A	E end of CT	33+	2-6 in wide zone	N25°W, 38°W	None	Right-Lateral Normal, SW side down (?)	Small	____	Displaces Sk	Mod with loc ext	Minor Chlorite	On-strike with EII-1. Drag Indicates right-lateral movement.
EII-2	From between ESFPCII and WPB to SWT NE of CT	188+	1-12 in wide zone	N10°-20°W, 68°W	None	Right-Lateral Normal, SW side down	NS=1 ft 2 in	1.6	Displaces Sk	Mod with loc sev	Minor Chlorite, Minor Quartz	Quartz crystals in small vugs within fault are undisturbed. Splays into fault CII-2A. Drag indicates some Left-lateral movement.
EII-3	Just SE of CII	49	1-4 in wide zone	N25°-40°W, 78°-90°W	None	Right-Lateral	HS=8 ft	____	Displaces Sk	SL	Chlorite	Splays into CII-1. Drag indicates right-lateral movement.

TABLE 2.5-3 JOINTING IN SITE BEDROCK

Rock Unit	Average Set Orientation	Degree of Development	Spacing	Occurrence – Distribution	Remarks
Newburyport	N35°-45°E, 35°-40°NW	Very Good	6in-8ft	Very common	Local strike variations for this set range from N10°-50°E.
	N35°-45°E, 50°-75°SE	Good to fair	1-10ft	Fairly common	Conjugate with above set.
	N10°-30°W, 55°-65°SE	Good	6-12ft	Common	
	N45°E, 80°-90°NW	Good to fair	Very wide	Occasional	Parallel to diabase dikes, often calcite-coated or filled.
	N90°E, 80°S-80°N	Fair to poor	Very wide	Occasional	
	N50°-60°W, 40°-50°NE	Fair	Very wide	Occasional	
Kittery	N70°-90°W, 70°S-60°N	Very good	2in-6ft	Very common	Parallel to foliation
	N35°-55°E, 35°-40°NW	Fair to very good	1-3ft	Very common to occasional	More common within 50-100 ft of contacts with Newburyport.
	N25°-40°E, 55°-65°SE	Fair	5ft	Common to occasional	More common within 50-100ft of contacts with Newburyport.
	N10°-25°W, 50°-70°SW	Fair to poor	1-10ft	Occasional	

Rock Unit	Average Set Orientation	Degree of Development	Spacing	Occurrence – Distribution	Remarks
Kittery	N10°-50°W, 30°-50°SW	Fair to poor	1-10ft	Occasional	
	N0°-15°E, 55°-75°W	Fair to poor	1-10ft	Occasional	
	N25°-55°W, 30°-35°NE	Fair to poor	Very wide	Occasional	
	N40°-55°W, 60°-80°SW	Fair to poor	Very wide	Occasional	Locally well-developed.

TABLE 2.5-4 FOUNDATION EXCAVATIONS AND ABBREVIATIONS USED

(Unit No. I or former Unit II indicated as necessary)

Administration Building	AB
Containment Building	CI or CII
Control Building	CBI or CBII
Circulating Water Pumphouse	CP
Cooling Tower	CT
Circulating Water Trench	CWT
Diesel Generator Building	DI or DII
Discharge Tunnel Shaft	DS
Emergency Feedwater Pump Building	EFPBI or EFPBII
Equipment Hatch	EHI or EHII
East Steam & Feedwater Pipe Chase	ESFPCI or ESFPCII
Equipment Vault	EVI or EVII
Fuel Storage Building	FI or FII
Ringer Crane	GII
Haul Road	HI
Heater Bay (in Turbine Building)	HBI or HBII
Intake Tunnel Shaft	IS
Primary Auxiliary Building	PI or PII
Reactor Pit (in Containment Building)	RI or RII
RCA Tunnel	RCAII
S-Column Line Trench	
(in Turbine Building)	SCLTI or SCLTII
Service Water Pumphouse	SP
Service Water Trench	SWT
Turbine Building	TI or TII
Tank Farm	TFI or TFII
Trench W	TWII
Waste Processing Building	WPB

TABLE 2.5-5 **EARTHQUAKES IN THE NORTHEAST LATITUDE 40.0N TO 48.0N LONGITUDE 64.0W TO 75.0W**

The information contained in this table is historical information and is not acceptable for electronic format. A copy of this information may be obtained through the Records Management Department.

TABLE 2.5-6 SEISMIC EVENTS WITH DUBIOUS LOCATION OR ORIGIN

Date	Origin Time	Latitude*	Longitude*	Intensity	Remarks
1730 Dec. 30		42.7	70.6	IV-V	Location Uncertain Cape Ann Region
1734 Nov. 23		42.7	70.6	IV-V	Location Uncertain Cape Ann Region
1737 Feb. 17		42.4	71.0	IV	Location Uncertain Felt in Boston and Vicinity
1739 Aug. 13		42.7	70.6	IV-V	Location Uncertain Cape Ann Region
1761 Mar. 12	0215 L.	42.7	70.6	V	Location Uncertain Cape Ann Region
1766 Jan. 23	0500	43.65	70.28	IV	Location Uncertain Portland, Maine Region
1766 Aug. 25	0105	41.5	71.3	F	Dubious seismic origin – probably a meteor
1785 Jan. 2	1215	46.0	67.0	VIII	Location Uncertain Reported from Portland, Maine to Baltimore, Maryland
1808 June 26	1951	44.0	70.0	V	Location Uncertain Coastal Maine

Date	Origin Time	Latitude*	Longitude*	Intensity	Remarks
1860 Mar. 16		42.25	71.17	IV	Location Uncertain Reported from Eastern and Southeastern Massachusetts
1892 July 25				IV	Georges Shoals – location uncertain, reported by pilot boat
1903 Jan. 21	1000	42.1	70.9	V	Dubious seismic origin – probable frost action
1903 Jan. 22		41.95	71.3	IV	Dubious seismic origin – frost action
1921 July 29	1614	42.22	71.07	IV	Location Uncertain – isolated felt report from Cambridge, Massachusetts
1925 July 1		46.0	68.0	IV	Dubious seismic origin
1954 Feb. 13		42.15	72.60	III-IV	Dubious seismic origin – probable frost action (2 shocks)
1973 Feb. 3		41.5	71.7	V	Location and origin dubious; not recorded by seismograph stations in the area (U.S. Earthquakes, 1973)

* For computer retrieval only.

TABLE 2.5-7 JESUIT SEISMOLOGICAL ASSOCIATION STATIONS

Station	Latitude	Longitude	Elevation Meters	Date Opened Day	Date Opened Month	Date Opened Year	Date Closed Day	Date Closed Month	Date Closed Year	Location
BUF	42.9333N	78.8500W	195	01	01	1912		--		Buffalo, NY
CHI	41.9000N	87.6333W	183	01	09	1912		--		Chicago, IL
CNN	39.1450N	84.4967W	203	01	01	1927	01	01	1963	Cincinnati, OH
CLE	41.4888N	81.5321W	328	01	01	1904		--		Cleveland, OH
FOR	40.8631N	73.8856W	24	01	01	1910		--		Fordham, NY
GEO	38.9000N	77.0667W	29	01	01	1911		--		Georgetown, DC
MLW	43.0333N	87.9167W	194	01	01	1909		--		Milwaukee, WI
NOL	29.9483N	90.1200W	2	01	01	1910		--		New Orleans, LA
SHA	30.6944N	88.1428W	61	01	12	1910		--		Spring Hill, AL
WES	42.3847N	71.3221W	60	01	01	1929		--		Weston, MA
FLO	38.8017N	90.3700W	160	09	07	1961	08	03	1971	Florisant, MO
--	38.6364N	90.2333W	--	01	01	1910		early 60's		St. Louis, MO
--	38.6361N	90.2361W	--			1927		--		St. Louis, MO
--	37.3167N	89.5333W	--			1938		--		Cape Girardeau, MO
--	34.7833N	92.3500W	--			1930		mid 60's		Little Rock, AR

*Macelwane (1925-1950)

TABLE 2.5-8 **WORLD-WIDE STATIONS IN EASTERN UNITED STATES***

Station	Latitude	Longitude	Elevation Meters	Date Opened Day	Date Opened Month	Date Opened Year	Date Closed Day	Date Closed Month	Date Closed Year	Location
AAM	42.2997N	83.6561W	249	01	01	1940		--		Ann Arbor, MI
ATL	33.4333N	84.3375W	273	21	06	1963		--		Atlanta, GA
BLA	37.2112N	80.4205W	634	04	09	1962		--		Blacksburg, VA
FLO	38.8017N	90.3700W	160	09	07	1961	08	31	1971	Florisant, MO
FVM	37.9840N	90.4260W	--	10	05	1974		--		French Village, MO
GEO	38.9000N	77.0667W	43	07	12	1961		--		Georgetown, DC
MDS	43.3722N	89.7600W	278	16	01	1962	10	06	1968	Madison, WI
MNN	44.9145N	93.1900W	--	07	05	1962	04	11	1965	Minneapolis, MN
OGD	41.0875N	74.5958W	367	01	01	1960		--		Ogdensburg, NJ
OXF	34.5118N	89.4092W	101	01	08	1963	01	05	1976	Oxford, MS
SCP	40.8098N	77.8694W	353	26	01	1962		--		State College, PA
SHA	30.6944N	88.1428W	61	01	12	1910		--		Spring Hill, AL
WES	42.3874N	71.3221W	60	01	01	1929		--		Weston, MA

* Institute of Science and Technology, University of Michigan (see References).

TABLE 2.5-9 **SEISMOGRAPH STATIONS IN EASTERN CANADA***

Station	Latitude	Longitude	Elevation Meters	Date Opened Day	Date Opened Month	Date Opened Year	Date Closed Day	Date Closed Month	Date Closed Year	Location
TNT	43.6670N	79.3990W		01	09	1897	01	01	1942	Toronto, Ont.
SHF	46.3300N	72.4500W				1928	08	12	1965	Shawinigan Falls, Que.
SFA	47.1200N	70.8200W	232			1928	31	07	1975	Seven Falls, Que.
HAL	44.6300N	63.6000W	56			1915				Halifax, N.S.
KLC	48.0900N	80.0200W		19	12	1939	30	06	1957	Kirkland Lake, Ont.
MNT	45.5000N	73.6200W	112	01	04	1956				Montreal, Que.
OTT	45.3900N	75.7200W	83	01	01	1906				Ottawa, Ont.
LND	42.5900N	81.1400W		01	01	1961	31	05	1967	London, Ont.
CHQ	46.8900N	71.3000W	145	11	11	1971				Charlesbourg, Que.
LHC	48.4200N	89.2700W	196	28	02	1969				Thunder Bay, Ont.
PBQ	55.2800N	77.7400W	20	14	09	1972				Poste-De-La-Baleine, Que.
POC	47.3600N	70.0400W	61	20	01	1972				La Pocatiere, Que.
QCQ	46.7800N	71.2800W	91	24	09	1971				Quebec, Que.
SCB	43.7200N	79.2300W	153	01	01	1962		01	1974	Scarborough, Ont.
SCH	54.8200N	66.7800W	540	22	07	1962				Schefferville, Que.

Station	Latitude	Longitude	Elevation Meters	Date Opened Day	Date Opened Month	Date Opened Year	Date Closed Day	Date Closed Month	Date Closed Year	Location
SIC	50.1900N	66.7400W	283	01	01	1962				Seven Islands, Que.
STJ	47.5700N	52.7300W	62	01	06	1964				St. John's, Nfld.
SUD	46.4700N	80.9700W	267	22	11	1967				Sudbury, Ont.
UNB	45.9500N	66.6300W	56	01	09	1971				Fredericton, N. B.
GWC	55.2910N	77.7520W	8	29	09	1965	01	07	1972	Great Whale R., Que.
MNQ	50.5333N	68.7744W	487	01	01	1974				Manicouagan, Que.
MIQ	46.2300N	75.5800W		01	01	1974				Maniwaki, Que.
HV	49.1100N	68.1600W		01	04	1974	01	12	1974	Hauterive, Que.
LGQ	53.6900N	77.7300W	190	04	08	1976				La Grande, Que.
LMQ	47.5500N	70.3300W	419	03	11	1976				La Malbaie, Que.
GNT	46.3630N	72.3720W	10	04	24	1978				Gentilly, Que.

*United States Department of Commerce (1972)
Wetmiller and Horner (1978)

TABLE 2.5-10 LIST OF OPERATING N.E.U.S.S.N. SEISMIC STATIONS BY STATE JULY-SEPTEMBER 1978

STA	Latitude DG MN SEC	Longitude DG MN SEC	Elevation Meters		Operator
Connecticut					
BCT	412936.0N	732301.9W	69	Brookfield	WES
ECT	415004.7N	732440.8W	342	Ellsworth	WES
HDM	412908.7N	723123.6W	24	Haddam	WES
NSC	412850.7N	715105.7W	110	N. Stonington	WES
UCT	414954.0N	721502.0W	149	Storrs	WES
Delaware					
BBD	392046.0N	754036.0W	18	Blackbird	DGS
GTD	384429.0N	752452.0W	15	Georgetown	DGS
NED	394215.2N	754229.5W	46	Newark	DGS
Maine					
AGM	470454.0N	690124.0W	240	Allagash	WES
BPM	443754.0N	684721.6W	80	Bucksport	WES
CBM	465557.0N	680714.8W	250	Caribou	WES
D1A	470330.8N	690556.2W	304	Dickey	WES
D2A	470749.3N	690908.8W	402	Dickey (Kelly Mtn)	WES
D3A	470515.2N	691007.4W	259	Dickey (Carter Brook)	WES
D4A	471117.2N	691636.1W	490	Dickey (Rocky Mtn)	WES
D5A	470040.7N	691554.0W	365	Dickey (Browns Brook)	WES
D6A	470520.4N	692944.5W	430	Dickey (Two Mile Stream)	WES
EMM	444421.0N	672922.0W	20	East Machias	WES
HKM	443923.0N	693826.9W	79	Hinckley	WES
JKM	453919.8N	701433.4W	378	Jackman	WES
MIM	451437.0N	690225.0W	140	Milo	WES
TRM	441534.9N	701518.3W	113	Turner	WES

STA	Latitude DG MN SEC	Longitude DG MN SEC	Elevation Meters		Operator
Massachusetts					
COD	412438.9N	700450.1W	-85	Cape Cod	MIT
DUX	420407.0N	704604.0W	27	Duxbury	MIT
FLR	414260.0N	710717.5W	52	Fall River	WES
GLO	423825.0N	704338.0W	15	Gloucester	MIT
HRV	423023.0N	713330.0W	180	Harvard	MIT
LNX	422020.0N	731620.6W	345	Lenox	WES
QUA	422723.8N	722225.8W	201	Quabbin	WES
WES	422304.9N	711919.5W	60	Weston	WES
WFM	423638.0N	712926.0W	87	Westford	MIT
WGMA	421720.4N	813506.0W	130	Westboro	WGE*
New Hampshire					
BNH	443526.1N	711523.0W	472	Berlin	WES
CSNH	434857.6N	712743.2W	200	Center Sandwich	WGE
DNH	430721.0N	705341.2W	24	Durham	MIT
GHNH	435212.0N	710708.4W	200	Goe Hill	WGE
HNH	434219.0N	721708.0W	180	Hanover	WES
LANH	433527.6N	712924.0W	200	Laconia	WGE
MBNH	434337.2N	711919.2W	200	Moultonborough	WGE
ONH	431645.0N	713019.9W	280	Oakhill	MIT
PNH	430343.0N	720808.9W	659	Pitcher Mtn	MIT
WBNH	433614.4N	710556.4W	200	Wolfeboro	WGE
WNH	435206.0N	712359.0W	220	Whiteface	MIT
New Jersey					
GMTN	405257.0N	741104.2W	165	Garret Mountain	LDO
GPD	410103.6N	742739.0W	360	Green Pond	LDO
LVNJ	404834.2N	744505.4W	201	Long Valley	LDO
OGD	410400.0N	743659.9W	363	Ogdensburg	LDO
PQN	410026.3N	750509.0W	229	Pahaquarry	LDO

STA	Latitude DG MN SEC	Longitude DG MN SEC	Elevation Meters		Operator
PRIN	402200.6N	744304.2W	110	Princeton	LDO
TABN	395151.0N	743946.2W	30	Tabernacle	LDO
New York					
ALF	421331.2N	774749.7W	671	Alfred	LDO
ALX	441921.0N	755540.8W	122	Alexander Bay	LDO
APH	435028.7N	742949.1W	564	Airport Hangar	LDO
BGR	444943.8N	742227.0W	329	Bangor	LDO
BLM	411946.9N	735718.0W	134	Blum	CON*
CLIN	415230.0N	735056.4W	168	Clinton	LDO
CLY	435104.7N	742656.4W	579	Crystal Lake	LDO
CROG	435418.0N	752445.0W	244	Groghan	LDO
CTR	435226.9N	742735.9W	585	Castle Rock	LDO
DANY	444530.0N	735008.4W	507	Dannemora	LDO
DBM	411739.9N	735829.9W	27	Dunderburg Mtn	CON*
DNY	425010.7N	781007.7W	381	Dersam	LDO
DPL	411510.0N	735439.0W	67	Delli Paoli	CON*
EGN	435134.6N	742854.6W	549	Eagles Nest	LDO
GCB	411946.0N	735519.0W	150	Gobbelet	CON*
GSC	411558.0N	740014.0W	110	Girl Scout Camp	CON*
HNY	424954.6N	753053.4W	500	Hamilton	LDO
IPS	411602.0N	735654.0W	0		CON*
AMNH	404651.0N	735825.8W	0	Manhattan	LDO
MSNY	445954.0N	745143.2W	55	Massena	LDO
OCN	435305.4N	743145.6W	701	Over Castle Rock	LDO
OSB	412137.0N	725525.9W	212	Osborn	CON*
PAL	410015.0N	735432.9W	91	Palisades	LDO
PNY	445002.9N	733317.9W	177	Plattsburg	LDO
PTN	443420.9N	745858.1W	238	Potsdam	LDO
SANY	431025.8N	785213.2W	172	Sanborn	LDO

STA	Latitude DG MN SEC	Longitude DG MN SEC	Elevation Meters		Operator
SNP	411427.0N	735816.0W	30	Stoney Pt	CON*
SPS	411806.9N	735326.0W	168	St. Peters School	CON*
SRM	411342.0N	740050.0W	165	Scherman	CON*
STL	411119.0N	740012.9W	125	Stiles	CON*
TBR	410829.9N	741319.9W	261	Table Rock	LDO
UWL	435016.2N	743236.0W	561	Utowana Lake	LDO
WGL	412132.0N	735357.9W	152	Wegel	CON*
WND	422015.0N	740909.0W	602	Windham	LDO
WNY	442327.5N	735134.2W	598	Wilmington	LDO
WPNY	414810.8N	735814.4W	76	Westpark	LDO
WPR	411516.7N	733508.3W	152	Ward Pound Ridge	LDO
WVLY	422815.0N	783406.0W	600	West Valley	LDO
Pennsylvania					
BVR	404200.N	801960.0W	0	Beaver	PSU
ERI	420760.0N	795859.9W	0	Erie	PSU
MVL	395957.0N	762102.0W	0	Millersville	MSC
PHI	400659.9N	750760.0W	0	Abington	PSU
SCP	404742.0N	775153.9W	352	State College	PSU
Rhode Island					
None					
Vermont					
BVT	432055.8N	723506.9W	300	Baltimore	WES
COV	443439.6N	730845.0W	85	Colchester	LDO
DVT	445743.2N	721015.2W	370	Derby	WES
FLET	444322.0N	725706.0W	366	Fletcher	LDO
MARL	425018.0N	724803.0W	580	Marlboro	LDO
MDV	435956.9N	731052.1W	134	Middlebury	LDO
MGVT	445449.0N	723740.0W	262	Montgomery	LDO
MPVT	441642.0N	723624.0W	240	Montpelier	LDO

* Station codes not all cleared through NEIC.

Operator Code

CON – Consolidated Edison, Indian Point, New York
DGS – Delaware Geological Survey
EPB – Earth Physics Branch, Dept. of Energy, Mines, and Resources, Can.
LDO – Lamont-Doherty Geological Observatory of Columbia University
MIT – Massachusetts Institute of Technology
MSC – Millersville State College
PSU – Pennsylvania State University
WES – Weston Observatory, Boston College
WGE – Weston Geophysical Engineers, Inc.

TABLE 2.5-11 SITE INTENSITIES OF HISTORICAL EARTHQUAKES

Date			(GMT)				Lat.	Long.	Epicentral	Magnitude			Dist. To Site		Site Intensity	
Yr	Mo	Da	Hr	Mn	Sec	L*	(N)	(W)	Intensity	m_b	m_{bLg}	M_L	MI	KM	A[1]	B[2]
1534							47.60	70.10	IX-X				326.2	524.9	4.8-5.8	
1638	06	11	20				47.65	70.17	IX				329.2	429.8	4.8	
1643	06	11	13	00			42.80	70.80	IV				7.2	11.6	4.0	
1661	02	10	12				45.50	73.00	VII				208.7	335.9	3.5	
1663	02	05	17	30			47.60	70.10	X				326.2	524.9	5.8	
1665	02	24					47.80	70.00	VIII				340.4	547.8	3.7	
1685	02	18					42.70	70.80	IV				13.9	22.4	4.0	
1727	11	09	22	40		L	42.80	70.60	VII				14.0	22.5	7.0	VII
1727	11	09	23	35		L	42.80	70.60	IV				14.0	22.5	4.0	
1727	11	10	02	15		L	42.80	70.60	IV				14.0	22.5	4.0	
1727	11	14	17	00		L	42.80	70.60	IV-V				14.0	22.5	4.0-5.0	
1727	11	18	11	20		L	42.80	70.60	IV				14.0	22.5	4.0	
1727	11	24	04	00		L	42.80	70.60	II-III				14.0	22.5	2.0-3.0	
1727	12	01					42.80	70.60	IV				14.0	22.5	4.0	
1727	12	16					42.80	70.60	IV				14.0	22.5	4.0	
1727	12	19	10	00		L	42.80	70.60	IV				14.0	22.5	4.0	

*Denotes local time.

[1] Site intensity calculated using: $I_{site} = I_o + 3.7 - .0011\ (\Delta km) - 2.7 Log_{10}\ (\Delta km)$ (Gupta and Nuttli, 1976). Arabic numerals used instead of Roman to denote intensity.

[2] Site intensity observed from isoseismal maps. Parentheses indicate an estimated value.

Date Yr	Mo	Da	(GMT) Hr	Mn	Sec	L*	Lat. (N)	Long. (W)	Epicentral Intensity	Magnitude m_b	m_{bLg}	M_L	Dist. To Site MI	KM	SiteIntensity A[1]	B[2]
1727	12	28	22	30		L	42.80	70.60	IV				14.0	22.5	4.0	
1727	12	29	04	00		L	42.80	70.60	II-III				14.0	22.5	2.0-3.0	
1728	01	04	23	00		L	42.80	70.60	IV-V				14.0	22.5	5.0	
1728	01	12	14	00		L	42.80	70.60	II-III				14.0	22.5	2.0-3.0	
1728	02	04	21	30		L	42.80	70.60	IV				14.0	22.5	4.0	
1728	02	08	06	30		L	42.80	70.60	IV				14.0	22.5	4.0	
1728	02	10	15	30		L	42.80	70.60	V				14.0	22.5	5.0	
1728	05	16					42.80	70.60	IV				14.0	22.5	4.0	
1728	07	30	10	00		L	42.80	70.60	IV				14.0	22.5	4.0	
1728	08	02	03	15		L	42.80	70.60	IV				14.0	22.5	4.0	
1729	11	25	08	00		L	42.80	70.60	IV				14.0	22.5	4.0	
1729	12	08	20	00		L	42.80	70.60	IV				14.0	22.5	4.0	
1730	03	09	01	45		L	42.80	70.60	IV				14.0	22.5	4.0	
1730	04	23	20	00		L	42.80	70.60	IV				14.0	22.5	4.0	
1730	12	22	18	45		L	42.80	70.60	III				14.0	22.5	3.0	
1731	01	12	19	00		L	42.80	70.60	IV				14.0	22.5	4.0	
1731	01	22	24	00		L	42.80	70.60	IV				14.0	22.5	4.0	

* Denotes local time.

[1] Site intensity calculated using: $I_{site} = I_o + 3.7 - .0011\ (\Delta km) - 2.7 Log_{10}\ (\Delta km)$ (Gupta and Nuttli, 1976). Arabic numerals used instead of Roman to denote intensity.

[2] Site intensity observed from isoseismal maps. Parentheses indicate an estimated value.

Date Yr	Mo	Da	(GMT) Hr	Mn	Sec	L*	Lat. (N)	Long. (W)	Epicentral Intensity	Magnitude m_b	m_{bLg}	M_L	Dist. To Site MI	KM	Site Intensity A[1]	B[2]
1731	10	12	23	00		L	42.80	70.60	IV				14.0	22.5	4.0	
1732	09	16	16	00			45.50	73.60	VIII				225.3	362.6	4.4	(IV)
1734	07	10	03	15		L	42.80	70.60	II-III				14.0	22.5	2.0-3.0	
1736	11	23	02	00		L	42.80	70.60	IV				14.0	22.5	4.0	
1736	11	23	06	00		L	42.80	70.60	II-III				14.0	22.5	2.0-3.0	
1737	09	20	10	20		L	42.80	70.60	IV				14.0	22.5	4.0	
1737	12	18					40.80	74.00	VII				217.5	350.1	3.4	
1744	06	03					42.80	70.60	II-III				14.0	22.5	2.0-3.0	
1744	06	14	10	15		L	42.50	70.90	VI				27.8	44.7	5.2	(IV)
1744	06	14	17	00			42.52	70.92	IV				26.5	42.7	3.3	
1745	01	03					42.80	70.60	II-III				14.0	22.5	2.0-3.0	
1755	11	18	04	12		L	42.70	70.30	VIII				30.6	49.3	7.1	VI-VII
1755	11	18	05	29			42.70	70.30	IV				30.6	49.3	3.1	
1755	11	22	20	27		L	42.70	70.30	V				30.6	49.3	4.1	IV
1755	12	19	20	15			42.70	70.30	IV				30.6	49.3	3.1	
1766	06	14					42.70	70.90	III				14.1	22.7	3.0	
1766	12	13	18	40			43.10	70.80	IV				13.9	22.4	4.0	

* Denotes local time.

1 Site intensity calculated using: $I_{site} = I_o + 3.7 - .0011 (\Delta km) - 2.7 Log_{10} (\Delta km)$ (Gupta and Nuttli, 1976). Arabic numerals used instead of Roman to denote intensity.

2 Site intensity observed from isoseismal maps. Parentheses indicate an estimated value.

Date Yr	Mo	Da	(GMT) Hr	Mn	Sec	L*	Lat. (N)	Long. (W)	Epicentral Intensity	Magnitude m_b	m_{bLg}	M_L	Dist. To Site MI	KM	Site Intensity A[1]	B[2]
1791	05	06	08	00		L	41.50	72.50	VI-VII				128.5	206.8	3.2-4.2	F
1791	12	06	23				47.40	70.50	VIII				310.8	500.2	3.9	
1801	03	01	15	30		L	43.07	70.77	IV				12.2	19.7	4.0	
1805	04	25	18	20			42.50	70.90	IV				27.8	44.7	3.2	
1807	01	13	23	00		L	43.00	71.00	IV				10.6	17.1	4.0	
1810	11	09	21	15		L	43.00	70.80	V				7.2	11.6	5.0	V
1811	12	16	08	00			36.60	89.60	XII				1085.3	1746.5	5.0	<IV
1812	01	23	15				36.60	89.60	XII				1085.3	1746.5	5.0	
1812	02	07	09	45			36.60	89.60	XII				1085.3	1746.5	5.0	
1814	11	28	19	14		L	43.70	70.30	IV-V				61.5	98.9	2.2-3.2	F
1816	09	09					45.50	73.60	VII				225.3	362.6	3.4	
1817	10	05	11	45		L	42.50	71.20	V-VI				33.1	53.2	4.0-5.0	(III)
1823	07	23	06	55		L	42.90	70.60	IV-V				12.1	19.5	4.0-5.0	IV
1837	01	15	07				42.50	70.95	IV				28.1	45.3	3.2	
1846	05	30	13	30			42.70	70.30	IV				30.6	49.3	3.1	
1846	08	25	04	45		L	42.50	70.80	V				27.7	44.5	4.2	(IV)
1847	08	08	10	00		L	41.70	70.10	V-VI				91.0	146.4	2.7-3.7	NF

* Denotes local time.

1 Site intensity calculated using: $I_{site} = I_o + 3.7 - .0011\ (\Delta km) - 2.7Log_{10}\ (\Delta km)$ (Gupta and Nuttli, 1976). Arabic numerals used instead of Roman to denote intensity.

2 Site intensity observed from isoseismal maps. Parentheses indicate an estimated value.

Yr	Date Mo	Da	Hr	(GMT) Mn	Sec	L*	Lat. (N)	Long. (W)	Epicentral Intensity	Magnitude m_b	m_{bLg}	M_L	Dist. To Site MI	KM	SiteIntensity A[1]	B[2]
1852	11	27	23	45		L	43.00	70.90	V				7.5	12.1	5.0	(IV)
1854	12	11	00	30		L	43.00	70.80	IV-V				7.2	11.6	4.0-5.0	(IV)
1857	12	23	13	30		L	44.10	70.20	VI				88.7	142.8	3.7	NF
1860	10	17	11	15			47.50	70.10	VIII-IX				319.3	513.9	3.8-4.8	
1869	10	22	11	00			45.00	66.20	VIII				272.1	437.9	4.1	
1870	10	20	16	30			47.40	70.50	IX				310.8	500.2	4.9	
1872	11	18	14	00		L	43.20	71.60	IV-V				43.5	70.0	2.6-3.6	NF
1874	11	24					42.70	70.90	IV				14.1	22.7	4.0	
1879	10	25	22	30		L	42.98	71.47	IV				32.3	51.9	3.0	
1880	05	12	07	45		L	42.70	71.00	IV-V				16.0	25.7	3.9-4.9	(III-IV)
1880	07	20	19	00		L	42.98	71.47	IV				32.3	51.9	3.0	
1881	06	19					42.80	70.90	III				7.5	12.1	3.0	
1882	12	19	17	24		L	43.20	71.40	V				35.0	56.3	3.9	(NF)
1884	08	10	19	07			40.60	74.00	VII				227.1	365.5	3.4	F
1884	11	23	12	30		L	43.20	71.70	V				48.0	77.3	3.5	NF
1886	01	17	17	14		L	42.77	71.45	IV				32.1	51.7	3.0	
1886	09	01	02	51			32.90	80.00	X				851.0	1369.4	3.7	NF
1891	05	01	19	10		L	43.20	71.60	V				43.5	70.0	3.6	(NF)
1893	11	27	16	50			45.50	73.30	VII				216.7	348.7	3.5	

* Denotes local time.

1 Site intensity calculated using: $I_{site} = I_o + 3.7 - .0011\ (\Delta km) - 2.7 Log_{10}\ (\Delta km)$ (Gupta and Nuttli, 1976). Arabic numerals used instead of Roman to denote intensity.

2 Site intensity observed from isoseismal maps. Parentheses indicate an estimated value.

Date Yr	Mo	Da	(GMT) Hr	Mn	Sec	L*	Lat. (N)	Long. (W)	Epicentral Intensity	Magnitude m_b	m_{bLg}	M_L	Dist. To Site MI	KM	Site Intensity A[1]	B[2]
1897	03	23	18	07		L	45.50	73.60	VII				225.3	362.6	3.4	
1903	04	24	12	30			42.70	71.00	IV				16.0	25.7	3.9	
1905	07	15	05	10			44.20	70.00	V-VI				99.0	159.3	2.6-3.6	(III)
1905	08	30	10	40			43.10	70.70	V				15.5	24.9	4.9	(III)
1907	10	16	00	10			42.80	71.00	V				10.6	17.1	5.0	(III-IV)
1910	08	21	18	45	00.		42.70	71.10	IV				19.1	30.7	3.7	
1915	02	21	02	03			42.80	71.10	IV				14.8	23.9	4.0	
1918	08	21	05	15			44.20	70.50	VI				91.3	146.9	3.7	(NF)
1924	09	30	08	52	30		47.60	69.70	VII-VIII		5.5		328.9	529.2	2.8-3.8	
1925	01	07	13	07			42.60	70.60	V				24.0	38.6	4.4	(IV)
1925	03	01	02	19	20.		47.60	70.10	IX		6.6	7.0	326.2	524.9	4.8	IV
1925	03	09					42.93	71.47	IV				31.9	51.3	3.0	
1925	10	09	13	55			43.70	71.10	VI				56.7	91.2	4.3	NF
1926	03	18	21	09			42.80	71.80	V				49.0	78.9	3.5	(NF)
1927	03	09	04	08			43.30	71.40	IV-V				39.4	63.5	2.8-3.8	NF
1927	06	01	12	23			40.30	74.00	VII				242.3	389.9	3.3	
1929	08	12	11	24	48.		42.87	78.35	VIII		5.2	5.8	379.4	610.6	3.5	NF
1929	11	18	20	32	00.7		44.50	56.30	X			7.2	733.1	1179.8	4.1	III
1931	04	20	19	54			43.40	73.70	VII		4.7	5.0	147.9	238.1	4.0	NF
1934	08	02	14	58			42.60	70.70	IV				21.9	35.2	3.5	
1936	11	10	02	46			43.55	71.43	V				53.7	86.5	3.4	

* Denotes local time.

1 Site intensity calculated using: $I_{site} = I_o + 3.7 - .0011\ (\Delta km) - 2.7Log_{10}\ (\Delta km)$ (Gupta and Nuttli, 1976). Arabic numerals used instead of Roman to denote intensity.

2 Site intensity observed from isoseismal maps. Parentheses indicate an estimated value.

Date			(GMT)														
Yr	Mo	Da	Hr	Mn	Sec	L*	Lat. (N)	Long. (W)	Epicentral Intensity	Magnitude m_{bLg}	M_n	M_L	Dist. To Site MI	KM	Site Intensity A[1]	B[2]
1940	12	20	07	27	26.		43.80	71.30	VII		5.4	5.8	66.2	106.6	5.1	IV
1940	12	24	13	43	44.		43.80	71.30	VII		5.4	5.8	66.2	106.6	5.1	IV
1940	12	27	19	56	09.		43.80	71.30			3.8	3.9	66.2	106.6	3.1	
1943	03	14	14	02	27.5		43.70	71.57				3.9	66.2	106.6	3.8	
1944	09	05	04	38	45.		44.97	74.90	VIII		5.8	5.9	247.0	397.5	4.2	III
1954	07	29	19	57	06.		42.70	70.70	V			4.0	15.5	25.0	4.9	
1957	04	26	11	40	06.		43.60	69.80	VI		4.8	4.7	71.1	114.5	4.0	I-IV
1958	09	19	17	45			43.60	70.20	V				58.0	93.3	3.3	
1962	12	29	06	19	10.		42.80	71.70	V			4.3	44.0	70.8	3.6	
1963	10	16	15	31	01.8		42.50	70.80	V		3.9	4.2	27.7	44.5	4.2	IV
1963	10	30	17	36	57.9		42.70	70.80	IV-V		2.4	5.0	13.9	22.4	4.0-5.0	
1963	12	04	21	32	34.9		43.60	71.60	IV-V			3.7	61.5	99.0	2.2-3.2	
1964	06	26	11	04	46.		43.30	71.90	V	2.6		3.6	60.1	96.7	3.2	
1966	10	23	23	05	34.		43.00	71.80	IV-V			3.1	48.9	78.8	2.5-3.5	
1969	08	06	16	03			43.80	71.40	V				68.1	109.6	3.1	
1971	10	21	00	54	46.2		42.70	71.15	V				20.9	33.6	4.5	
1973	06	15	01	09	05.		45.39	71.03			4.9		172.0	276.8	3.7	(III)
1975	08	03	01	03	22.		42.67	70.85				2.4	15.9	25.5	3.5	
1978	08	25	20	01	30.5		42.87	70.83			2.3		2.1	3.4	2.3	

* Denotes local time.

1 Site intensity calculated using: $I_{site} = I_o + 3.7 - .0011\ (\Delta km) - 2.7 Log_{10}\ (\Delta km)$ (Gupta and Nuttli, 1976). Arabic numerals used instead of Roman to denote intensity.

2 Site intensity observed from isoseismal maps. Parentheses indicate an estimated value.

TABLE 2.5-12 SUMMARY OF ROCK PROPERTIES

Property	Rock Type [2]	Range of Values	Average Value
1. Permeability of Rock Mass (cm/sec)			
a. Borehole water pressure tests (20 ft test zones)	D, Q	0 to 7 x 10^{-3}	(1)
b. Pumping test, Boring F-5 (200 ft. thickness of rock)	D, Q	10^{-3}	1 x 10^{-3}
2. Compression (P) Wave Velocity (ft/sec)			
a. Seismic	D, Q	13,000 – 16,000	(1)
b. Uphole and crosshole geophysical tests	D	16,500 – 18,500	(1)
c. Laboratory sonic tests (no confining pressure)			
Dry specimens	D, Q	14,682 – 17,687	16,240
Saturated Specimens	D, Q	16,960 – 20,050	18,870
3. Shear (S) Wave Velocity (ft/sec)			
a. Uphole and crosshole geophysical tests	D	8,000 – 10,000	(1)
4. Density (g/cm^3)	D, Q	2.63 – 3.01	2.80
5. Unconfined Compressive Strength (psi)	D Q	6,000 – 34,000 5,900 – 19,200	18,300 12,100
6. Moduls of Elasticity – Initial Tangent Modulus E_i (10^6 psi)			
a. Uphole and crosshole geophysical tests	D	6.5 – 9.8	(1)
b. Laboratory unconfined compression tests	D, Q	0.2 – 13	(1)

TABLE 2.5-12 SUMMARY OF ROCK PROPERTIES

Property	Rock Type [(2)]	Range of Values	Average Value
7. Modulus of Elasticity at 50% of Ultimate Compressive Strength (10^6psi)			
a. Laboratory tangent modulus (E_{t50})	D, Q	1.3 – 6.3	(1)
b. Laboratory tangent modulus (E_{s50})	D, Q	7.4 - 12	(1)
8. Poisson's Ratio			
a. Unconfined compression tests; initial load	D, Q	0.17 – 0.36	(1)
b. Unconfined compression tests; 50% of ultimate compressive strength	D, Q	0.19 – 0.28	(1)
c. Uphole and crosshole geophysical tests (from P and S velocities)	D	0.29 – 0.35	(1)
9. In-Situ Rock Stresses (psi)			
a. Largest stress	D	150 – 2,150	1,240
b. Smallest stress	D	50 – 1,570	860

(1) Average value not computed

(2) D = Diorite
Q = Quartzite

TABLE 2.5-13 SUMMARY OF MATERIAL PROPERTIES

			Bedrock	Structural Backfill
1.	Material Description		Quartz diorite and quartzite	Widely graded sands and gravelly sands, trace of fines (SW)
2.	Compression Wave Velocity (ft/sec)			(1)
	a.	Seismic Survey	13,000 – 16,000	
	b.	Uphole and Crosshole Geophysical Tests	16,500 – 18,500	
	c.	Laboratory Sonic Tests	14,682 – 20,050	
3.	Shear Wave Velocity (ft/sec)			(1)
	a.	Uphole and Crosshole Geophysical Tests	8,000 – 10,000	
4.	Bulk Density (lbs/ft^3)		164 - 188	123 – 140(2)
5.	Shear Modulus, G ($lb/in.^2$)			
	a.	Calculated from shear wave velocity ($G – pv_s^2$)	$2.3 – 3.5 \times 10^6$	
	b.	From undrained triaxial tests, 95% Compaction, strain _0.1%		4,000(3)
	c.	From drained triaxial tests, 95% Compaction, strain _0.1%		5,250(3)
	d.	Plate Load Test, Initial Loading, 97% Compaction		3,800 – 3,950(3)
	e.	Plate Load Test, Reloading, 97% Compaction		7,500 – 11,150(3)

NOTES:

(1) Structural backfill compacted to at least 95% of maximum dry density as determined by ASTM 1557-78. Measurements of compression and shear wave velocities were not performed.

(2) Calculated from range of dry densities measured in the field during August 1979 using estimated water contents of 8 to 12%.

(3) Calculated from measured Young's modulus using equation $G = \frac{E}{2(1+v)}$ with V = 0.33 for drained conditions; v = 0.50 for undrained conditions.

TABLE 2.5-14 INDEX OF LABORATORY TESTS ON SAMPLES OF OVERBURDEN SOILS

Field Exploration Program	Laboratory Testing Performed	FSAR Appendix Containing Results
1. Initial Site Area Borings (B, D, E Series)	Water Contents on Split-Spoon Samples Plastic Limit q_u (penetrometer) on Split-Spoon Samples	2J
2. Circulating Water Tunnel Investigation (AIT, AAIT, ADT, F Series Borings)	Cyclic Triaxial Test on Undisturbed Sand Samples Sieve Analyses S_u (Torvane)	References 117 and 120
3. Additional Plant Site Borings (G Series)	Sieve Analyses	2I
4. Intake Tunnel Extension Borings (AIT Series, continued)	Atterberg Limits	Reference 118

TABLE 2.5-15 INDEX OF SUBSURFACE EXPLORATIONS

	Field Exploration Program	Boring Series	Date Performed	FSAR Subsection Summarizing Program	References Containing Logs and Report
1.	Initial Borings on Site and in Vicinity of Site	A, B, C, P	October 1968 to July 1969	2.5.4.3a	GEI-6(3) and FSAR Appendix 2D
2.	Additional Site Area Borings	D, E	July to December 1972	2.5.4.3b	FSAR Appendices 2D and 2J
3.	Seismic Surveys and Fathometer Surveys in tidal marsh, Hampton Harbor, barrier beach and off-shore	- -	March to April 1972 (also some previous surveys in Fall 1968)	2.5.4.3c and 2.5.4.4	FSAR Appendix 2K
4.	In-Situ Wave Velocity Measurements in Site Area	- -	June to July 1973	2.5.4.3d and 2.5.4.4	- -
5.	Circulating Water Tunnel Investigations	AIT, AAIT, ADT, F	April 1973 to May 1974	2.5.4.3e	GEI-1(1)
6.	In-Situ Rock Stress Measurements in Site Area	OC	June to July 1973	2.5.4.3f	FSAR Appendix 2H

(1) Geotechnical Engineers Inc, Report GEI-1, "Geotechnical Report, Circulating Water Tunnel", June 1974.

(3) Geotechnical Engineers Inc., Report GEI-6, "Drillers Logs for A, B, C and P Borings".

	Field Exploration Program	Boring Series	Date Performed	FSAR Subsection Summarizing Program	References Containing Logs and Report
7.	Scotland Road Fault Investigation	SRF	November 1973 to March 1974	2.5.4.3g	FSAR Appendix 2C
8.	Portsmouth Fault Investigation	PF	May 1974	2.5.4.3h	FSAR Appendix 2C
9.	Inclined Borings at Reactor Locations	E2	May to June 1974	2.5.4.3i	FSAR Appendix 2F
10.	Additional Plant Site Borings and Test Pit	G	September to October 1974	2.5.4.3j	FSAR Appendix 2I
11.	Intake Tunnel Extension Borings	AIT continued	June to August 1975	2.5.4.3k	GEI-3 (2)
12.	Exploratory Trenches at Reactor 2	- -	August to September 1974	2.5.4.3l	FSAR Appendix 2L
13.	Geologic Mapping of Construction Excavations	- -	1977 Through 1980	2.5.4.3m and 2.5.1.2.b.7	Reference 121

(2) Geotechnical Engineers Inc., Report GEI-3, “Geotechnical Report, Intake Tunnel Extension”, September 1975.

TABLE 2.5-16 SUMMARY OF PROPERTIES FOR OFFSITE BORROW[1]

Specific gravity	2.67
Maximum dry density, pcf	112-126
Optimum water content, %	12-14
Poisson's ration	
Drained, 90% compaction [2]	0.30
Drained, 95% compaction [2]	0.33
Undrained	0.5
Peak friction angle in degrees from triaxial tests	
Drained, 90% compaction	34
Drained, 95% compaction	39
Undrained, 90% compaction	34
Undrained, 95% compaction	36
Modulus from triaxial tests, 10^3 psi	
Drained, 90% compaction [2]	6
Drained, 95% compaction [2]	14
Undrained, 90% compaction [2]	6
Undrained, 95% compaction [2]	12
Modulus from plate load test on test fill, 10^3 psi	
Drained, 97% compaction, initial loading	10.1 – 10.5
Drained, 97% compaction, reloading	20.0 – 29.7

Notes:

(1) Based on laboratory and test fill studies described in Subsections 2.5.4.5.c.1 and 2.5.4.5.d and in Appendices 2M and 2N.

(2) For $\bar{\sigma}_{3c}$ = 7.1 psi, strain less than 0.1%. For values at larger stress levels and strain level, see Appendix 2M.

TABLE 2.5-17 SUMMARY OF PROPERTIES FOR SAND-CEMENT BACKFILL [(1)]

	Range	Average
Unit weight, pcf (after curing in humid room surface dry)	123.9 – 127.4	125
Drained friction angle in degrees from Triaxial Test – 28 days	-	46.6°
Drained cohesion intercept c in psi Triaxial Test - 28 days	-	17.5
Unconfined Compressive Strength, psi		
2-in. cubes, 7 days	72-85	75
2-in. cubes, 28 days	128-142	135
2.8-in.-dia. cylinders, 28 days	89-106	95
2-in. cubes, 90 days	118-139	130
Confined Compressive Strength, psi		
$\bar{\sigma}_c$ = 7.1 psi, 2.8-in.-dia. cylinders, 28 days	119-134	125
$\bar{\sigma}_c$ = 42.7 psi, 2.8-in.-dia. cylinders, 28 days	364-376	370
Modulus of Elasticity, 10^3 psi		
Unconfined, 2-in. cube, 7 days	10.6-13.7	12
Unconfined, 2-in. cube, 28 days	19.1-33.3	25
Unconfined, 2-in. cube, 90 days	26.3-31.3	28
Unconfined, 2.8-in.-dia. cylinder, 28 days	34.3-75.0	54
$\bar{\sigma}_c$ = 7.1 psi, 2.8-in.-dia. cylinder, 28 days	17.4-32.6	24
$\bar{\sigma}_c$ = 42.7 psi, 2.8-in.-dia. cylinders, 28 days	32.9-39.6	36

NOTE: (1) Design mix (by weight): 1 part cement, 16.2 parts sand, 2.8 parts water.

TABLE 2.5-18 SUMMARY OF SAND –CEMENT FIELD AND LABORATORY DATA

Date	Description & Other Details	Ref.	Cement Content %/WT/ Batch (%/WT/Sand)	Cement WT/Batch LBS	Adjusted Sand WT Per Batch LBS	Water/Batch In Lbs.			Water/ Cement Ratio (WT) (Gal/Sack)	Water Temp °F	Sand/ Cement Temp °F	Slump In.	Air Content In %	Laboratory Density PCF		Nuclear Densometer 6″ Dir. Transm.			Cube Uncon. Comp. Strength – PSI (2″x2″)				Cyl. Uncon. Comp. Strength – PSI (6″ ϕ x 12″)			
						In Agg.	Added	Total						Wet WT (%MC)	Proctor Max. γd PCF	Wet WT PCF	Dry WT PCF (% Comp)	% MC	3 Days	7 Days	28 Days	90 Days	3 Days	7 Days	28 Days	90 Days
																				8	29			8	29	
9/18/77	Trial Batch Design	MM-	(12)	30	226.0	6.0 lbs	35.0 lbs	41.0 lbs	1.32	73	73	5-1/4	5.0	126.6						Days	Days			Days	Days	
		2651A	10.1						(14.93)											450	700	1050		390	870	1000
			(10)	25	231.0	6.0 lbs	34.0 lbs	40.0 lbs	1.55	72	71	5	6.2	126.9						550	580	1230		390	810	1050
			8.45						(17.45)											230	450	650		190	570	680
			(8)	20	236.2	6.2 lbs	33.8 lbs	40.5 lbs	1.96	69	71	5	6.0	126.3						250	380	580		240	550	670
			6.75						(22.07)											80	250	400		140	320	370
			(6)	15	241.3	6.3 lbs	34.2 lbs	40.5 lbs	2.61	69	70	5-1/4	7.9	125.2						100	240	430		150	300	390
			5.05						(29.4)											50	70	180	40	57	130	210
			(4)	10	246.5	6.5 lbs	34.5 lbs	41.0 lbs	4.0	70	68	5-1/4	8.7	122.6						30	100	230	30	50	120	200
			3.36						(44.64)											25	25	30		10	50	70
			(4)																	25	25	30		NA	40	70
9/28/77	Stump Dump Test Pit	PTL	3.45	114	2,730	-	-	56.0 gal			84	2	4.1	125.6												
		reprt	(6)	175	2,735	-	-	56.6 gal			70	3-1/2	3.8	128.8										NA	NA	50
		YD76	5.18																					70	110	50
	rodded																							60	110	220
																									110	180
			(8)	235	2,700	-	-	57.1 gal			74	4	2.8	132.0												240
			6.88																					120	150	320
																								120	150	300
	vibrated		(6)	175	2,735	_	_	56.6 gal			62	2-3/4	5.0	124.8										42	120	170
			5.18																					35	110	170
																									110	
																								8 days		
11/1/77	Duct Bedding 19P	PTL	(6)	175	2,735	-	-	56.6 gal			66	1-1/2	6.2	124.8					30	50	130	230	40	100	210	330
	South Set #1	S/C-1	5.18																30	80	150	230	40	100	230	310
	(non-safety related)																		30	30	180	200	40	100	220	270
	Duct Bedding 19P Set #2		(6)	175	2735	-	-	56.6 gal			56	1/4	5.5	124.8						80	100		60	130	240	270
	South		5.18																	90	130		60	140	260	280
	(non-safety related)																			80	150		60	120	260	240
11/3/77	PW Line East to South	PTL																								
	Pipe Shop	S/C-2	(6)	175	2,735	-	-	56.6 gal			56	3	4.5	124.0					50	60	100	150	10	60	100	180
	(non-safety related)		5.18																50	50	80	150	NA	60	130	150
																			80	50	80	120	NA	60	100	160
11/3/77	PTL Pittsburgh Lab.	PTL	(4) 3.29	109	2,730	-	-	56.0 gal	4.28										22.5	40.3	59.7					
	Test Data on Mix	177	(5) 4.1	137	2,730	-	-	56.0 gal	3.40										41.5	70.1	94.2					
	Design		(6) 4.88	164	2,730	-	-	56.0 gal	2.84										61.0	87.3	157.8					

2 days	4 days	6 days
30	60	60
20	50	60

Note:

- All Cylinder samples were molded in a Single-Use Mold, using tamping rods.
- Stripping of molded cylindrical specimen was conducted at the time of testing.
- Cube samples were stripped from mold after 24 hours and placed in plastic bag for curing in the curing room.
- Actual production batch weights were not available. Therefore only the design mix was given.

NA – Data was not available (usually because the sample crumbled or the movement of the needle was not readable in case of cube specimen).

Date	Description & Other Details	Ref.	Cement Content %/WT/ Batch (%/WT/Sand)	Cement WT/Batch LBS	Adjusted Sand WT Per Batch LBS	Water/Batch In Lbs.			Water/ Cement Ratio (WT) (Gal/Sack)	Water Temp °F	Sand/ Cement Temp °F	Slump In.	Air Content In %	Laboratory Density PCF		Nuclear Densometer 6″ Dir. Transm.			Cube Uncon. Comp. Strength – PSI (2″x2″)				Cyl. Uncon. Comp. Strength – PSI (6″ ϕ x 12″)			
						In Agg.	Added	Total						Wet WT (%MC)	Proctor Max. γd PCF	Wet WT PCF	Dry WT PCF (% Comp)	% MC	3 Days	7 Days	28 Days	90 Days	3 Days	7 Days	28 Days	90 Days
11/7/77	Potable Water Line	PTL	(6)	175	2735	-	-	56.6 gal			57	0	8.2	122.6					25	50	80	180	40	80	120	160
	North of Pipe Shop	S/C-3	5.18																50	50	100	250	30	80	150	180
	Set #1																		25	50	100	NA	40	80	140	140
	(non-safety related)																									
	Set #2																								120	120
																									110	120
																									140	120
11/16/77	East & South of Elec-	PTL	(6)	175	2735	-	-	56.6 gal			52	2	5.7	126.6					40	30	90	80	30	90	170	190
	trical Shop	S/C-4	5.18																50	30	50	50	30	80	170	180
	(non-safety related)																		25	30	50	30	20	NA	170	190
11/22/77	Manhole 22P	PTL	(6)	175	2735	-	-	56.6 gal			50	2-1/2	5.5	126.8					30	30	130	210	NA	NA	130	190
	(non-safety related)	S/C-5	5.18																30	30	100	200	NA	NA	110	180
																			30	30	100	210	20	70	130	180
12/5/77	Electrical Manhole 29P	PTL	(6)	175	2735	-	-	56.6 gal			58	2-1/4	4.5	128.4					30	50	50		20	50	110	
	(non-safety related)	S/C-6	5.18																30	50	50		20	60	120	
																			50	60	75		NA	70	130	
1/4/78	Electrical Duct Man-	PTL	5	169	2735	-	-	56.5 gal			40	2-1/2	6.0	125.2					NA	50	150		NA	90	140	
	Hole 2E & 3E Set #1	S/C-7																	NA	30	150		NA	80	150	
	(non-safety related)																		NA	50	150		NA	90	150	
	Set #2		5	169	2735	-	-	56.5 gal			53	1-3/4	6.2	NA					30	100	180		NA	80	170	
																			30	60	150		40	90	160	
																			NA	90	150		NA	NA	150	
1/12/78	Exeter-Hampton Duct	PTL	5	169	2735	-	-	56.5 gal			65	1-1/4	5.5	126.8	124.0	123.3	112.5	9.5	NA	50	60			80	160	
	Bank Sta. 3+25 to 3+50	S/C-8													@		(90.3)		NA	50	80			NA	140	
	Set #1										70	1-3/4	5.3	NA	14.0%	121.7	111.4	9.2	3 hours							
	(non-safety related)														OMC		(89.8)		NA	50	80			NA	160	
														NA	Sand	121.0	111.4	8.6								
															Alone		(89.8)									
																122.5	112.0	9.4								
																	(90.3)									
	Set #2										68	6	2.6	NA		121.7	111.7	8.9	3 days							
																	(90.1)		NA	50	30			80	130	
																119.9	111.1	7.9	NA	30	80			NA	130	
																	(89.8)		NA	50	80			NA	150	

Note:

- All Cylinder samples were molded in a Single-Use Mold, using tamping rods.
- Stripping of molded cylindrical specimen was conducted at the time of testing.
- Cube samples were stripped from mold after 24 hours and placed in plastic bag for curing in the curing room.
- Actual production batch weights were not available. Therefore only the design mix was given.

NA – Data was not available (usually because the sample crumbled or the movement of the needle was not readable in case of cube specimen).

Date	Description & Other Details	Ref.	Cement Content %/WT/ Batch (%/WT/Sand)	Cement WT/Batch LBS	Adjusted Sand WT Per Batch LBS	Water/Batch In Lbs.			Water/ Cement Ratio (WT) (Gal/Sack)	Water Temp °F	Sand/ Cement Temp °F	Slump In.	Air Content In %	Laboratory Density PCF		Nuclear Densometer 6″ Dir. Transm.			Cube Uncon. Comp. Strength – PSI (2″x2″)				Cyl. Uncon. Comp. Strength – PSI* (6″ ϕ x 12″)			
						In Agg.	Added	Total						Wet WT (%MC)	Proctor Max. γd PCF	Wet WT PCF	Dry WT PCF (% Comp)	% MC	3 Days	7 Days	28 Days	90 Days	3 Days	7 Days	28 Days	90 Days
1/23/78	Stump Dump-Test Pit	PTL YD105	5	169	2735	-	-	56.6 gal				1/2	4.7	126.8					30	80	150			90	190	
																			50	100	190			100	170	
																			30	130	180			100	170	
2/2/78	Exeter-Hampton Duct	SC-9	5	169	2735			56.6 gal			56	4-1/2	3	126.6					80	50	100			90	150	
	Line Set 1																		100	50	190			90	160	
	(non-safety related)																		80	30	160			-	170	
																			50	30	160			100	190	
																			80	10	110			90	210	
	Set 2		5	169	2735			56.6 gal			70	2-1/2	4.5	-					80	40	140			-	200	
2/3/78	Exeter-Hampton Duct	SC-10	5	169	2735			56.6 gal			70	3-1/4	4.6	127.6					30	30	110			80	180	
	Line Set 1																		30	10	120			80	160	
	(non-safety related)																		30	30	110				150	
																			50	10	150			NA	160	
																			50	40	160			NA	170	
	Set 2		5	169	2735			56.6 gal			54	3-1/2	3.5						30	30	110					
2/16/78	Service Water Trench	SC-11									59	2-3/4	5.0	126.8					30	40	210	250		50	200	240
	(safety-related) Set 1		5	169	2735			56.6 gal											10	50	160	250		70	250	N/A
																			30	50	150	180		-	260	
																			50	100	160	230		40	260	270
																			50	80	150	230		70	240	270
	Set 2		5	169	2735			56.6 gal			58	5-1/2	2.8						30	130	140	180			230	
2/17/78	Service Water Trench	SC-12									58	2	5.5	127.7					30	50	190	250		110	200	310
	(safety-related) Set 1		5	169	2735			56.6 gal											10	50	210	250		100	220	330
																			30	30	210	300				
																			30	30	160	180		120	210	270
																			10	30	140	180		130	240	280
	Set 2		5	169	2735			56.6 gal			54	3-1/4	3.8						40	40	140	150			250	

Note:
- All Cylinder samples were molded in a Single-Use Mold, using tamping rods.
- Stripping of molded cylindrical specimen was conducted at the time of testing.
- Cube samples were stripped from mold after 24 hours and placed in plastic bag for curing in the curing room.
- Actual production batch weights were not available. Therefore only the design mix was given.

*Safety-related data used in preparing Figure 2.5-45
NA – Data was not available (usually because the sample crumbled or the movement of the needle was not readable in case of cube specimen).

Date	Description & Other Details	Ref.	Cement Content %/WT/ Batch (%/WT/Sand)	Cement WT/Batch LBS	Adjusted Sand WT Per Batch LBS	Water/Batch In Lbs.			Water/ Cement Ratio (WT) (Gal/Sack)	Water Temp °F	Sand/ Cement Temp °F	Slump In.	Air Content In %	Laboratory Density PCF		Nuclear Densometer 6″ Dir. Transm.			Cube Uncon. Comp. Strength – PSI (2″x2″)				Cyl. Uncon. Comp. Strength – PSI* (6″ ϕ x 12″)			
						In Agg.	Added	Total						Wet WT (%MC)	Proctor Max. γd PCF	Wet WT PCF	Dry WT PCF (% Comp)	% MC	3 Days	7 Days	28 Days	90 Days	3 Days	7 Days	28 Days	90 Days
2/22/78	Service Water Trench (safety-related) Set 1	SC-13	5	169	2735			56.6 gal			54	2	5.5	126.2					50 50 50	50 50 50	90 110 110	230 220 220		80 90	140 160 N/A	240 250
	Set 2		5	169	2735			56.6 gal			48	2	5.5						60 60 50	50 50 50	100 100 100	230 170 230		90 90	150 150 N/A	250 250
	Set 3		5	169	2735			56.6 gal			51 51	2-1/2 2-1/2	3.7 3.7						100 100 60	50 50 80	180 150 130	270 240 240		90 80	180 180 N/A	230 230
1/24/78	GEI Laboratory Tests	GEI prlim reprt	5	1 (part by weight of batch)	16.18	-	-	2.79 gal						124.0 123.9 126.2 127.4 126.2 126.8 124.4 124.5 125.0 126.2 124.8 124.1 124.6 123.9 124.3 124.4 124.1 124.8						66.7 72.5 85.3	141.6 133.8 130.0	117.9 139.4 133.7			2.8" ϕ Cylinders 91 89 106 119 @ conf stress/7.1 PSI 134 @ conf stress/7.1 PSI 122 @ conf stress/7.1 PSI 372 @ conf stress/42.7 PSI 376 @ conf stress/42.7 PSI 364 @ conf stress/42.7 PSI	
3/7/78	Service Water Trench (safety-related) Set 1	SC-14	5	169	2735			56.6 gal			58	2	5.6	127.1										90 90	170 170 220	250
	Set 2	SC-14	5	169	2735			56.6 gal			52	1-1/4	5.2	-										110 120	170 170 160	200

Note:

- All Cylinder samples were molded in a Single-Use Mold, using tamping rods.
- Stripping of molded cylindrical specimen was conducted at the time of testing.
- Cube samples were stripped from mold after 24 hours and placed in plastic bag for curing in the curing room.
- Actual production batch weights were not available. Therefore only the design mix was given.

*Safety-related data used in preparing Figure 2.5-45

NA – Data was not available (usually because the sample crumbled or the movement of the needle was not readable in case of cube specimen).

Date	Description & Other Details	Ref.	Cement Content %/WT/ Batch (%/WT/Sand)	Cement WT/Batch LBS	Adjusted Sand WT Per Batch LBS	Water/Batch In Lbs.			Water/ Cement Ratio (WT) (Gal/Sack)	Water Temp °F	Sand/ Cement Temp °F	Slump In.	Air Content In %	Laboratory Density PCF		Nuclear Densometer 6″ Dir. Transm.			Cube Uncon. Comp. Strength – PSI (2″x2″)				Cyl. Uncon. Comp. Strength – PSI* (6″ ϕ x 12″)			
						In Agg.	Added	Total						Wet WT (%MC)	Proctor Max. γd PCF	Wet WT PCF	Dry WT PCF (% Comp)	% MC	3 Days	7 Days	28 Days	90 Days	3 Days	7 Days	28 Days	90 Days
3/7/78	Service Water Trench N9774, E6250 to N9774, E6300 safety-related																		60 60 50 80 60 80	110 110 - 125 110 100	160 100 130 150 160 150	260 270 280 200 150 160				
3/8/78	Service Water Trench N9774, E6250 to N9774, E6300 safety-related																		100 80 80	160 140 130	220 280 200	180 190 200		130 140 140	180 190 -	270 350 -
3/29/78	Service Water Trench N9774, E6250 to N9774, E6340 safety-related																		50 80 80	150 160 150	290 380 -	320 300 340		90 90 -	300 280 280	330 320 -

Note:
- All Cylinder samples were molded in a Single-Use Mold, using tamping rods.
- Stripping of molded cylindrical specimen was conducted at the time of testing.
- Cube samples were stripped from mold after 24 hours and placed in plastic bag for curing in the curing room.

*Data used in preparing Figure 2.5-45

TABLE 2.5-19 SUMMARY OF PROPERTIES OF QUARTZITE TUNNEL CUTTINGS

Specific gravity	2.83
Maximum dry density, pcf (ASTM D1557)	146-153
Optimum water content, %	5-7
Modulus from plate load test, 10^3 psi	
Controlled placement, 95.3% compaction, initial loading	28.3–35.9
Controlled placement, 95.3% compaction, reloading	54.3-66.6
No special control, 93.3% compaction, initial load	7.3-7.7
No special control, 93.3% compaction, reload	25.2-40.3
No special control, drained for 2 weeks, initial load	13.2-21.2
No special control, drained for 2 weeks reload	43.1-49.2
Stratified with gravelly sand, no special control, initial load	17.0-26.1
Stratified with gravelly sand, no special control, reload	41.2-45.3

TABLE 2.5-20 TYPES OF ENGINEERED BACKFILL BENEATH CATEGORY I STRUCTURES

Category I Structure	Type of Engineered Backfill Between Bottom of Structure and Top of Sound Bedrock (1)			Allowable Bearing Pressure	Maximum Bearing Pressure
	Fill Concrete	Offsite Borrow	Tunnel Cuttings	tsf	tsf
Unit No. 1					
Containment Structure	X			60	12
Containment Enclosure Building	X			60	36
Containment Enclosure Ventilation Area	X			60	2.8
Control Building	X			60	
Diesel Generator Building	X			60	
Non-Essential Switchgear Room	X			60	
RHR Spray Equipment Vault	X			60	
Primary Auxiliary Building	X			60	
Fuel Storage Building	X			60	
Fuel Storage Facility Wall	X			60	
Condensate Storage Tank	X			60	5.2
Emergency Feedwater Pumphouse	X			60	14
Steam and Feedwater Pipe Chase (East)	X			60	4.0
Steam and Feedwater Pipe Chase (West)	X			60	18
Pre-Action Valve Building	X			60	4.5
Personnel Hatch Area	X			60	
Tank Farm Area	X			60	
Refueling Water Storage Tank	X			60	
Reactor Makeup Water Storage Tank	X			60	

Category I Structure	Type of Engineered Backfill Between Bottom of Structure and Top of Sound Bedrock (1)			Allowable Bearing Pressure	Maximum Bearing Pressure
	Fill Concrete	Offsite Borrow	Tunnel Cuttings	tsf	tsf
<u>Other Structures</u>					
Circulating Water Pumphouse	X			60	
Service Water Pumphouse	X			60	
Electrical Control Room	X			60	
Intake Transition Structure	X			60	
Discharge Transition Structure	X			60	
Piping Tunnels	X			60	
Waste Processing Building	X			60	
Service Water Cooling Tower	X			60	
Safety-Related Electrical Manholes		X (2)	X (2)	2.5	0.5
Safety-Related Electrical Duct Banks		X (3)		-	-
Safety-Related Service Water Pipes		X (4)		-	-

NOTES:

(1) Backfill Concrete and sand-cement were not used as engineered backfill beneath the foundations of any seismic Category I structures.

(2) Offsite borrow was used beneath all safety-related electrical manholes except Manhole W19/20. The maximum thickness of offsite borrow beneath safety-related manholes is approximately 18 ft. Manhole W19/20 is founded on tunnel cuttings with a few layers of offsite borrow included within the tunnel cuttings. The thickness of the combined tunnel cuttings and offsite borrow beneath this manhole is 15.3 ft. (See Fig. 2.5-42c.)

(3) The maximum thickness of offsite borrow beneath safety related electrical duct banks is approximately 18 ft.

(4) The thickness of offsite borrow beneath safety-related service water pipes is 15 ft. or less, except in the area between the Circulating Water/Service Water Pumphouse and the Intake/Discharge Transition Structures where the thickness of offsite borrow beneath the service water pipes is approximately 25 ft.

TABLE 2.5-21 PROPERTIES FOR SEISMIC DEFORMATION ANALYSIS OF REVETMENT

Property	Revetment Stone	Offsite Borrow 90% or 95% Compaction	Glacial Till	Filter Cloth
1. Unit Weight				
Saturated – below water	140 pcf	136 pcf	140 pcf	-
Moist – above water	126 pcf	126 pcf	-	-
2. Shear Modulus Parameter, K_2 (1)	170	55	110	-
3. Damping at low strain Level ($\leq 10^{-6}$ in. / in.)	0.5%	0.5%	0.5%	_
4. Poisson's ratio, μ				
Saturated – below water	0.3	0.48	0.48	-
Above water table	0.3	0.3	0.3	-
5. Friction angle	36°	34°	36°	32°

(1) Parameter K_2 used to compute shear modulus at low strain level ($\leq 10^{-6}$ in. /in.) with equation $G_{max} – 1000K_2(\bar{\sigma}_m)^{1/2}$ where $\bar{\sigma}_m$ is the octahedral effective stress.