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The Northeast Utilities System

June 30, 2000
B18128

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Subject: Millstone Nuclear Power Station, Unit No. 1, Docket No. 50-245
10CFR50.71(e) Submittal of the Defueled Safety Analysis Report
and the 10CFR50.59 Annual Report for 1999

References: (1) NU Letter B17337, "Millstone Nuclear Power Station, Unit No. 1; Revision 11 to the Updated Final Safety Analysis Report," dated June 30, 1998.
(2) NU letter B17801, "Millstone Nuclear Power Station, Unit No. 1; 10CFR50.59 Annual Report for 1998" dated June 30,1999.

Enclosed is the Millstone Unit 1 Defueled Safety Analysis Report (DSAR). This DSAR is being submitted to satisfy the requirement of 10 CFR 50.71(e). This DSAR is essentially a complete rewrite from the previous Updated Final Safety Analysis Report (UFSAR). The initial issue of the DSAR was issued in September 1999, and did not contain revision bars. Since that time, four changes approved through June 29, 2000, have been incorporated. These changes are identified by revision bars and change numbers.

This transmittal contains one unbound original (provided as Attachment 1) and ten bound copies of the DSAR. The single volume DSAR replaces the entire 4-volume UFSAR. Future updates to the DSAR will be provided as replacement pages.

This DSAR accurately presents changes made since the previous revision to the UFSAR which was submitted on June 30, 1998 (Reference 1).

10CFR50.71(e)(2)(ii) stipulates that this submittal include an identification of changes made under the provisions of 10 CFR 50.59 that were not previously submitted to the Commission. The last submittal was provided on June 30, 1999 (Reference 2). Attachment 2 provides a synopsis of each relevant Safety Evaluation. Complete copies of the Safety Evaluations are available at the Millstone Unit 1 site.

In addition, Attachment 3 contains a description of commitments that were changed during 1999 which warrant NRC notification in the annual report per NEI 99-04, "Guidelines for Managing NRC Commitment Changes."

A053
1/11

Please direct any questions regarding this submittal to Mr. Bryan Ford at (860) 437-5895.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

Frank Rothen
Vice President - Nuclear Work Services

Subscribed and sworn to before me

this 30 day of JUNE, 2000

Diane M. Phillipo
Notary Public

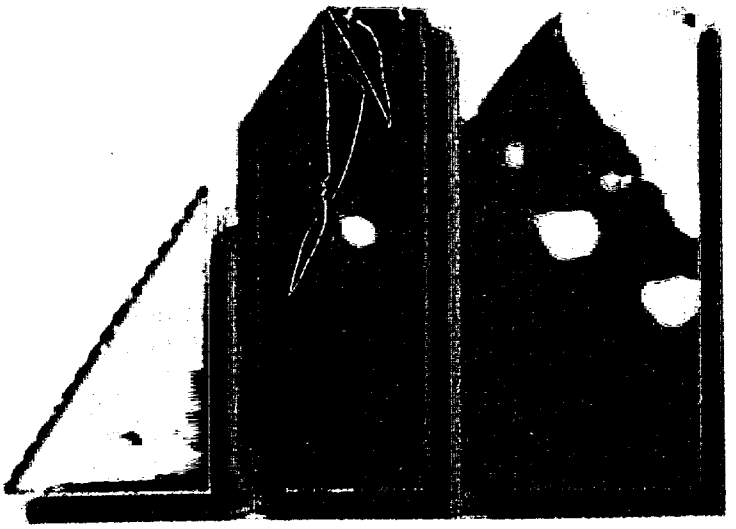
Date Commission Expires:

DIANE M. PHILLIPO
Notary Public
My Commission Expires Dec. 31, 2000

cc: H. J. Miller, Region I Administrator (w/ bound Attachment 1)
J. B. Hickman, NRC Project Manager, Millstone Unit No. 1 (w/ bound Attachment 1)
P. C. Cataldo, Resident Inspector, Millstone Unit No. 1 (w/o Attachment 1)

Attachment 1 to B18128
Millstone Unit 1
Defueled Safety Analysis Report

Millstone Nuclear Power Station



Unit 1

DEFUELED SAFETY ANALYSIS REPORT

Millstone
Nuclear Power Station
Unit 1

DEFUELED SAFETY ANALYSIS REPORT

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No. _____

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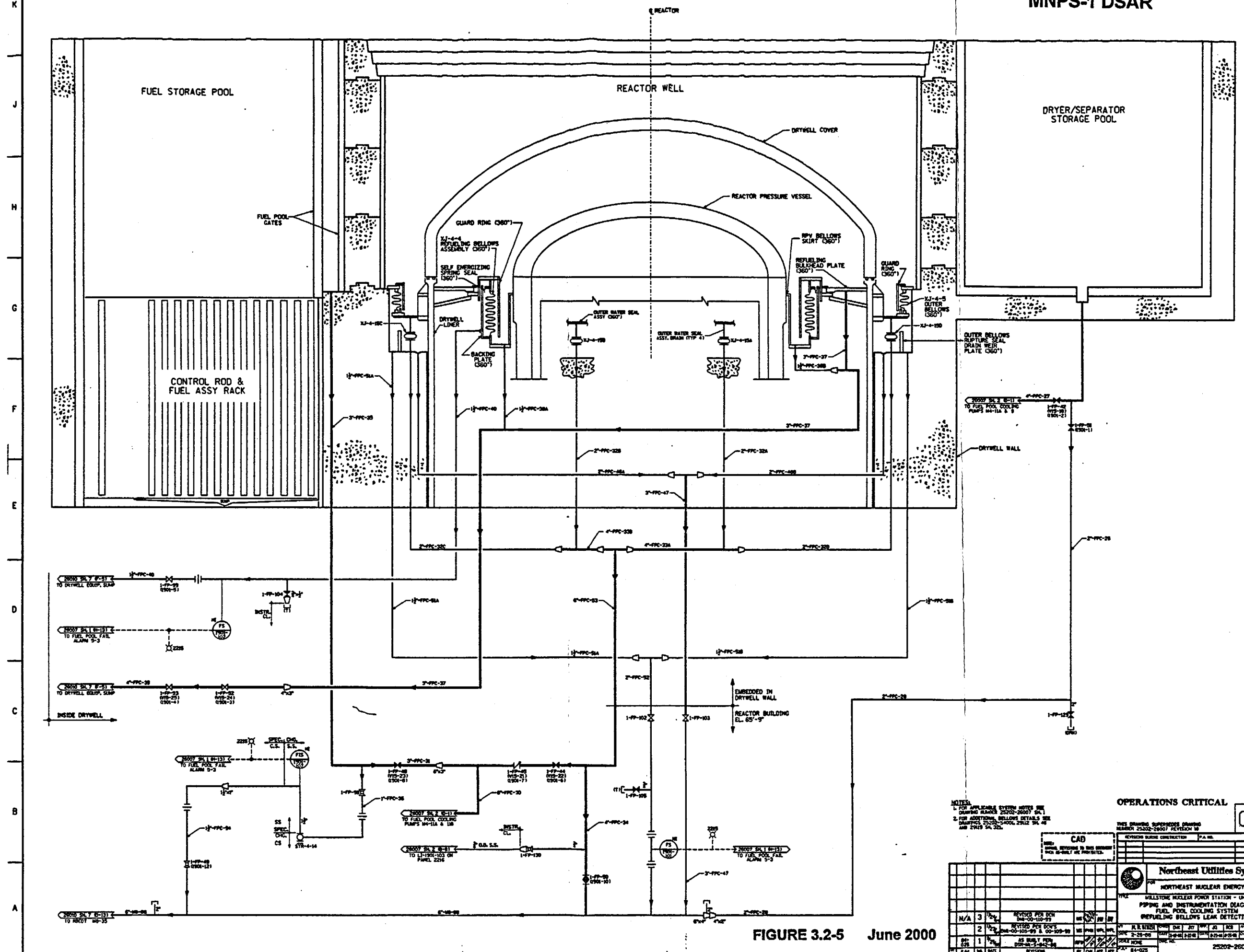

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CHAPTER 1

INTRODUCTION AND GENERAL DESCRIPTION OF PLANT

1.1 INTRODUCTION

This Defueled Safety Analysis Report (DSAR) is submitted by the Connecticut Light and Power Company (CL&P), Western Massachusetts Electric Company (WMECO) and the Northeast Nuclear Energy Company (NNECO) in support of the decommissioning for Millstone Unit No. 1 at the Millstone Nuclear Power Station in Waterford, Connecticut. CL&P and WMECO own Millstone Unit No. 1 and NNECO operated Millstone Unit No. 1 for them.

The DSAR is the principle licensing source document describing the pertinent equipment, structures, systems, operational constraints and practices, accident analyses, and decommissioning activities associated with the existing defueled condition of Millstone Unit No. 1. As such, the DSAR is intended to serve in the same role as the Final Safety Analysis Report of Millstone Unit No. 1 during the periods of power operation between 1970 and 1998. The DSAR is applicable throughout the decommissioning of Millstone Unit No. 1. The decommissioning process is dynamic. The issuance of the DSAR does not alleviate NNECO from continuing to follow all required surveillances, procedures, technical specifications or similar documents, until those documents are officially modified using approved processes.

Construction of Millstone Unit No. 1 was authorized by a provisional construction permit CPPR-20, on May 19,1966, in AEC Docket 50-245. Millstone Unit No. 1 was completed and ready for fuel loading during October 1970. The plant went into commercial operation on December 28, 1970. On July 21, 1998, pursuant to 10 CFR 50.82(a)(1)(i) and 10 CFR 50.82(a)(1)(ii), NNECO certified to the NRC that, as of July 17, 1998, Millstone Unit No. 1 had permanently ceased operations and that fuel had been permanently removed from the reactor vessel. The issuance of this certification fundamentally changes the

licensing basis of Millstone Unit No. 1 in that the NRC-issued 10 CFR 50 license no longer authorizes operation of the reactor or emplacement or retention of fuel in the reactor vessel. Therefore, as of July 21, 1998, only those conditions or activities associated with the safe storage of fuel and radiological protection (including waste handling, storage and disposal) are applicable to the defueled Millstone Unit No. 1 plant.

Millstone Unit No. 1 was a single-cycle, boiling water reactor with a Mark I containment which was designed, furnished and constructed by General Electric Company as prime contractor for CL&P and WMECO. The General Electric Company engaged Ebasco Services Incorporated as architect-engineer. Millstone Unit No. 1 had a reactor thermal output of 2011 megawatts and a net electrical output of 652.1 megawatts. The Millstone site is located in the town of Waterford, New London County, Connecticut, on the north shore of Long Island Sound.

TABLE 1.1-1

MILLSTONE UNIT NO.1 LICENSING MILESTONES

Event	Date
Construction Permit Issued	May 19, 1966
FSAR Filed	November 1, 1968
Provisional operating License Issued	October 7, 1970
Full-Term Operating License Issued	October 31, 1986
Full Power License	October 7, 1970
Initial Criticality	October 26, 1970
Synchronized to the Grid	November 1970
100 Percent Power	January 6, 1971
Commercial operation	December 28, 1970
Permanently Ceased Operations	July 21, 1998

1.2 GENERAL PLANT DESCRIPTION

1.2.1 Plant Site and Environs

1.2.1.1 Location and Site

The site for the Millstone Nuclear Power Station consists of a tract of land of approximately 500 acres located in the town of Waterford, Connecticut on the north shore of Long Island Sound and on the east side of Niantic River Estuary. It is located 3.2 miles west-south-west of New London, and 40 miles south-east of Hartford, Connecticut. The site is bounded on the west, south, and portions of the east sides by Long Island Sound. The nearest residential boundary is 855 meters north-east of the major structures of Millstone Unit No. 1. Chapter 2 contains more detailed information on the site and surrounding areas.

1.2.1.2 Site Ownership

The site is owned by two tenants in common, except for that portion of land designated for the Millstone Unit 3 site, which is owned by its participants in ownership.

1.2.1.3 Access to the Site

The immediate area around the station, excluding the intake and discharge canal, is completely enclosed by a security fence. This fence establishes the protected area boundary of the station. Access to the station is controlled by Security Personnel.

1.2.1.4 Description of the Environs

Adjacent to the site to the north and west is cultivated land with residential dwellings. The village of Niantic, consisting of a small commercial complex and attendant residential development, is 1.5 miles north-west of the Reactor Building. Other residential areas adjoin the site at the end of the plant access road and at distances of 1 to 3 miles.

New London, 3.2 miles ENE of the Reactor Building, is the nearest urban complex and includes mixed residential, commercial, and industrial uses.

1.2.1.5 Geology

The site area is underlain by Monson gneiss and Westerly granite. The Westerly granite intrudes the Monson gneiss, is more resistant to weathering and therefore forms ridges. Seismic surveys disclosed no unusual or extreme subsurface conditions. Chapter 2 contains more detailed information on geology and seismic qualities.

1.2.1.6 Seismology and Design Response Spectra

The Millstone Point site area is placed in Zone 2 (zone of moderate damage) on the seismic probability map of the 1964 Uniform Building Code.

The seismic design for critical items for this station is based on dynamic analysis of acceleration or velocity response spectrum curves which are based on a ground motion of 0.07g.

The preceding design criteria are for critical items only, that is, for Class I items. Class 1 items are defined in Chapter 3.

1.2.1.7 Hydrology

The plant site natural grade level is at an elevation of approximately 14 ft above mean sea level.

Because of the contours of the land and ground strata, and the distance of the reactor from water supplies, no water accidentally released from the plant can reach industrial or drinking water supplies.

Adequate dilution flow, both from plant cooling water flow and from tidal ocean currents, limit the average concentration of released radioactive waste materials near the plant to values well below those prescribed in 10 CFR 20. Chapter 2.0 contains more detailed information on hydrology.

1.2.1.8 Meteorology

The meteorology of the site area is basically that of a sea-coast location with relatively favorable atmospheric dilution conditions prevailing. The inland terrain in Connecticut is not pronounced enough to produce any significant local modifications of synoptic conditions at the shoreline. The shoreline areas do, however, experience local modifications of synoptic patterns because of the temperature differences between air over land and air over water.

The site is located in an area occasionally traversed by hurricanes. The design basis hurricane for Millstone has 124 mph maximum gradient winds and a 17 mph speed of translation. This is significantly more intense than the worst on record (hurricane of 1938).

It has been estimated that a tornado can be expected to strike a point on the Millstone site about every 1,804 years. In spite of this low probability, the features of the plant important to the safe storage of irradiated fuel have been designed to withstand 300 mph winds.

It is concluded that from the viewpoint of site meteorology, the site is suitable for the station as described. (Chapter 2 contains more detailed information concerning meteorology.)

1.2.1.9 Site Environmental Radioactivity Monitoring Program

An environmental radioactivity monitoring program was initiated and has been conducted at the site since April 1967. Data are collected to measure radioactivity present in the environs. The program is continuing in order to assure prompt detection and evaluation of any changes in radioactivity.

1.2.2 Summary Plant Description

The plot plan (Figure 1.2-1) shows the general arrangement of Millstone Unit No. 1 on the Millstone Point site. The reactor building houses fuel storage facilities, refueling equipment and other auxiliary equipment.

The Radioactive Waste Building, located northeast of the Reactor Building, is a two-story concrete structure containing the control, processing, packaging and storage areas for waste processing. The overall arrangement of this building is shown in Figures 1.2-2 and 1.2-3.

1.2.3 Systems

1.2.3.1 Fuel Storage and Fuel Handling

1.2.3.1.1 Fuel Storage and Handling Equipment

New fuel can be stored in the Reactor Building in the new fuel dry storage vault located near the refueling pool area and serviced by work area equipment. The storage racks are full length, top entry, and are designed to prevent an accidental critical array, even in the event the vault becomes flooded. Vault drainage is provided to prevent possible water collection.

The spent fuel storage pool holds fuel assemblies, control rods, and small vessel components. The pool system contains provisions to maintain water cleanliness and

instrumentation to monitor water level. Makeup water is available from the demineralized water system (via the condensate transfer system) and the fire water system. The racks in which fuel assemblies are placed are designed and arranged to ensure subcriticality in the pool.

The handling of spent fuel is performed within the Reactor Building. This employs a refueling platform for underwater fuel transport, storage racks for fuel and control rods in a storage pool, underwater fuel preparation stations, and floor mounted jib cranes. Control rods can be stored in the fuel pool racks or on hooks on the side of the pool.

Structural design of the fuel storage and equipment storage facilities meets all requirements for Class I structures. For additional information, refer to Chapter 3.

1.2.3.1.2 Fuel Pool Cooling System

The fuel pool cooling system provides cooling and clarifies the spent fuel pool water when required.

The fuel pool cooling system consists of a circulating pump, heat exchanger, skimmer surge tanks, a filter, a demineralizer, system piping, valves, and instrumentation and controls. For additional information, refer to Chapter 3.

1.2.3.2 Radioactive Waste Processing Systems

The radioactive waste processing systems are designed to control the release of plant-produced radioactive material to within the limits specified in 10 CFR 20 and Appendix I to 10 CFR 50. This is done by various methods such as collection, filtration, and dilution. The methods employed for the controlled release of these wastes are dependent primarily upon the state of the material: liquid or solid.

1.2.3.2.1 Liquid Radwaste System

The liquid radwaste system collects, treats, stores, and disposes of all radioactive liquid wastes. These wastes are collected in sumps and drain tanks at various locations throughout the plant and then transferred to the appropriate collection tanks in the Radwaste Building for treatment, storage, and disposal. Wastes to be discharged from the system are processed on a batch basis. Processed liquid wastes may be returned or discharged to the environs through the circulating water discharge canal. The liquid wastes from the discharge canal are further diluted in the quarry to achieve a permissible concentration for release.

Equipment is selected, arranged, and shielded to permit operation, inspection, and maintenance with minimum personnel exposure. For example, tanks and processing equipment which will contain significant radiation sources are located behind shielding; sumps, pumps, instruments, and valves are located in controlled access rooms or spaces. Processing equipment is selected and designed to require a minimum of maintenance.

Protection against accidental discharge of liquid radioactive waste is provided by valves, instrumentation for detection, alarms for abnormal conditions, and procedural controls. For additional information, refer to Chapter 4.

1.2.3.2.2 Solid Radwaste System

Solid wastes originating from nuclear system equipment maybe stored in the spent fuel storage pool and prepared for off-site shipment in approved shipping containers.

Process solid wastes are collected and appropriately prepared for off-site shipment. Examples of these solid wastes are filter residue, spent resins, paper, air filters, rags, and used clothing. For additional information, refer to Chapter 4.

1.2.3.3 Radiation Monitoring and Control

1.2.3.3.1 Process Radiation Monitoring

Radiation monitors are provided on various lines to monitor for radioactive materials released to the environs via process liquids and gases or for detection of process system malfunctions. These monitors annunciate alarms and/or provide signals to initiate corrective actions.

Ventilation stack monitors provide monitoring functions of the activity release rate of all radioactive gases exiting from the stack. Stack particulate and iodine samplers are also provided to permit monitoring of any significant release. For additional information, refer to Chapter 4.

1.2.3.3.2 Area Radiation Monitors

Radiation monitors are provided to monitor for abnormal radiation at various locations. These monitors actuate alarms when abnormal radiation levels are detected.

1.2.3.3.3 Liquid Radwaste Processing System Control

The liquid radwaste system is designed to safely and economically collect, store, process, and dispose of, or recycle, all radioactive or potentially radioactive liquid waste generated. The system operates on a batch basis and consists of subsystems to process and treat each of the various kinds of liquid radwaste encountered.

1.2.3.3.4 Solid Radwaste Control

The solid radwaste facility has capability for handling, processing and transfer of wet solids to high integrity cask containers for shipment.

1.2.3.4 Auxiliary Systems

1.2.3.4.1 Reactor Building Closed Cooling Water System

The Reactor Building closed cooling water system (RBCCW) provides cooling water to the spent fuel pool cooling system.

The system consists of circulating pumps, heat exchangers, a surge tank, and a chemical feeder.

1.2.3.4.2 Service Water System

The service water system provides cooling water for the RBCCW.

The service water system is comprised of a single open loop. Water is taken from Long Island Sound and pumped through a strainer. The strained water is routed to heat exchangers and then discharged to the discharge tunnel.

1.2.3.4.3 Fire Protection System

Fire protection and detection systems are provided at Millstone Unit No. 1 to protect structures, systems, and components important to the defueled condition of the unit.

The fire protection system includes a fire water supply system that consists of two fire water tanks, fire water pumps and a distribution system that delivers fire water to all parts of the plant.

Fire water systems within the plant protect individual hazards and include sprinkler systems, deluge systems, and pre-action water systems.

1.2.3.4.4 Electrical Power System

1.2.3.4.4.1 AC Power Supply

The electric power system includes the electrical equipment and connections required to supply power to station auxiliaries.

1.2.3.4.4.2 DC Power Supply

The 125V dc electrical system provides a source of stored electrical power to perform certain plant functions if other sources of power to the station become unavailable. The 125V dc electrical system is powered by two types of sources, lead acid batteries and static battery chargers.

The 24 volt dc power system provides a source of energy to the process radiation monitoring system and other auxiliary instrumentation. Each 24V dc battery has a battery charger sized to carry maximum connected loads in addition to recharging a discharged battery.

1.2.3.5 Station Communication System

The plant communication system provides for reliable on-site and off-site communications both under normal and contingency conditions.

1.2.3.6 Station Water Purification, Treatment and Storage System

This system provides demineralized makeup water to Millstone Unit No. 1 for use in RBCCW and the spent fuel pool.

1.2.3.7 Condensate Storage and Transfer System

The function of the condensate storage and transfer system is to provide make up water to the spent fuel pool.

The condensate storage and transfer system consist of a sufficiently sized tank, condensate transfer pumps and control and support equipment.

1.2.3.8 Plant Air System

The plant air system is used to provide instrument air at required temperatures and pressures.

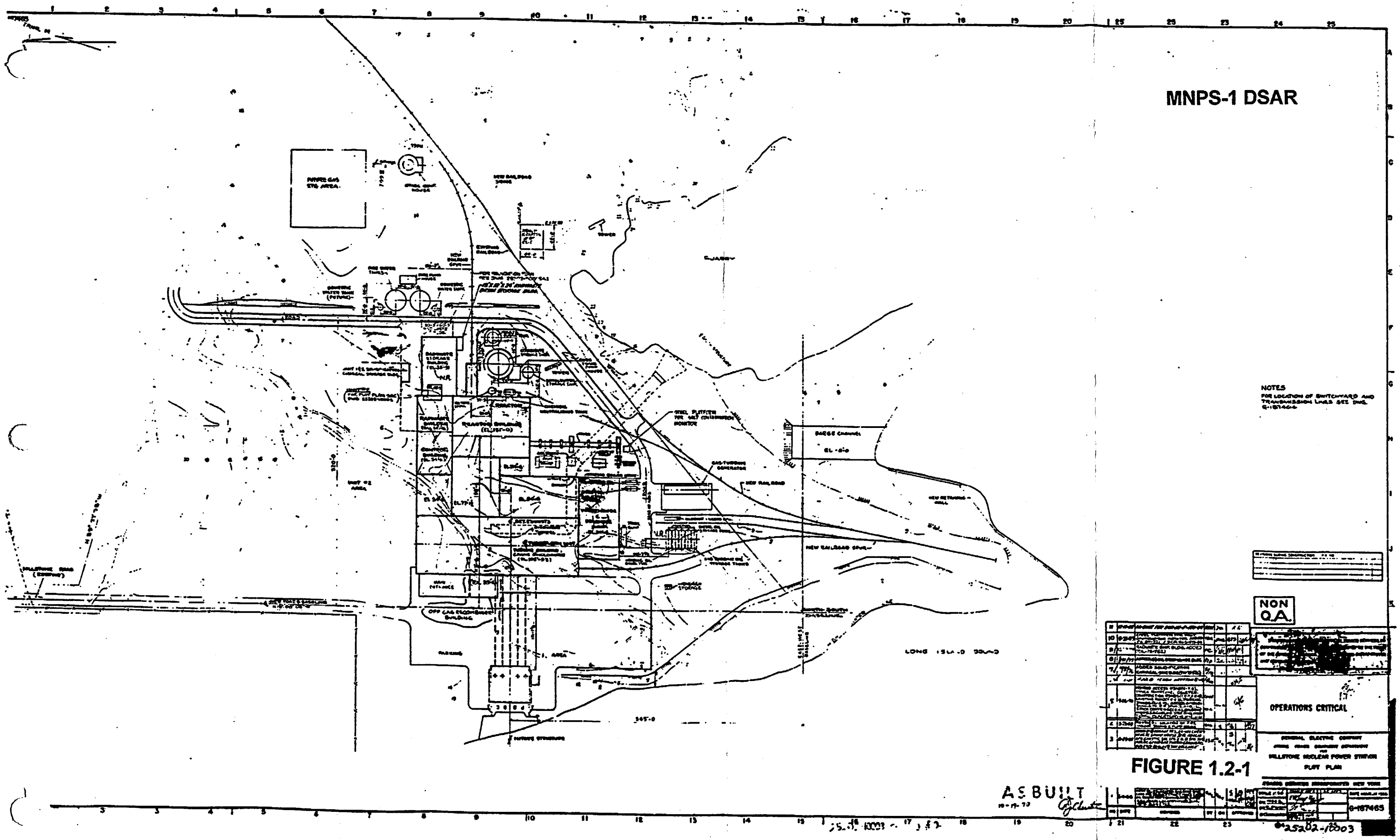
NOTES
FOR LOCATION OF SWITCHYARD AND TRANSMISSION LINES SEE DWG. E-187464
NON Q.A.
OPERATIONS CRITICAL
GENERAL ELECTRIC COMPANY
MILLSTONE NUCLEAR POWER STATION
PLOT PLAN
E-187465
LONG ISLAND SOUND
BARGE CHANNEL
AS BUILT

FIGURE 1.2-1

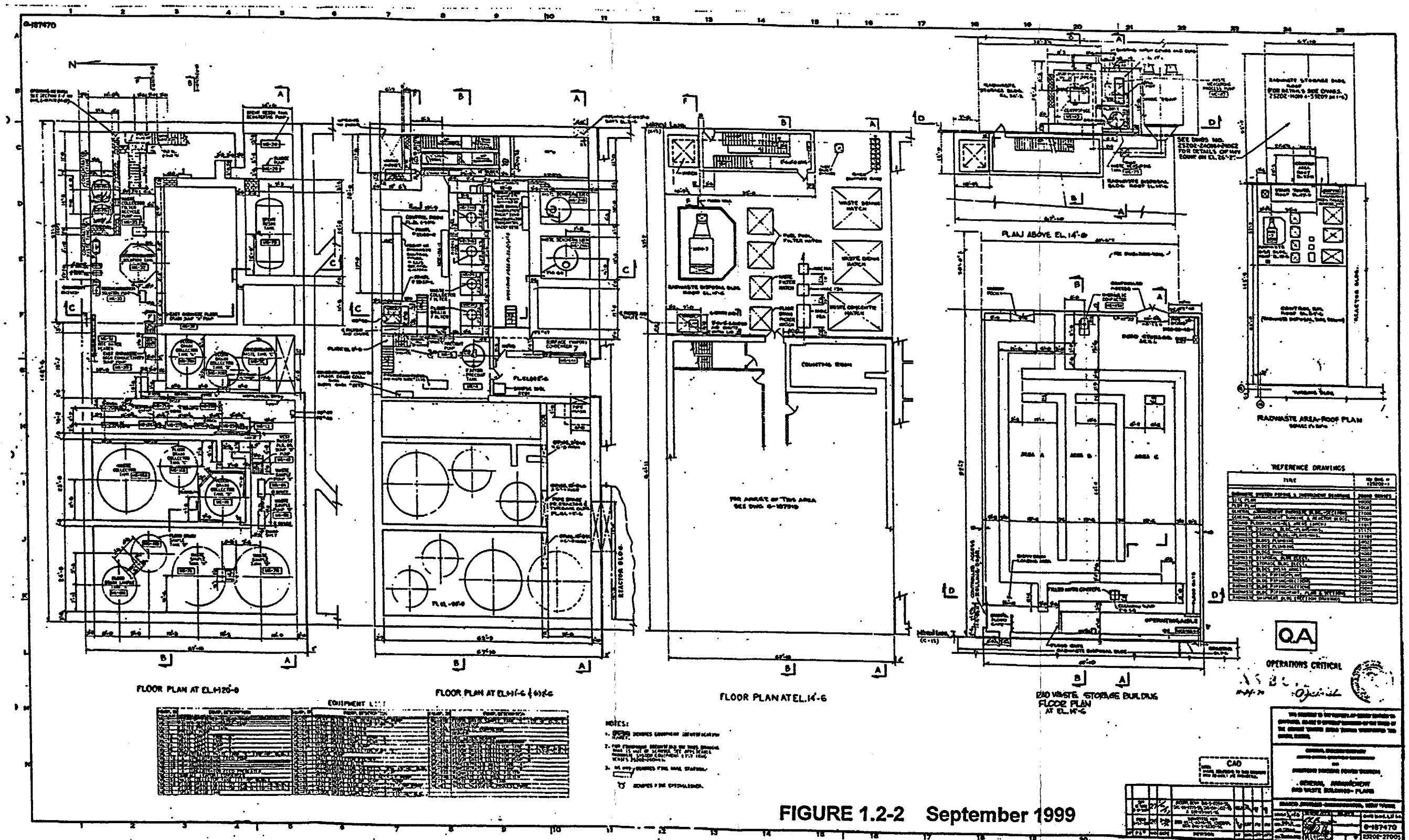

FIGURE 1.2-2 September 1999

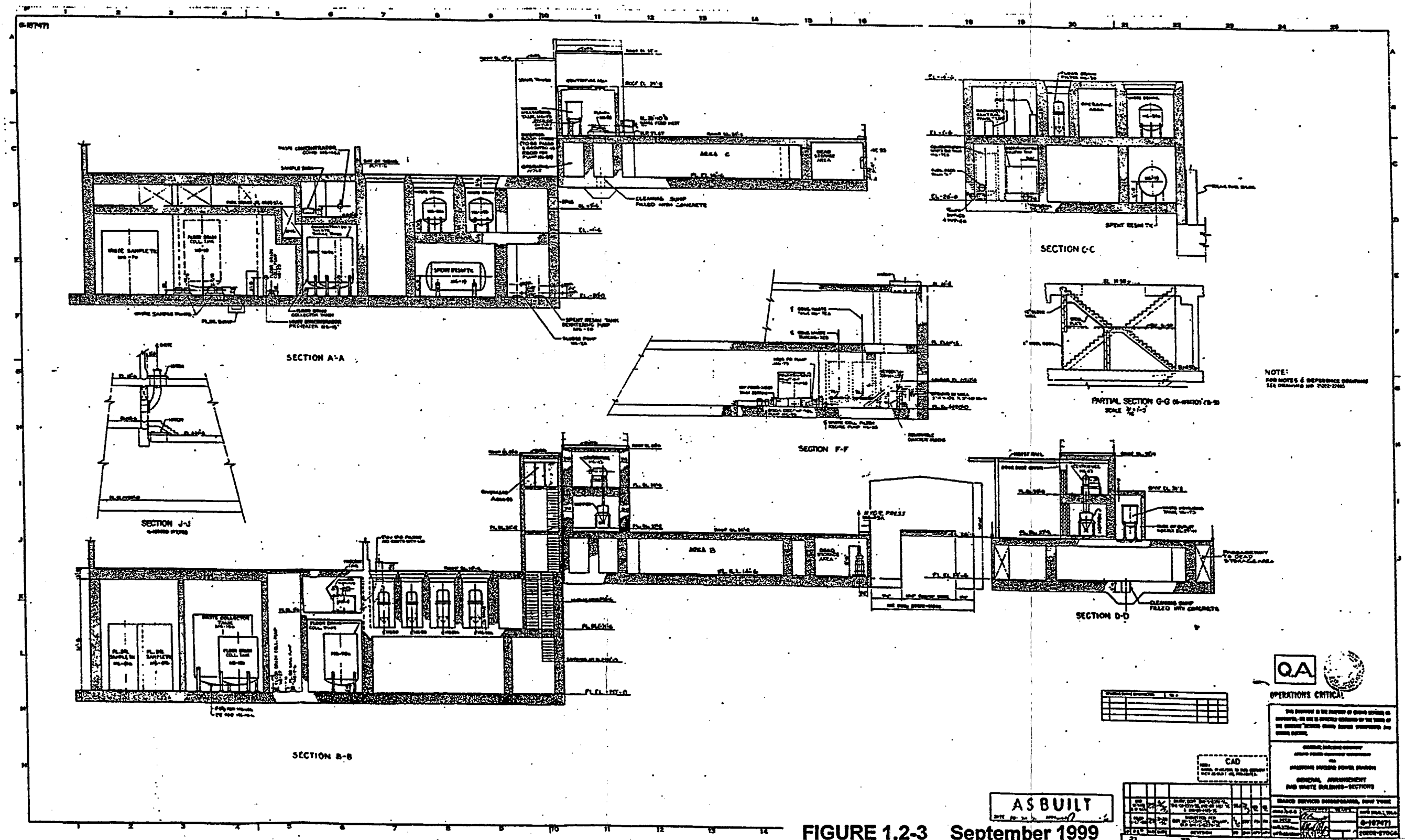

FIGURE 1.2-3 September 1999

1.3 IDENTIFICATION OF AGENTS AND CONTRACTORS

1.3.1 Applicant's Subsidiaries

Northeast Nuclear Energy Company (NNECO) acts as the agent for the Applicants and is responsible for the decommissioning of Millstone Unit No. 1. NNECO is a wholly owned subsidiary of Northeast Utilities.

1.3.2 Nuclear Steam Supply System Supplier

General Electric Company was the nuclear steam system supplier for the plant.

1.3.3 Architect/Engineer

Ebasco Services Incorporated was the Architect/Engineer for Millstone Unit No. 1.

1.3.4 Turbine-Generator Supplier

The turbine generator was manufactured by General Electric Company.

1.4 MATERIAL INCORPORTED BY REFERENCE

Certain aspects of Millstone Unit No. 1 discussed in the Millstone Unit No. 1 Technical Specifications are contained in change 28 of the Updated Final Safety Analysis Report. The listing of this material is discussed below.

Technical Specification or Bases Section		UFSAR Section
B3.1	Reactor Protection System	7.2
B3.2	Protective Instrumentation	7.3
B3.3	Reactivity Controls	4.6, 7.7
B3.5	Core and Containment Cooling Systems	15.7, 6.3
B3.6H	Primary System Boundary	7.3
B4.7D	Containment Systems	6.2
5.3	Reactor Vessel	5.3
5.4	Containment	3.8, 6.2

In addition the Millstone Unit No. 3 FSAR is incorporated herein by reference.

1.5 CONFORMANCE TO NRC REGULATORY GUIDES

1.5.1 Summary Discussion

The AEC issued Appendix A 'General Design Criteria' to 10 CFR 50 in July 1971. In November 1970, Safety Guides, later to become Regulatory Guides, began to be published. These guides provided acceptable means for complying with specified general design criteria. They were not in effect at the time Millstone Unit No. 1 began operation with Provisional Operating License (POL) DPR-21, issued October 7, 1970.

Millstone Unit No. 1 submitted summaries of compliance to these guides in the early 1970s in support of the application for a full-term operating license (Reference 1.5-1).

Before acting on this application, the NRC (formerly AEC) initiated the Systematic Evaluation Program (SEP) in 1977 to review the designs of older operating nuclear reactor plants in order to confirm and document their safety. Millstone Unit No. 1 was identified as an SEP plant.

The SEP objectives were:

- To establish documentation that shows how the criteria for each operating plant reviewed compare with current criteria on significant safety issues and to provide a rational for acceptable departures from these criteria.

- To provide the capability to make integrated and balanced decisions with respect to any required backfitting.

- To provide for early identification and resolution of any significant deficiencies.

- To assess the safety adequacy of the design and operation of currently licensed nuclear power plants.

- To use available resources efficiently to minimize requirements for additional resources by NRC or industry.

- To ensure that the safety assessments were adequate for conversion of provisional operating licenses to full-term operating licenses.

The final version of the SEP program report included the status of all applicable generic activities (TMI and USIs), including those that formed the basis for the Integrated Safety Analysis Program (ISAP) being implemented by the Licensee. Based upon the acceptable conclusions reached in SEP, the NRC issued the full-term operating license for Millstone Unit No. 1 on October 31, 1986.

1.5.2 Reference

1.5-1 Millstone Nuclear Power Station Unit 1 Application for Full-Term Operating License, September 1, 1972.

CHAPTER 2

SITE CHARACTERISTICS

2.1 LOCATION AND AREA

The Millstone site is located in the Town of Waterford, New London County, Connecticut, on the north shore of Long Island Sound. The 524-acre site occupies the tip of Millstone Point between Niantic Bay on the west and Jordan Cove on the east and is situated 3.2 miles west-southwest of New London and 40 miles southeast of Hartford.

The Millstone Unit No. 1 containment structure is located immediately south of Millstone 2 and 3. The geographical coordinates of the centerline of the reactor is as follows:

	Latitude and Longitude	Northing and Easting
Millstone Unit No. 1	N 41° 18'32"	N 173, 800
	W 72° 10'04"	E 759, 965

The site is owned by two tenants in common: Connecticut Light & Power Company and Western Massachusetts Electric Company, except for that portion of land designated for the Millstone Nuclear Power Station Unit 3 site which is owned by its participants in ownership. Figures 2.1-1 through 2.1-4 identify the site.

The site protected area is considered the restricted area. The restricted area has been conspicuously posted and administrative procedures, including periodic patrolling, have been imposed to control access to the area. For the purpose of radiological dose assessment of accidents, the exclusion area boundary (EAB) was considered the actual site boundary for overland sectors, except in the Fox Island / discharge channel area on the south end of the site. For all water sectors, the nearest land site boundary distance was used.

The actual distances used for each sector for each release point are given in Table 2.1-1.

Any significant normal releases are discharged to the atmosphere via the Millstone Unit No. 1 stack. The distance from the Millstone Unit No. 1 stack to the nearest residential property boundary in the Millstone Point Colony development (Point A on Figure 2.1-3) is approximately 2,415 feet. This development, adjacent to the eastern site boundary, consists of single family homes on 104 half-acre lots. One of the conditions of the sale of the site to the Hartford Electric Light Company and the Connecticut Light and Power Company was that permanent dwellings would never be permitted in the beach area of the development. Because of this restriction, normal release doses are calculated at Point A rather than at the nearest point on the site boundary. Point A is northeast of the Millstone Unit No. 1 stack. The distance to the nearest land sector used in dose calculations for normal effluents is given in Table 2.1-1.

NNECO has complete control of activities within the exclusion area, except for the passage of trains along the Providence & Worcester (P&W) / Amtrak Railroad track which runs east-west through the site.

To ensure the safety of people within the exclusion area during an emergency, an emergency plan for the site has been prepared. The plan includes provisions for alarms both inside and outside buildings and delineates the evacuation routes and assembly areas to be used. The State of Connecticut Emergency Plan also provides for the control of activities in that portion of the exclusion area extending offshore through a written agreement between the NNECO and the U.S. Coast Guard at their station in New London, Connecticut.

The owners have encouraged public use of portions of the site. Ownership rights have not, however, been relinquished, and the owners can, and have provision to, fulfill their obligations with respect to 10 CFR 20, "Standards for Protection Against Radiation".

A portion of the exclusion area is leased to the Town of Waterford for public recreation and is used primarily for soccer and baseball games. Figure 2.1-3 shows the general location of these activities. No attempt is made to restrict the number of persons using these facilities. Estimates of maximum attendance indicate that about 2,000 visitors could be within the exclusion area at any one time at the soccer and baseball fields. The NNECO Emergency Plan provides for removal of the visitors from the site. The number and configuration of roads and highways assure ready egress from the areas described above (Figures 2.1-2, 2.1-3, and 2.1-4).

2.1.1 Population

The total 1990 population within 10 miles of the station was estimated to be 120,443. This population is expected to increase to about 129,846 people by the year 2000 and to a total of approximately 142,277 people by the year 2030 (New York State Department of Economic Development, 1989 (Reference 2.1-1); State of Connecticut Office of Policy and Management, 1991 (Reference 2.1-2); US Department of Commerce, Bureau of the Census, 1990 Census of Population (Reference 2-1-3)). The 10 mile area includes portions, or all of, New London and Middlesex Counties in Connecticut and a small portion on Suffolk County of Fishers Island which is part of the town of Southold, New York. Figure 2.1-5 shows counties and towns within the 10 mile area. Town populations and population densities are provided in Table 2.1-2.

The Town of Waterford, in which Millstone Unit No. 1 is located, contained a total population of 17,930 people in 1990 at an average density of 547 people per square mile (US Department of Commerce Bureau of the Census 1991) (Reference 2.1-3). The population growth of Waterford was small with the 1990 total representing only a 0.5 percent increase over its 1980 population. Compared to towns immediately surrounding it, with the exception of New London, Waterford had the lowest increase in population between 1980 and 1990 (US Department of Commerce Bureau of the Census, 1991 (Reference 2.1-3)).

Waterford's growth has been consistently slowing down over the past 30 years, as shown in Table 2.1-3. This slow growth is projected by state demographers to continue

at a low rate through the year 2000, at which time the population is expected to reach 18,480. After that, it is projected to decrease in population. By the year 2010 (the last year of projections), the town's population is projected to be 18,080 (Connecticut Office of Policy and Management, Interim Population Projections, 1991 (Reference 2.1-2)). Population distribution by sector for the area within 10 miles of Millstone Unit No. 1 is shown for the years 1990, 2000, 2010, 2020 and 2030 in Tables 2.1-4 through 2.1-8, that are keyed to the population sectors identified in Figure 2.1-6.

Population distribution within 10 miles is based on 1990 US Census data by Census Block (Reference 2.1-3). The population within a Census Block was assumed to be distributed evenly over its land area, unless USGS 7.5 minute quadrangle maps indicated the population to be concentrated in only on portion of the Block. The proportion of each Block area in each grid sector was determined and applied to the Block total population, yielding the population in each grid sector. Population projections, by municipality, supplied by Connecticut's Office of Policy and Management provided growth factors for projection of Projections, 1991 (Reference 2.1-2).

2.1.1.1 Population Distribution Within 50 Miles

The area within 50 miles of Millstone Unit No. 1 includes portions, or all, of eight counties in Connecticut, four counties in Rhode Island and one county in New York. Figure 2.1-7 shows counties and towns within the 50 mile area. In 1990, the 50-mile area contained approximately 2,835,159 people (U.S. Department of Commerce), 1990 Census of Population and Housing (Reference 2.1-4). This population is projected to increase to about 3,223,654 by the year 2030 (Connecticut Office of Policy and Management, 1991 (Reference 2.1-2); New York State Department of Economic Development, 1989 (Reference 2.1-1); Rhode Island Department of Administration, 1989 (Reference 2.1-5); US Department of Commerce, 1990 Census of Population and Housing, 1991 (Reference 2.1-4)). Population distribution by sector for the area within 50 miles of Millstone Unit No. 1 is shown for the years 1990, 2000, 2010, 2020 and 2030 in Tables 2.1-9 through 2.1-13, which are keyed to the population sectors identified in Figure 2.1-9.

Population distribution and projections within the 50 mile region surrounding Millstone Unit No. 1 were calculated based on population by municipalities and were assigned to sectors based on land area allocation. Projections for the 50 mile area were based on country-wide projections.

2.1.1.2 Transient Population

Seasonal population increases resulting from an influx of summer residents total approximately 10,500. However, many of the beaches and recreation facilities in the area are used by residents, and therefore, do not represent any increase in population but instead a slight shift in population. There are, however, a number of schools, industries, and recreation facilities which create daily and seasonal variations in sector populations. Tables 2.1-14 through 2.1-16 show annular sector population variations resulting from school enrollments, industrial employment, and recreation facilities (with documented attendance).

2.1.1.3

The low population zone (LPZ) surrounding Millstone Unit No. 1 encompasses an area within a radial distance of about 2.4 miles. The distance was chosen based on the requirements of 10 CFR 100.11. Figure 2.1-8 shows topographical features, transportation routes, facilities, and institutions within the LPZ.

The LPZ contained approximately 9,846 people in 1990, with an average density of 545 people per square mile. By the year 2030, the LPZ population is projected to increased to about 11,629, or an average density of 643 people per square mile (US Department of Commerce, Bureau of the Census, 1991 (Reference 2.1-3); Connecticut Office of Policy and Management, 1991 (Reference 2.1-2); US Geological Survey (Reference 2.1-6)). The LPZ population distribution for 1990 and 2030 is shown in Table 2.1-17. Table 2.1-18 shows the 1991-1992 school and employment distribution within the LPZ. Both tables are keyed to Figure 2.1-9.

Daily and seasonal variations due to transient population are minimal within the LPZ. Several beaches are located within the area; however, they are predominantly used by local residents and generally have no facilities for parking or accommodation of large groups. Three schools, Great Neck Elementary and Southwest Elementary in Waterford, and Niantic Elementary in East Lyme, are located within the LPZ. Major employment consists of the Camp Rowland Military Reservation and Hendel Petroleum. The New London Country Club is also located within the LPZ.

2.1.1.4 Population Center

The closest population center to Millstone Unit No. 1 (as defined by 10 CFR 100 to contain more than 25,000 residents) is the city of New London which contained a 1990 population of 28,540 people at an average population density of 5,189 people per square mile (US Department of Commerce Bureau of the Census 1991). The distance between Millstone Unit No. 1 and the city's closest corporate boundary is about 3.3 miles to the northeast, just beyond the minimum distance requirement set by 10CFR100.

The region within 50 miles of Millstone Unit No. 1 includes portions, or all, of 11 Metropolitan Statistical Area's. The populations of these areas are shown in Table 2.1-19.

There were 38 population centers within 50 miles of Millstone Unit No. 1, containing 25,000 or more people in 1990. They are listed in Table 2.1-20 with the populations indicated.

The population of the area within 50 miles of Millstone was approximately 2,800,000 in 1990, with an average density of 361 people per square mile. This density is lower than the NRC comparison figure of 500 people per square mile (NRC Regulatory Guide 1.70, Revision 3, Reference 2.1-7). Within 30 miles of Millstone, the population density is considerably less, at an average of 189 people per square mile. By 2030, the 50-mile population is projected to increase to 3,200,000 or an average population density of

about 410 people per square mile, considerable lower than the NRC comparison figure for end-year plant life of 1,000 people per square mile. Within 30 miles, the average density will be 223 persons per square miles by the year 2030. Population densities by sector for 1990 and 2030 are shown for within 10 miles of Millstone in Tables 2.1-21 and 2.1-23 respectively, which are keyed to Figure 2.1-6, and for within 50 miles of Millstone in Tables 2.1-23 and 2.1-24, respectively, which are keyed to Figure 2.1-7. Cumulative population densities 1990 and 2030 are shown in Tables 2.1-25 and 2.1-26, respectively.

2.1.2 Land Use

The area around the Millstone site contains three major industrial facilities (Dow Chemical Corporation, Pfizer Corporation, and Electric Boat division of General Dynamics Corporation); two transportation facilities (Groton/New London) Airport and the New London Transportation Center; and four military installations (U.S. Navy Submarine Base, U.S. Coast Guard Academy, Camp Rowland, and Stone's Ranch Military Reservation).

There is also an interstate highway (Interstate 95), passenger and freight railroad lines, gas distribution lines, above ground gas and oil storage facilities and two major waterways (Long Island Sound, Thames River) in the vicinity of the Millstone site.

There are no major gas transmission lines, oil transmission or distribution lines, under ground gas storage facilities, drilling or mining operations, or firing, or bombing ranges near the site.

Aircraft patterns and routes are shown of Figures 2.1-10 and 2.1-11. Figure 2.1-12 shows the road and highway system in the area of the Millstone site.

2.1.2.1 Description of Facilities

A summary of the significant industrial, transportation, military, and industrial related facilities, and products and materials used, is shown in Table 2.1-27 as listed below.

1. Dow Chemical Corporation of Allen Point, Ledyard, Connecticut is located on the east bank of the Thames River approximately 10 miles north-northeast of the site. Dow Chemical employs approximately 115 people and produces organic compounds, such as Styron, Styrofoam, and a base product of latex paints. All materials are moved to and from the company by truck and/or railroad.

2. Pfizer Corporation of Eastern Point Road, Groton, Connecticut is located on the east bank of the Thames River, approximately 4.9 miles east-northeast of the site. Pfizer Corporation employs approximately 3,000 persons and produces organic compounds and pharmaceutical materials, such as citric acid, antibiotics, synthetic medicines, vitamins and caffeine. All materials are moved to and from Pfizer corporation by truck and/or railroad.

3. Electric Boat Division of General Dynamics of Eastern Point Road, Groton, Connecticut is located approximately 5 miles east-northeast of the site. Electric boat employs approximately 12,000 persons, and is a producer of submarines and oceanographic equipment for commercial industry and the U.S. Navy. The nature of products produced at Electric Boat requires that they handle substantial amounts of nuclear material which is licensed under the Naval Reactors Division. All material is moved by truck, railroad, and/or barge to and from the company with the exception of completed ships which leave under their own power.

4. Groton / New London Airport, approximately 6 miles east-northeast of the site, handles regularly scheduled commercial passenger flights. Approximately 13 persons are employed at Groton/New London Airport on a full-time basis, excluding airline and car rental employees. The National Guard has an aircraft repair facility at the airport that has approximately 140 full-time employees.

5. The New London Transportation Center, located at City Pier, New London on the west bank of the Thames River, is approximately 4 miles northeast of the site. Approximately 20 persons are employed there on a full time basis. The New London Transportation Center is a large complex in downtown New London in the City Pier area. It encompasses numerous facilities, including a train station, several ferry companies, commercial and private boat slips, an interstate bus terminal, local bus inter-changers, and commercial land transportation facilities. It serves as the prime entrance and exit for New London for civilian and commercial travel.

6. U. S. Navy Submarine Base, Groton, Connecticut is located on the east bank of the Thames River, approximately 7 miles northeast of the site. The base population includes approximately 8,500 military personnel. In addition, there are about 1,800 civilian employees at the base. The U.S. Navy Submarine Base provides logistics as well as training and operation of the base and its ships (nuclear and non-nuclear). All materials are moved by truck, railroad, barge and / or ship, to and from this government installation.

7. The U.S. Coast Guard Academy, New London, Connecticut is located on the west bank of the Thames River, approximately 5.6 miles northeast of the site. Approximately 900 cadets attend the academy, while approximately 360 military and civilian personnel are employed here.

8. Camp Rowland, located approximately 2 miles northwest of the site, is a training headquarters for the Connecticut Army National Guard. It is owned and operated by the Military Department of the State of Connecticut. On a full-time basis, it employs 16 persons (military and civilian), including the headquarters for the Connecticut Military Academy, post Operations personnel, and 745th Signal Company. On a part-time basis, during various weekends, Camp Rowland is occupied by varying numbers of troop units for administrative training maneuvers, billeting, and supply functions for the Connecticut Army National Guard. During the training maneuvers there may be from 300 to 1,200 people at the facility. Camp Rowland is an

administrative training center for troops of the Connecticut Army National Guard. Because of the solely administrative nature of its occupancy, the camp's operation has no effect on the Station's operation.

9. In addition to Camp Rowland, the Military Department of the State of Connecticut also maintains a field training facility known as Stone's Ranch Military Reservation, located approximately 7 miles northwest of the site. Fourteen persons are employed there full-time for two regional motor vehicle and equipment maintenance shops. It is also occupied on a part-time basis by varying numbers of troop units for periods of field training for the Connecticut Army National Guard. During some weekend training sessions there may be up to 500 people at the facility.

Limited quantities of munitions and explosives are stored in underground bunkers at this facility. These materials are used in quarry operations for the Connecticut Army Corps of Engineers. No live ammunition is used at the facility. All materials are moved to and from Stone's Ranch by truck.

In addition, a small paved utility landing strip is located at Stone's Ranch. While capable of handling light, fixed-wing aircraft, the strip is not routinely used except for occasional rotary-wing operations. Because of its distance from the site, the limited quantity of materials stored and used, and the type of aircraft operations occurring at the facility, Stone's Ranch Military Reservation does not pose any hazard to the Millstone station.

10. Hess Oil Corporation of Eastern Point Road, Groton, Connecticut is located on the east bank of the Thames River, approximately 5 miles east-northeast of the site. It is located north of Pfizer Corporation, and south of General Dynamics-Electric Boat Division and services as a fuel storage facility. There are about 14 persons employed there on a full time basis. Hess Oil Corporation operates a fuel distribution and storage facility for home heating oil and kerosene. There are large above ground tanks capable of storing

heating oil, residual fuel oil, and kerosene. The fuel arrives by ships or barges and is distributed by trucks.

11. There is one medium-sized propane storage area in the proximity of the Millstone site. Hendel Petroleum Company, is located in Waterford, approximately 2.5 miles northeast of the site on Great Neck Road, and employs about 75 people. Hendel Petroleum Company operates a fuel distribution facility for commercial and residential use. There are 5 above ground tanks (3-30,000 gallons and 2-16,000 gallons) which are capable of storing 126,000 gallons total of propane gas. The facility also stores 40,000 gallons of gasoline, and 40,000 gallons of No. 2 fuel oil. The propane for the facility arrives by train and truck, and is distributed by truck.

On the Millstone site, at the Fire Training Facility located approximately 2,800 feet to the north of the protected area are two 1,000 gallon propane cylinders. The two cylinders are used to supply propane to the fire simulator. The Fire Training Facility was constructed in 1994 for the purpose of training NU's fire brigade members. The Training Facility consists of six live burn "mock-ups" which replicate nuclear power plant fire hazards. Propane is used to fuel these "fireplaces." The two storage cylinders are positioned such that their ends are pointed away from the Millstone site. Both cylinders are above ground domestic storage cylinders designed per ASME Code for Pressure Vessels, Section VIII Division 1-92.

12. Montville Station is a Fossil Fuel powered electric generating plant operated by Connecticut Light & Power Company in Montville, Connecticut. It is located on the west bank of the Thames River, approximately 9.5 miles north-northeast of the site. Approximately 67 people are employed there. It is capable of providing 498 MW of electric power. The fuel is stored in three large above ground tanks, capable of storing approximately 175,000 barrels of fuel each; two medium above ground tanks, capable of storing approximately 12,000 barrels of fuel each; and two small above ground

tanks, capable of storing approximately 250 barrels of fuel each. The fuel arrives by barge or trucks.

2.1.2.2 Pipelines

There are no major gas transmission lines within 5 miles of the site. There are two medium pressure gas distribution lines in near proximity of the site. The nearest gas distribution line is approximately 2.9 miles from the site, located along Rope Ferry Road in Waterford. This 35 psi gas distribution line is a 6-inch plastic pipeline, buried approximately 3 feet deep. The control valve for this line is located at the intersection of Clark Lane and Boston Post Road in Waterford. The second gas distribution line, ends at and serves the shopping center complex, near the intersection of I-95 and Parkway North, approximately 4 miles north of the site. This 35 psi gas distribution line is an 8-inch plastic pipeline buried approximately 3 feet deep. The control valve for this line is located at the complex where it intersects with Parkway North.

There are no oil transmission or distribution lines within 5 miles of the Millstone site.

2.1.2.3 Waterways

Ships that pass by the site in the shipping channels of Long Island Sound are of two types: general cargo freighters, usually partially unloaded, with drafts of 20 to 25 feet, and deep draft tankers with drafts of 35 to 38 feet. Both of these classes of ships must remain at least 2 miles offshore to prevent running aground on Bartlett Reef.

No oil barges pass to the shore side of Bartlett Reef, and since there are no tank farms in Niantic Bay, no oil barges pass with 2 miles of the site.

Barge traffic in the vicinity of the site has been diminishing over the past several years due to the decrease in the amount of oil used by area facilities. Barge traffic is heaviest during the winter months, and averages only 1 barge per day during these months. On the average of once a month, a barge carrying 15,000 barrels of sulfuric acid is towed

past the site outside of Bartlett Reef. Approximately 10 ships per day traverse the Reef in the vicinity, 6 miles of the site.

For these reasons, it is concluded that shipping accidents would not adversely affect Millstone 3 safety related facilities.

2.1.2.4 Airports

Groton / New London Airport, approximately 6 miles east-northeast of the site, handles regularly scheduled commercial passenger flights. It is served by U.S. Air Express. It has two runways: 5-23, which is 5,000 feet long; and 15-33, which is 4,000 feet long. Both runways are illuminated. There is a control tower at Groton / New London, with ILS (Instrument Landing System) and VOR (Very High Frequency Omni Range) navigation aides located on the airfield. The ILS is associated with runway 5. As shown on Figure 2.1-10, the landing patterns used do not direct traffic near the Millstone site.

The largest commercial aircraft to use Groton / New London Airport on a regularly scheduled basis are Beechcraft 1900's which carry approximately 19 passengers. The only jets using the airport on a regular basis are two small chartered Cessna Citation which carry 10 passengers.

The largest military aircraft to use Groton/New London Airport on an occasional basis are C-130's and C-23's. Additionally, there are several military helicopters stationed at the airport.

In 1995 there were approximately 4,490 military flights, approximately half of which were military helicopters. Millstone Station is not in the flight path of these flights, and pilots are briefed to avoid the site.

As shown on Figure 2.1-11, the air lane nearest the site is V58 which is approximately 4 miles northeast of the site. Other adjacent air lanes include V16, which is approximately 6 miles northwest of the site, and V308, which is approximately 8 miles east of the site.

The nearest high-altitude jet route, J121-581, passes approximately 9 miles southeast of the site. A second jet route, J55, passes approximately 12 miles northwest of the site.

2.1.2.5 Highways

The area around the Millstone site is served by interstate, state and local roads. These are shown on Figure 2.1-12. The nearest major highway which would be used for frequent transportation of hazardous materials is U.S. Interstate 95, which is located 4 miles from the Millstone site. Other principal highways which pass near the site include U.S. Highway 1 which is located 3 miles from the site, and State Highway 156, located 1.5 miles from the site.

These separation distances exceed the minimum distance criteria given in Regulatory Guide 1.91, Revision 1 and provide assurance that any transportation accidents resulting in explosions or toxic gas releases of truck size shipments of hazardous materials would not have a significant adverse effect on the safe operation or shutdown capability of the unit.

2.1.2.6 Railroads

The site is traversed from east to west by a Providence & Worcester (P&W)/Amtrak railroad right-of-way. The mainline tracks are more than 2,000 feet from the Millstone Unit No. 1 Reactor Building structure.

Both P&W and Amtrak trains are currently diesel powered. However, Amtrak, the operator of the passenger train service, plans to electrify its passenger trains, and has embarked on a project to construct overhead electric lines to power the trains. These new lines will not affect the site nor the overhead transmission lines leading out of the site which traverse the railroad line above the tracks.

The Department of Transportation and P&W/Amtrak have been contacted for information concerning rail traffic on the mainline tracks. Approximately eighteen scheduled passenger trips per day pass along the tracks near the Millstone site.

Approximately one freight train per day passes by the site. Hazardous material shipped on the track include chlorine, anhydrous ammonia, carbon dioxide, propane, ethyl alcohol, rosin, ammonium nitrate, and hydrochloric acid. See Table 2.1-28 for a list of hazardous materials handled over this track which are potentially capable of producing significant missiles.

Records of hazardous materials incidents dating back a number of years show no incident occurring between East Lyme and New London, Connecticut, including the trackage near the Millstone site. See Section 2.1.3 for a more detailed evaluation of potential accidents.

The railroad spur serves the Millstone Nuclear Power Station exclusively. The switch for that spur is normally set for through traffic. In order to reach any station facility, a train car must also pass through a second switch, which is normally set to direct traffic past the station to a dead end near the Sound. Therefore, the possibility of unauthorized transport of hazardous materials on the spur is very remote.

There are no grade crossings on or adjacent to the site at which hazardous materials might be transported across the tracks.

2.1.2.7 Projections of Industrial Growth

Pipelines

No expansion of facilities is presently planned in the area for oil distribution within the southeastern region of Connecticut. The gas distribution line along Rope Ferry Road ends at Waterford high School, approximately 2.9 miles from the Millstone site. The gas distribution line at I-95 and Parkway North ends at, and serves the shopping complex approximately 4 miles from the Millstone site.

Waterways

As previously mentioned, ship and barge traffic in the area of Millstone site has decreased over the past several years. No new ship or barge traffic is anticipated at this time in the Niantic Bay area on Long Island Sound near location of the intake structures.

Airports

No expansion of facilities at Groton / New London Airport is proposed although some improvements to the facility, such as expansion of the approach lights, and upgrading of the terminal and runways in planned. Southeastern Connecticut Regional Planning Agency (SCRPA) recommends that a master plan be prepared for the airport before any major physical improvements are made. The agency has previously adopted the policy that Groton / New London Airport should remain a small feeder airport providing connection to larger airports and direct service to a limited number of cities with a 500-mile radius.

2.1.3 Determination of Design Basis Events

The area around the Millstone site was investigated and found to contain no explosives, chemicals, airborne pollutants, flammable or dangerous gases, nor tanks or pipelines near enough to the site to pose a danger if they were to explode or burn.

A railroad right-of-way of P&W/Amtrak companies transverses the site from east to west. The mainline tracks are about 0.5 miles from the Millstone Unit No. 1 Reactor building and upgrade from the plant. Traffic on the spur of the mainline track which extends onto the site is controlled to minimize the possibility of railroad traffic-related accidents.

A spur of the P&W/Amtrak railroad serves the Millstone Nuclear Power Station exclusively. The switch for that spur is normally set for through traffic. To reach any station facility, the locomotive must pass through a second switch, which is normally set

to direct traffic past the station to a dead end near the Sound. Therefore, the possibility of unauthorized transport of hazardous materials does not exist on the spur.

Hazardous materials that are shipped on the track which crosses the site between New Haven and New London include chlorine, anhydrous ammonia, carbon dioxide, propane, ethyl alcohol, rosin, ammonium nitrate, and hydrochloric acid. Among these materials, only the shipment of propane (about 44 carloads per year) is in the "frequently shipped quantities of hazardous material" category as defined in Regulatory Guide 1.78.

The nearest major highway which would be used for frequent transportation of hazardous materials is U.S. Interstate 95, which is located at a distance of 4 miles from the Millstone site. This separation distance exceeds the minimum distance criteria given in Regulatory Guide 1.91, Revision 1; and therefore, provides assurance that any transportation accidents resulting in explosions of truck size shipments of hazardous materials will not have an adverse effect on the safe operation of the plant.

Based upon the size of Groton / New London airport and the location of flight paths, the impact of an airplane on Millstone Unit No. 1 is highly unlikely.

There are no major gas transmission lines within 5 miles of the site. The nearest low pressure gas distribution line is 2.9 miles from the site and is located near Waterford High School on Rope Ferry Road.

The closest oil transmission line is approximately 5 miles from the site in Groton Connecticut.

Because they are 5 miles or more away from the site, both the major gas and oil transmission lines constitute no threat to the safe conduct of activities associated with storage of irradiated fuel or decommissioning of Millstone Unit No. 1 or to the site in general.

2.1.4 Effects of Design Basis Events

Propane gas is heavier than air and can form a potentially explosive mixture in air. However as shown on topographic maps of the area, the rail line on which propane is shipped through the site runs through an excavation in the hill which is approximately 20 ft. below the natural contour of the ground immediately north of the reactor facilities. This railroad cut would channel a heavier-than-air propane cloud in an east-west direction away from the plant. The map indicates that the remainder of the topography of the site is about the same grade as the rail line and therefore would not cause a gravity flow of the cloud toward the plant site.

2.1.5 References

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2.1-20 NTSB-RAR-81-1, 1980. National Transportation Safety Board Railroad Accident Report for Muldraugh, Ky.

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TABLE 2.1-1

DISTANCES FROM RELEASE POINTS TO RECEPTORS

(Meters)

Downwind Sector	Unit 1 Stack To EAB	Unit 1 Stack To Nearest Land	Unit 1 Stack To Nearest Residence
SSW	496 (2)	14,500	14,500
SW	496 (2)	3660	3820
WSW	496 (2)	3270	3290
W	496 (2)	3050	3070
WNW	649	2700	2760
NW	710	947	997
NNW	1029	1029	1029
N	1677	1695	1695
NNE	813	813	813
NE	496 (1)	496	736
ENE	496 (2)	1101	1560
E	496 (2)	1410	1480
ESE	496 (2)	1640	1760
SE	496 (2)	31,700	31,700
SSE	496 (2)	12,390	12,390
S	496 (2)	13,100	13,100

(1) Shortest Exclusion Area Boundary Distance in any Landward Sector

(2) Water Sector, shortest exclusion area boundary distance in any landward sector is used when greater than shoreline distance

TABLE 2.1-2

1990 POPULATION AND POPULATION DENSITIES
CITIES AND TOWNS WITHIN 10 MILES OF MILLSTONE

Municipality	1990 Population Total	1990 Population Density (People/Square Mile)	1980-1990 Change (%)
East Lyme	15,340	451	10.6
Groton (including City)	45,144	1,442	9.9
Ledyard	14,913	391	8.6
Lyme	1,949	61	7.0
Montville	16,673	397	1.3
New London	28,540	5,189	-1.0
Old Lyme	6,535	283	6.1
Old Saybrook	9,552	637	2.9
Waterford	17,930	547	0.5
Southold, New York (Fishers Island)	19,836	394	3.5

NOTES:

Based on 1990 US Census of Population and Housing.

Includes total 1990 population of all municipalities totally or partially within 10 miles of the site.

TABLE 2.1-3

POPULATION GROWTH 1960-1990

Municipality	Total Population 1960	1970	1980	1990	% Change 1960-1970	1970-1980	1980-1990
East Lyme	6,782	11,399	13,870	15,340	68.1	21.7	10.6
Groton	29,937	38,523	41,062	45,144	28.7	6.6	9.9
Ledyard	5,395	14,558	13,735	14,913	169.8	-5.7	8.6
Lyme	1,183	1,484	1,822	1,949	25.4	22.8	7.0
Montville	7,759	15,662	16,455	16,673	101.9	5.1	1.3
New London	34,182	31,630	28,842	28,540	-7.5	-8.8	-1.0
Old Lyme	3,068	4,964	6,159	6,535	61.8	24.1	6.1
Old Saybrook	5,274	8,468	9,287	9,552	60.6	9.7	2.9
Waterford	15,391	17.227	17,843	17,930	11.9	3.6	0.5

SOURCES:

1980 Census of Population, Number of Inhabitants, Connecticut, PC80-1-A8, 12/81.

1970 Census of Population, Number of Inhabitants, Connecticut, PC10-A8, 4/71.

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1990 Census of Population and Housing, Connecticut, CPH-1-8, 7/91.

TABLE 2.1-4

POPULATION DISTRIBUTION WITHIN 10 MILES OF MILLSTONE
1990 CENSUS

Sector	Distance to Plant 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	Total
N	16	722	866	784	116	213	542	209	536	1,717	5,721
NNE	13	359	1,146	1,978	1,861	1,622	2,242	2,242	2,192	3,142	16,221
NE	165	455	839	3,888	10,584	7,752	8,164	8,129	911	1,961	42,646
ENE	22	455	292	4,963	971	7,186	3,748	3,047	1,008	2,662	24,354
E	0	636	413	1,804	193	552	0	63	1,434	904	5,999
ESE	0	143	36	0	0	0	0	0	115	214	508
SE	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	14	0	0	0	0	0	0	0	14
WSW	0	0	489	91	86	312	472	158	0	74	1,682
W	0	178	1,061	1,014	440	763	475	562	881	408	5,782
WNW	0	476	1,165	1,946	346	239	211	1,654	509	417	6,981
NW	0	634	873	1,192	1,140	644	599	101	209	81	5,473
NNW	148	314	892	522	646	918	221	429	456	314	4,860
Total	354	4,372	8,086	18,200	16,383	20,201	16,098	16,594	8,251	11,894	120,443

TABLE 2.1-5

POPULATION DISTRIBUTION WITHIN 10 MILES OF MILLSTONE

2000 PROJECTED

Sector	Distance to Plant 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	Total
N	18	778	932	845	126	230	582	225	578	1,852	6,166
NNE	14	387	1,234	2,131	2,006	1,749	1,796	2,415	2,366	3,389	17,487
NE	179	489	905	4,191	11,441	7,359	8,802	8,765	983	2,115	46,203
ENE	24	492	314	5,352	1,045	7,746	4,041	3,285	1,087	2,870	26,256
E	0	685	444	1,944	208	597	0	68	1,546	975	6,467
ESE	0	154	39	0	0	0	0	0	125	233	551
SE	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	14	0	0	0	0	0	0	0	14
WSW	0	0	528	98	92	336	509	169	0	78	1,810
W	0	192	1,144	1,093	473	821	513	606	950	436	6,228
WNW	0	514	1,255	2,118	373	258	227	1,83	548	448	7,524
NW	0	684	940	1,285	1,229	695	646	108	226	88	5,901
NNW	158	304	961	564	696	990	238	462	491	339	5,239
Total	393	4,715	8,710	19,621	17,663	21,781	17,354	17,886	8,900	12,823	129,846

TABLE 2.1-6

POPULATION DISTRIBUTION WITHIN 10 MILES OF MILLSTONE

2010 PROJECTED

Sector	Distance to Plant 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	Total
N	18	803	961	871	129	237	600	230	595	1,908	6,352
NNE	14	399	1,272	2,197	2,068	1,804	1,853	2,492	2,437	3,495	18,031
NE	184	504	930	4,321	11,767	8,617	9,074	9,036	1,013	2,180	47,626
ENE	25	507	324	5,518	1,078	7,988	4,166	3,387	1,119	2,960	27,072
E	0	707	458	2,005	215	616	0	70	1,593	1,005	6,669
ESE	0	159	41	0	0	0	0	0	138	255	593
SE	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	15	0	0	0	0	0	0	0	15
WSW	0	0	54	102	95	346	525	175	0	79	1,867
W	0	198	1,179	1,126	440	488	847	530	625	443	6,.417
WNW	0	529	1,294	2.184	385	266	234	1,838	566	461	7,757
NW	0	705	969	1,325	1,267	716	666	111	232	90	6,081
NNW	163	350	992	582	718	1,021	245	476	506	350	5,403
Total	404	4,861	8,980	20,231	18,210	22,458	17,893	18,440	9,180	13,226	133,883

TABLE 2.1-7

POPULATION DISTRIBUTION WITHIN 10 MILES OF MILLSTONE

2020 PROJECTED

Sector	Distance to Plant 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	Total
N	19	828	990	899	133	243	620	236	613	1,968	6,549
NNE	14	411	1,310	2,264	2,132	1,860	1,909	2,569	2,513	3,602	18,584
NE	188	519	960	4,455	12,134	8,885	9,355	9,318	1,044	2,247	49,105
ENE	25	523	333	5,689	1,220	8,236	4,296	3,492	1,151	3,052	27,907
E	0	728	472	2,067	222	635	0	72	1,642	1,036	6,874
ESE	0	162	41	0	0	0	0	0	144	268	615
SE	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	15	0	0	0	0	0	0	0	15
WSW	0	0	562	105	98	356	541	180	0	80	1,922
W	0	205	1,216	1,161	504	874	546	644	1,011	450	6,611
WNW	0	544	1,226	2,252	398	274	242	1,895	583	476	8,000
NW	0	727	998	1,365	1,308	738	687	114	239	93	6,269
NNW	168	361	1,023	600	738	1,053	253	491	523	362	5,572
Total	414	5,008	9,256	20,857	18,777	23,154	18,449	19,011	9,463	13,634	138,023

TABLE 2.1-8

POPULATION DISTRIBUTION WITHIN 10 MILES OF MILLSTONE

2030 PROJECTED

Sector	Distance to Plant 0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	Total
N	19	855	1,021	927	136	250	638	242	631	2,027	6,746
NNE	14	425	1,351	2,334	2,196	1,916	1,968	2,650	2,590	3,712	19,156
NE	193	535	990	4,592	12,510	9,160	9,644	9,606	1,075	2,315	50,620
ENE	26	539	343	5,866	1,145	8,492	4,428	3,598	1,188	3,147	28,772
E	0	751	487	2,132	229	655	0	73	1,692	1,068	7,087
ESE	0	167	43	0	0	0	0	0	151	281	642
SE	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	15	0	0	0	0	0	0	0	15
WSW	0	0	580	108	101	366	558	185	0	81	1,979
W	0	212	1,254	1,197	520	901	561	663	1,043	458	6,809
WNW	0	560	1,377	2,323	409	281	249	1,956	602	490	8,247
NW	0	748	1,029	1,407	1,349	761	708	116	246	95	6,459
NNW	174	371	1,055	618	761	1,085	261	507	539	374	5,745
Total	426	5,163	9,545	21,504	19,356	23,867	19,015	19,596	9,757	14,048	142,277

TABLE 2.1-9

POPULATION DISTRIBUTION WITHIN 50 MILES OF MILLSTONE

1990 CENSUS

Sector	Distance to Plant 0-10	10-20	20-30	30-40	40-50	Total
N	5,721	22,283	26,357	32,610	18,658	105,629
NNE	16,221	34,824	23,730	27,465	35,598	137,838
NE	42,848	9,444	11,334	29,987	199,334	292,947
ENE	24,354	23,914	16,498	43,001	99,721	207,488
E	5,999	10,712	7,992	10,920	0	35,623
ESE	508	0	0	836	0	1,344
SE	0	0	807	0	0	807
SSE	0	0	2,420	0	0	2,420
S	0	1,614	13,541	0	0	15,155
SSW	0	2,443	12,569	14,807	4,498	34,317
SW	14	938	22,042	8,252	143,933	175,179
WSW	1,682	2,471	0	0	20,389	24,542
W	5,782	27,956	34,384	184,723	267,465	520,310
WNW	6,981	12,474	27,895	148,259	259,824	455,433
NW	5,473	6,215	31,331	191,767	365,578	600,364
NNW	4,860	8,809	17,850	115,424	78,820	225,762
Total	120,443	164,097	248,750	808,051	1,493,818	2,835,159

TABLE 2.1-10

POPULATION DISTRIBUTION WITHIN 50 MILES OF MILLSTONE

2000 PROJECTED

	Distance to Plant					
Sector	0-10	10-20	20-30	30-40	40-50	Total
N	6,166	24,028	28,707	35,404	20,273	114,578
NNE	17,487	37,551	25,721	29,926	38,135	148,820
NE	46,203	10,183	12,196	31,611	206,940	307,133
ENE	26,256	25,744	17,633	45,998	105,848	221,509
E	6,467	11,497	8,553	11,687	0	38,204
ESE	551	0	0	895	0	1,446
SE	0	0	878	0	0	878
SSE	0	0	2,635	0	0	2,635
S	0	1,759	14,742	0	0	16,501
SSW	0	2,660	13,688	16,122	4,897	37,367
SW	14	1,022	24,000	8,985	156,725	190,746
WSW	1,810	2,641	0	0	22,201	26,652
W	6,228	29,887	36,343	195,006	281,709	549,173
WNW	7,524	13,340	29,762	156,623	273,153	480,402
NW	5,901	6,660	33,435	200,205	380,339	626,540
NNW	5,239	9,492	19,194	121,620	83,732	239,277
Total	129,846	176,464	267,517	854,082	1,573,952	3,001,861

TABLE 2.1-11

POPULATION DISTRIBUTION WITHIN 50 MILES OF MILLSTONE

2010 PROJECTED

Sector	Distance to Plant 0-10	10-20	20-30	30-40	40-50	Total
N	6,352	24,773	300,056	36,785	21,101	119,067
NNE	18,031	38,716	26,730	31,421	39,720	154,618
NE	47,626	10,499	12,626	32,221	210,368	313,340
ENE	27,072	26,652	18,530	48,258	109,494	230,006
E	6.669	11,986	8,981	12,272	0	39,908
ESE	593	0	0	940	0	1,533
SE	0	0	920	0	0	920
SSE	0	0	2,761	0	0	2,761
S	0	1,847	15,445	0	0	17,292
SSW	0	2,788	14,344	16,896	5,132	39,160
SW	15	1,073	25,151	9,416	164,248	199,903
WSW	1,867	2,689	0	0	23,267	27,823
W	6,417	30,426	37,096	199,100	286,889	559,928
WNW	7,757	13,590	30,311	159,776	278,156	489,590
NW	6,081	6,807	34,052	202,762	384,902	634,604
NNW	5,403	9,778	19,778	123,964	85,735	244,658
Total	133,883	181,624	276,781	873,811	1,609,012	3,075,111

TABLE 2.1-12

POPULATION DISTRIBUTION WITHIN 50 MILES OF MILLSTONE

2020 PROJECTED

	Distance to Plant					
Sector	0-10	10-20	20-30	30-40	40-50	Total
N	6,549	24,541	31,470	38,219	21,963	123,742
NNE	18,584	39,916	27,784	32,989	41,349	160,622
NE	49,105	10,825	13,051	32,748	213,221	318,950
ENE	27,907	27,557	19,336	50,343	112,285	234,428
E	6,874	12,452	9,376	12,811	0	41,513
ESE	615	0	0	981	0	1,596
SE	0	0	965	0	0	965
SSE	0	0	2,894	0	0	2,894
S	0	1,939	16,184	0	0	18,123
SSW	0	2,922	15,033	17,707	5,379	41,041
SW	15	1,127	26,355	9,869	172,131	209,497
WSW	1,922	2,737	0	0	24,383	29,042
W	6,611	30,974	37,863	203,283	292,190	570,921
WNW	8,000	13,844	30,871	162,992	283,254	498,961
NW	6,269	6,957	37,678	205,354	389,518	642,776
NNW	5,572	10,070	20,382	126,369	87,794	250,187
Total	138,023	186,861	286,242	893,665	1,643,467	3,148,258

TABLE 2.1-13

POPULATION DISTRIBUTION WITHIN 50 MILES OF MILLSTONE

2030 PROJECTED

Sector	Distance to Plant 0-10	10-20	20-30	30-40	40-50	Total
N	6,746	26,332	32,953	39,716	22,860	128,607
NNE	19,156	41,155	28,879	34,637	43,058	166,885
NE	50,620	11,159	13,494	33,286	219,112	324,671
ENE	28,772	28,495	20,176	52,519	115,158	245,120
E	7,087	12,937	9,789	13,375	0	43,188
ESE	642	0	0	1,024	0	1,666
SE	0	0	1,011	0	0	1,011
SSE	0	0	3,033	0	0	3,033
S	0	2,036	16,957	0	0	18,993
SSW	0	3,062	15,755	18,558	5,637	43,012
SW	15	1,183	27,619	10,342	180,394	219,553
WSW	1,979	2,787	0	0	25,554	30,320
W	6,809	31,532	38,647	207,551	297,607	582,146
WNW	8,247	14,102	31,441	166,276	288,449	508,515
NW	6,459	7,110	35,317	207,981	394,192	651,059
NNW	5,745	10,373	21,003	128,835	89,919	255,875
Total	142,277	192,263	296,074	914,100	1,678,940	3,223,654

TABLE 2.1-14

TRANSIENT POPULATION WITHIN 10 MILES OF MILLSTONE

1991-1992 SCHOOL ENROLLMENT

Sector	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	Total
N	0	310	0	0	0	0	0	74	0	413	797
NNE	0	0	0	374	897	2,073	174	0	0	444	3,962
NE	0	0	636	210	697	1,352	1,542	534	0	0	4,971
ENE	0	0	0	2,501	0	888	0	1,043	1,609	266	6,307
E	0	181	0	0	0	1,330	0	0	183	0	1,805
ESE	0	0	0	0	0	0	0	0	0	0	68
SE	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	0	0	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	263	0	864	0	1,127
WNW	0	0	345	0	0	0	0	0	0	0	345
NW	0	0	0	843	0	0	0	0	0	0	843
NNW	0	0	0	298	1,250	0	0	0	0	0	1,548
TOTAL	0	602	981	4,226	2,844	5,643	1,979	1,651	2,656	1,191	21,773

Note: Includes student enrollment only.

Sources: Connecticut Department of Education listing of schools:

Telephone survey conducted in March 1992.

TABLE 2.1-15

TRANSIENT POPULATION WITHIN 10 MILES OF MILLSTONE

EMPLOYMENT

Sector	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	Total
N	0	0	0	300	0	0	0	0	0	200	500
NNE	0	0	0	0	0	0	375	375	109	277	1,134
NE	0	0	375	80	831	0	375	375	0	0	2,036
ENE	0	0	0	0	8,800	5,500	820	0	0	0	15,120
E	0	0	0	0	0	0	0	0	0	0	0
ESE	0	0	0	0	0	0	0	0	0	0	68
SE	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0	256	0	256
SW	0	0	0	0	0	0	0	0	0	0	0
WSW	0	0	0	0	0	0	0	0	0	0	0
W	0	0	0	0	0	0	0	0	0	0	0
WNW	0	0	0	0	0	0	125	125	0	0	250
NW	0	500	0	843	0	0	125	125	0	0	750
NNW	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	500	375	380	9,631	5,500	1,820	1,000	363	477	20,046

Note: Firms with 50 employees or more

Excludes plant employee population.

Sources: Telephone survey conducted in March 1992

TABLE 2.1-16

TRANSIENT POPULATION WITHIN 10 MILES OF MILLSTONE
STATE PARKS AND FOREST (WITH DOCUMENTED ATTENDANCE)

FACILITY	LOCATION	TOTAL ANNUAL ATTENDANCE	SUMMER DAILY ATTENDANCE
State Parks:			
Bluff Point	ENE/E 6-8	97,641	490*
Fort Griswold	ENE 5-6	58,965	200*
Haley Farm	ENE/E 7-9	11,675	60*
Harkness Memorial	E 2-3	157,962	790*
Rocky Neck	W 3-5	412,495	2,360**
State Forests:			
Nehantic	WNW/NNW 7-10	81,146	400*

Notes:

* Daily summer attendance based on 90% of yearly attendance from April through September.

** Includes campers from April 15 to September 15.

Source:

State of Connecticut DEP - Office of Parks and Forests, 1990 Park Attendance.

TABLE 2.1-17

LOW POPULATION ZONE

PERMANENT POPULATION DISTRIBUTIONS

DIRECTION	1990 CENSUS	2030 PROJECTED
N	1,298	1,536
NNE	903	1,065
NE	1,144	1,351
ENE	768	909
E	760	899
ESE	179	212
SE	0	0
SSE	0	0
S	0	0
SSW	0	0
SW	3	3
WSW	429	506
W	1,025	1,211
WNW	1,046	1,233
NW	1,167	1,377
NNW	1,124	1,327
TOTAL LPZ	9,846	11,629

Sources:

1990 Census of Population and Housing

Connecticut Office of Policy and Management, Interim Population Projections Series 91.1, 4/91.

TABLE 2.1-18

LOW POPULATION ZONE

SCHOOL ENROLLMENT AND EMPLOYMENT

DIRECTION	SCHOOL	EMPLOYMENT
N	310	0
NNE	0	0
NE	0	75
ENE	0	0
E	292	0
ESE	0	0
SE	0	0
SSE	0	0
S	0	0
SSW	0	0
SW	0	0
WSW	0	0
W	0	0
WNW	345	0
NW	0	500
NNW	0	0
TOTAL LPZ	947	575

Notes:
1991-1992 Student Enrollment
Firms with 50 employees or more.

Source:
Telephone survey conducted in March 1992; Connecticut Department of Education school listing.

TABLE 2.1-19

METROPOLITAN AREAS WITHIN 50 MILES OF MILLSTONE

1990 CENSUS POPULATION

AREA	1990 POPULATION
Bridgeport - Milford, CT PMSA	443,722
Bristol, CT PMSA	79,488
Fall River, MA-RI PMSA	157,272
Hartford, CT PMSA	767,899
New Haven - Meriden, CT MSA	530,240
Nassau - Suffolk, NY PMSA	2,609,212
New Britain, CT PMSA	148,188
New London - Norwich, CT-RI MSA	266,819
Providence, RI PMSA	654,869
Waterbury, CT MAS	221,629
Middletown, CT PMSA	90,320

Notes:

PMSA - Primary Metropolitan Statistical Area.

MSA - Metropolitan Statistical Area.

Total population of metropolitan areas completely or only partially within 50 miles of the site.

TABLE 2.1-20

POPULATION CENTERS WITHIN 50 MILES OF MILLSTONE

STATE	MUNICIPALITY	1990 POPULATION
Connecticut	Branford	27,603
	Bristol	60,640
	Cheshire	25,684
	East Hartford	50,452
	East Haven	26,144
	Enfield	45,532
	Glastonbury	27,901
	Groton	45,144
	Hamden	52,434
	Hartford	139,739
	Manchester	51,618
	Meriden	59,479
	Middletown	42,762
	Milford	49,938
	Naugatuck	30,625
	New Britain	75,491
	New Haven	130,474
	New London	28,540
	Newington	29,208
	Norwich	37,371
	Shelton	35,418
	Southington	38,518
	Stratford	49,389
	Vernon	29,841
	Wallingford	40,822
	Waterbury	108,961
	West Hartford	60,110
	West Haven	54,021
	Wethersfield	25,651
	Windsor	27,817
Rhode Island	Coventry	31,083
	Cranston	76,060
	Johnston	26,542
	Newport	28,227
	Warwick	85,427
	West Warwick	29,268
New York	Brookhaven	407,779
	Southampton	44,976

Notes: Municipalities with 25,000 people or more
Municipalities completely or only partially within 50 miles.

Source: 1990 U.S. Census of Population and Housing.

TABLE 2.1-21

POPULATION DENSITY WITHIN 10 MILES OF MILLSTONE 1990
(PEOPLE PER SQUARE MILE)

Sector	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	Average
N	82	1,226	883	571	66	99	212	71	161	460	292
NNE	66	610	1,168	1,440	1,054	751	653	762	657	843	827
NE	842	772	855	2,830	5,993	3,591	3,200	2,761	273	526	2,183
ENE	112	772	298	3,612	550	3,328	1,469	1,035	302	714	1,241
E	0	1,080	421	1,313	109	256	0	21	430	242	306
ESE	0	243	37	0	0	0	0	0	34	57	26
SE	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	14	0	0	0	0	0	0	0	1
WSW	0	0	498	66	49	145	185	54	0	20	86
W	0	302	1,082	738	249	353	186	191	264	109	295
WNW	0	808	1,118	1,429	196	111	83	562	153	112	356
NW	0	1,076	890	868	646	298	235	34	63	22	279
NNW	755	533	909	380	366	425	87	146	137	84	248
Average	116	464	515	828	580	585	394	352	155	199	384

Source: 1990 Census of Population.

TABLE 2.1-22

POPULATION DENSITY WITHIN 10 MILES OF MILLSTONE 2030
(PEOPLE PER SQUARE MILE)

Sector	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	Average
N	97	1,452	1,041	675	77	116	250	82	189	544	344
NNE	71	722	1,377	1,700	1,243	887	771	900	776	995	976
NE	985	908	1,009	3,345	7,084	4,243	3,780	3,263	322	621	2,579
ENE	133	915	350	4,272	648	3,933	1,736	1,222	356	844	1,466
E	0	1,275	496	1,553	130	303	0	25	507	286	361
ESE	0	284	44	0	0	0	0	0	45	75	33
SE	0	0	0	0	0	0	0	0	0	0	0
SSE	0	0	0	0	0	0	0	0	0	0	0
S	0	0	0	0	0	0	0	0	0	0	0
SSW	0	0	0	0	0	0	0	0	0	0	0
SW	0	0	15	0	0	0	0	0	0	0	1
WSW	0	0	591	79	57	170	219	63	0	22	101
W	0	360	1,278	872	294	417	220	225	313	123	347
WNW	0	951	1,404	1,692	232	130	98	664	180	131	420
NW	0	1,270	1,049	1,025	764	352	278	39	74	25	329
NNW	888	630	1,075	450	431	503	102	172	162	100	293
Average	136	548	608	979	685	691	466	416	183	235	453

Source: CT Office of Policy and Management, Interim Population Projections Series 91.1, 4/91

TABLE 2.1-23

POPULATION DENSITY WITHIN 50 MILES OF MILLSTONE 1990

(PEOPLE PER SQUARE MILE)

Sector	0-10	10-20	20-30	30-40	40-50	Average
N	292	378	269	237	106	215
NNE	827	591	242	200	202	281
NE	2,183	160	116	218	1,129	597
ENE	1,241	406	168	313	564	423
E	306	182	81	79	0	73
ESE	26	0	0	6	0	3
SE	0	0	8	0	0	2
SSE	0	0	25	0	0	5
S	0	27	138	0	0	31
SSW	0	41	128	108	25	70
SW	1	16	225	60	815	357
WSW	86	42	0	0	115	50
W	295	475	350	1,345	1,514	1,061
WNW	356	212	284	1,079	1,471	928
NW	279	106	319	1,396	2,070	1,224
NNW	248	150	182	840	446	460
AVERAGE	384	174	158	368	528	361

Source: 1990 Census of Population and Housing.

TABLE 2.1-24

POPULATION DENSITY WITHIN 50 MILES OF MILLSTONE 2030
(PEOPLE PER SQUARE MILE)

Sector	0-10	10-20	20-30	30-40	40-50	Average
N	344	447	336	289	129	262
NNE	976	699	294	252	244	340
NE	2,579	190	138	242	1,224	662
ENE	1,466	484	206	382	652	499
E	361	220	100	97	0	88
ESE	33	0	0	7	0	3
SE	0	0	10	0	0	2
SSE	0	0	31	0	0	6
S	0	35	173	0	0	39
SSW	0	52	161	135	32	88
SW	1	20	281	75	1,021	447
WSW	101	47	0	0	145	62
W	347	536	394	1,511	1,685	1,187
WNW	420	240	320	1,210	1,633	1,036
NW	329	121	360	1,514	2,232	1,327
NNW	293	176	214	938	509	522
AVERAGE	453	204	189	416	594	410

Source: CT Office of Policy and Management, interim Population projections, Series 91.1, 4/91.

TABLE 2.1-25

CUMULATIVE POPULATION DENSITY WITHIN 50 MILES OF MILLSTONE 1990

(PEOPLE PER SQUARE MILE)

Sector	0-10	10-20	20-30	30-40	40-50	Average
N	292	378	269	237	106	215
NNE	827	591	242	200	202	281
NE	2,183	160	116	218	1,129	597
ENE	1,241	406	168	313	564	423
E	306	182	81	79	0	73
ESE	26	0	0	6	0	3
SE	0	0	8	0	0	2
SSE	0	0	25	0	0	5
S	0	27	138	0	0	31
SSW	0	41	128	108	25	70
SW	1	16	225	60	815	357
WSW	86	42	0	0	115	50
W	295	475	350	1,345	1,514	1,061
WNW	356	212	284	1,079	1,471	928
NW	279	106	319	1,396	2,070	1,224
NNW	248	150	182	840	446	460
AVERAGE	384	174	158	368	528	361

Source: 1990 Census of Population and Housing.

TABLE 2.1-26

CUMULATIVE POPULATION DENSITY WITHIN 50 MILES OF MILLSTONE 2030

(PEOPLE PER SQUARE MILE)

Sector	0-10	0-20	0-30	0-40	0-50
N	344	421	374	337	262
NNE	976	768	505	394	340
NE	2,579	787	426	346	662
ENE	1,466	730	438	414	499
E	361	255	169	138	88
ESE	33	8	4	5	3
SE	0	0	6	3	2
SSE	0	0	17	10	6
S	0	26	108	60	39
SSW	0	39	107	119	88
SW	1	15	163	125	447
WSW	101	61	27	15	62
W	347	488	436	906	1,187
WNW	420	285	305	701	1,036
NW	329	173	277	818	1,327
NNW	293	205	210	529	522
AVERAGE	453	266	223	307	410

TABLE 2.1-27

DESCRIPTION OF FACILITIES

	Facility	Location	Approx. No. Persons Employed or Stationed	Approximate Distance From Site Miles	Sector
	Industrial				
1.	Dow Chemical Corp	Ledyard	115	10+	NNE
2.	Pfizer Corporation	Groton	3,000	4.9	ENE
3.	Electric Boat (Division of General Dynamics	Groton	12,000	5	ENE
	Transportation				
4.	Groton/New London Airport (Trumbull)	Groton	153	6	ENE
5.	New London Transportation Center	New London	20	4	NE
	Military				
6.	U.S. Navy Submarine Base	Groton	10,300	7	NE
7.	U.S. Cost Guard Academy	New London	1,260	5.6	NE
8.	Camp Rowland	East Lyme	16	2	NW
9.	Stone's Ranch Military Reservation	East Lyme	14	7	NW
	Industrial Related Facilities				
10.	Hess Oil Corporation	Groton	14	5	ENE
11.	Hendel Petroleum Co.	Waterford	75	2.5	NE
12.	Montville Station Electric Generation Plant	Montville	67	10	NNE

TABLE 2.1-28

LIST OF HAZARDOUS MATERIALS POTENTIALLY CAPABLE OF PRODUCING SIGNIFICANT MISSILES

Hazardous Material	Avg. No. of Cars per Train Containing Hazardous Materials	Approx. No. of Cars per Year
1. Propane	2.20	44
2. Anhydrous Ammonia	0.266	5
Total	2.466	49

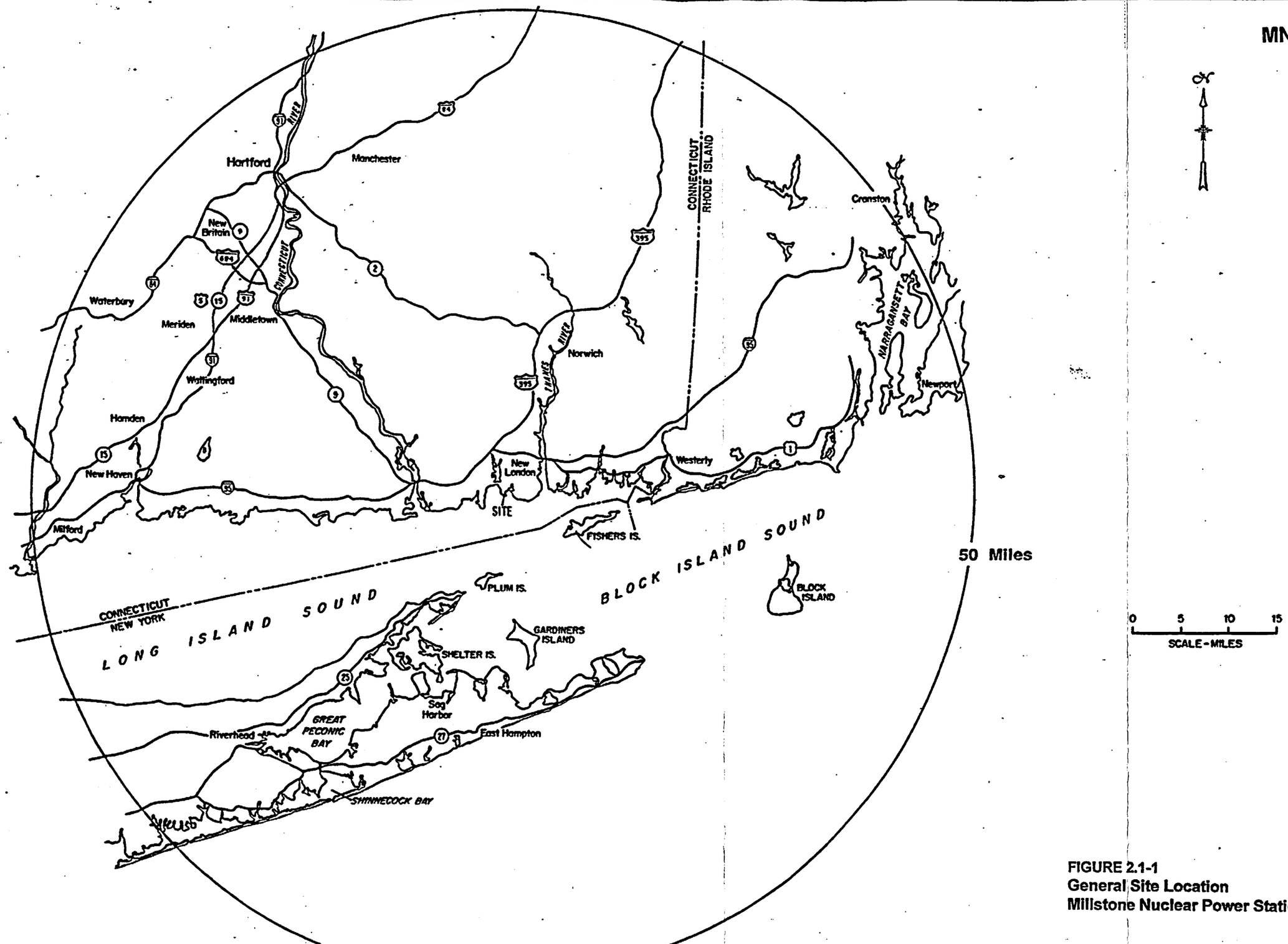


FIGURE 2.1-1
General Site Location
Millstone Nuclear Power Station

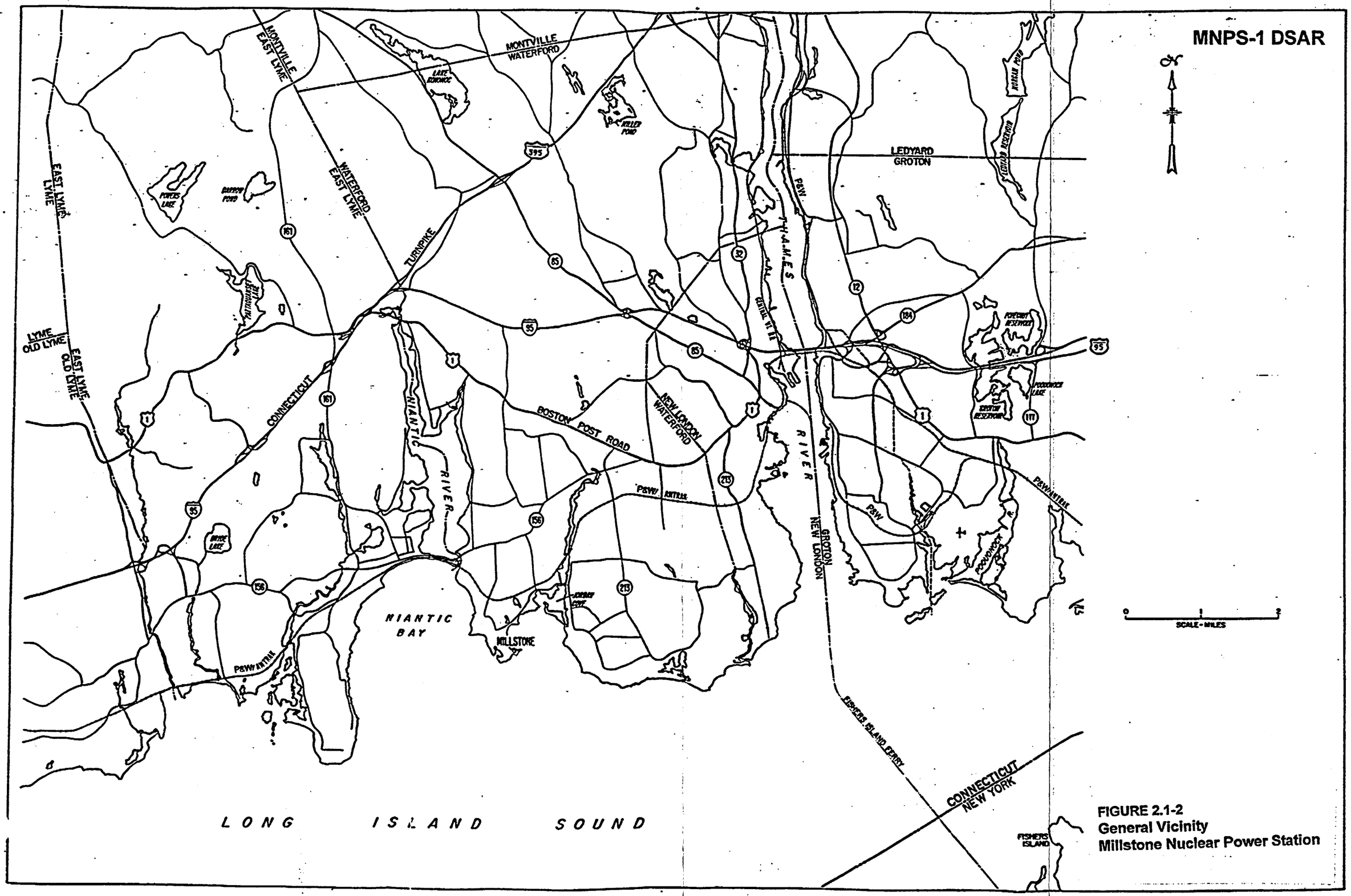


FIGURE 2.1-2
General Vicinity
Millstone Nuclear Power Station

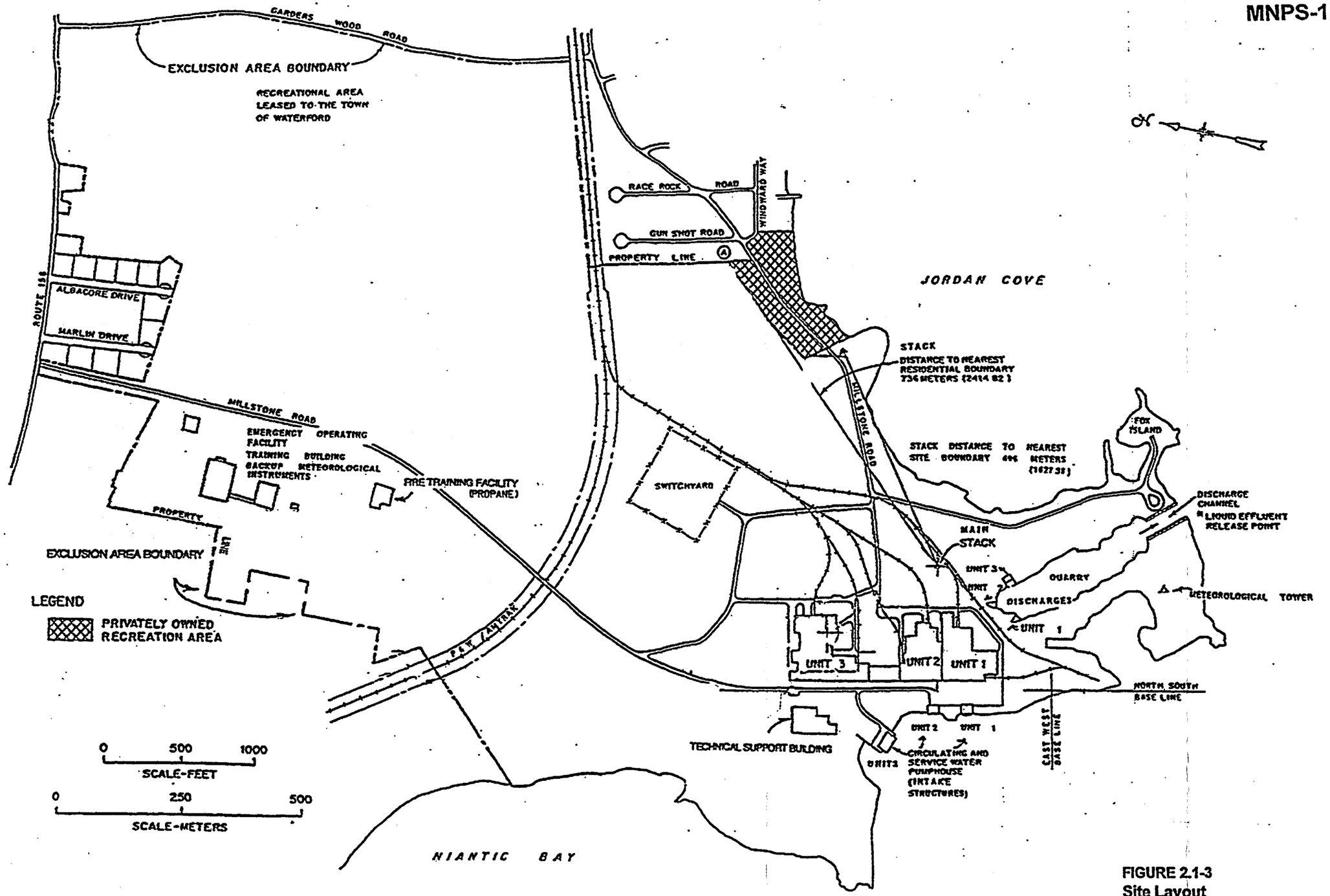


FIGURE 2.1-3
Site Layout
Millstone Nuclear Power Station

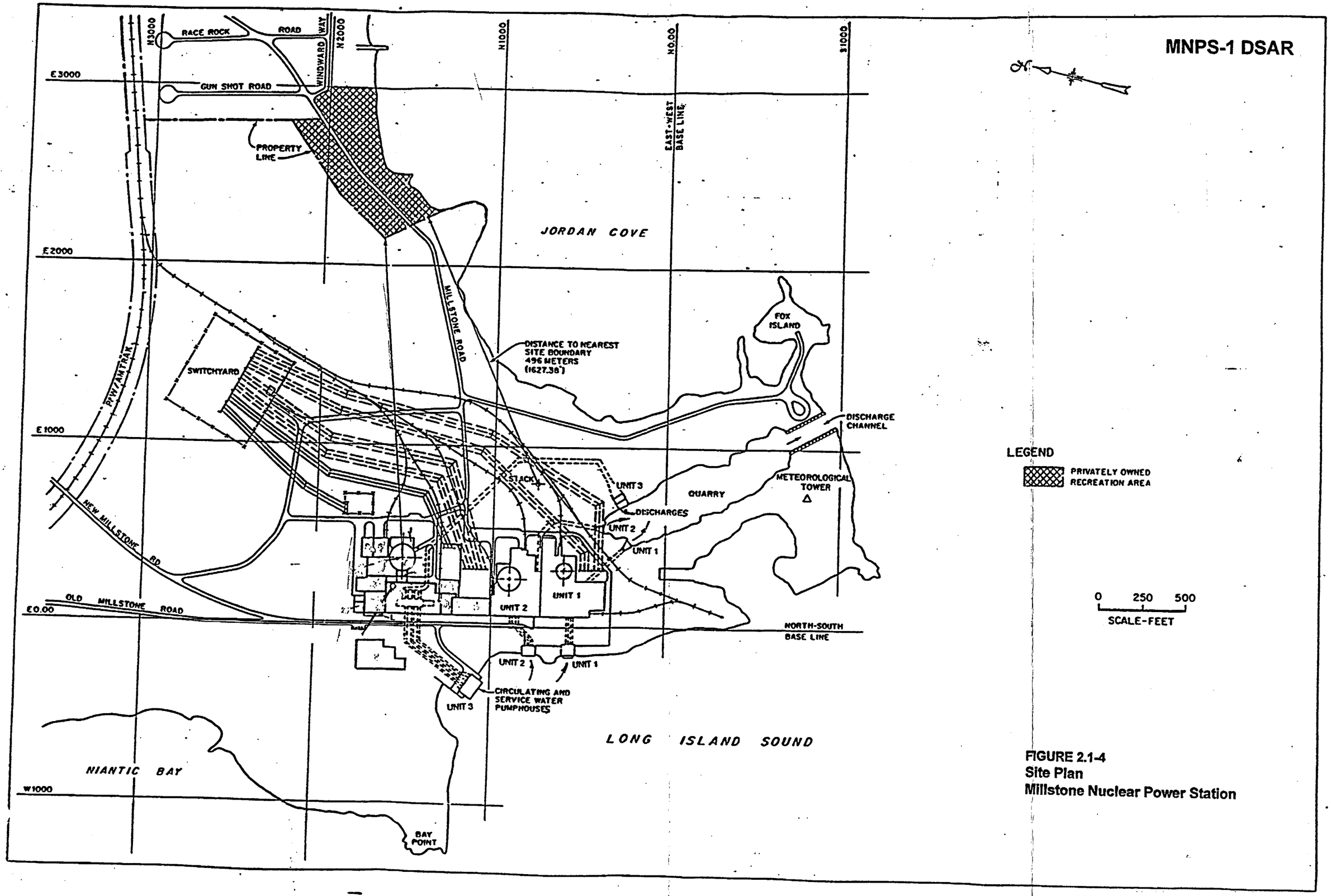


FIGURE 2.1-4
Site Plan
Millstone Nuclear Power Station

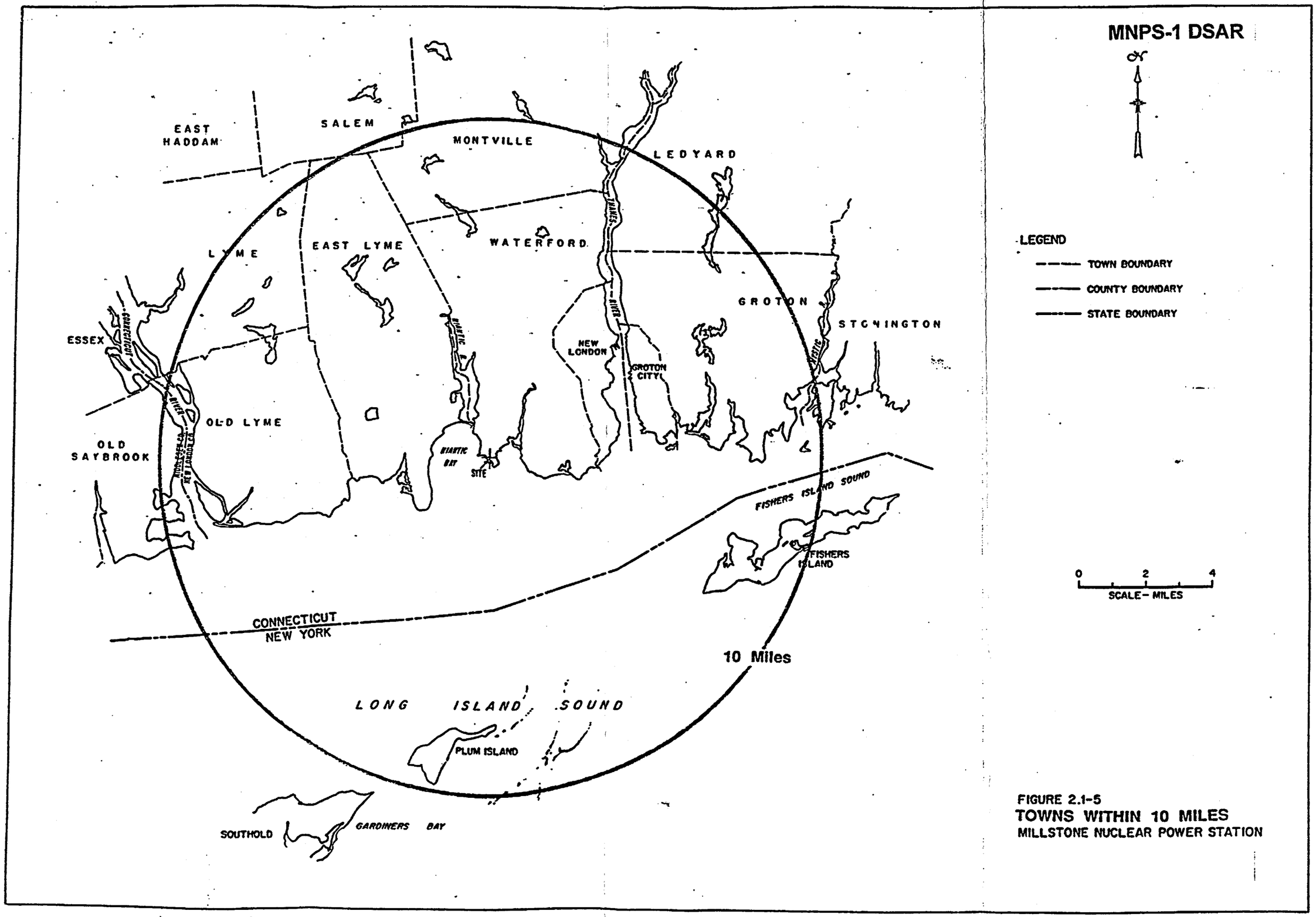
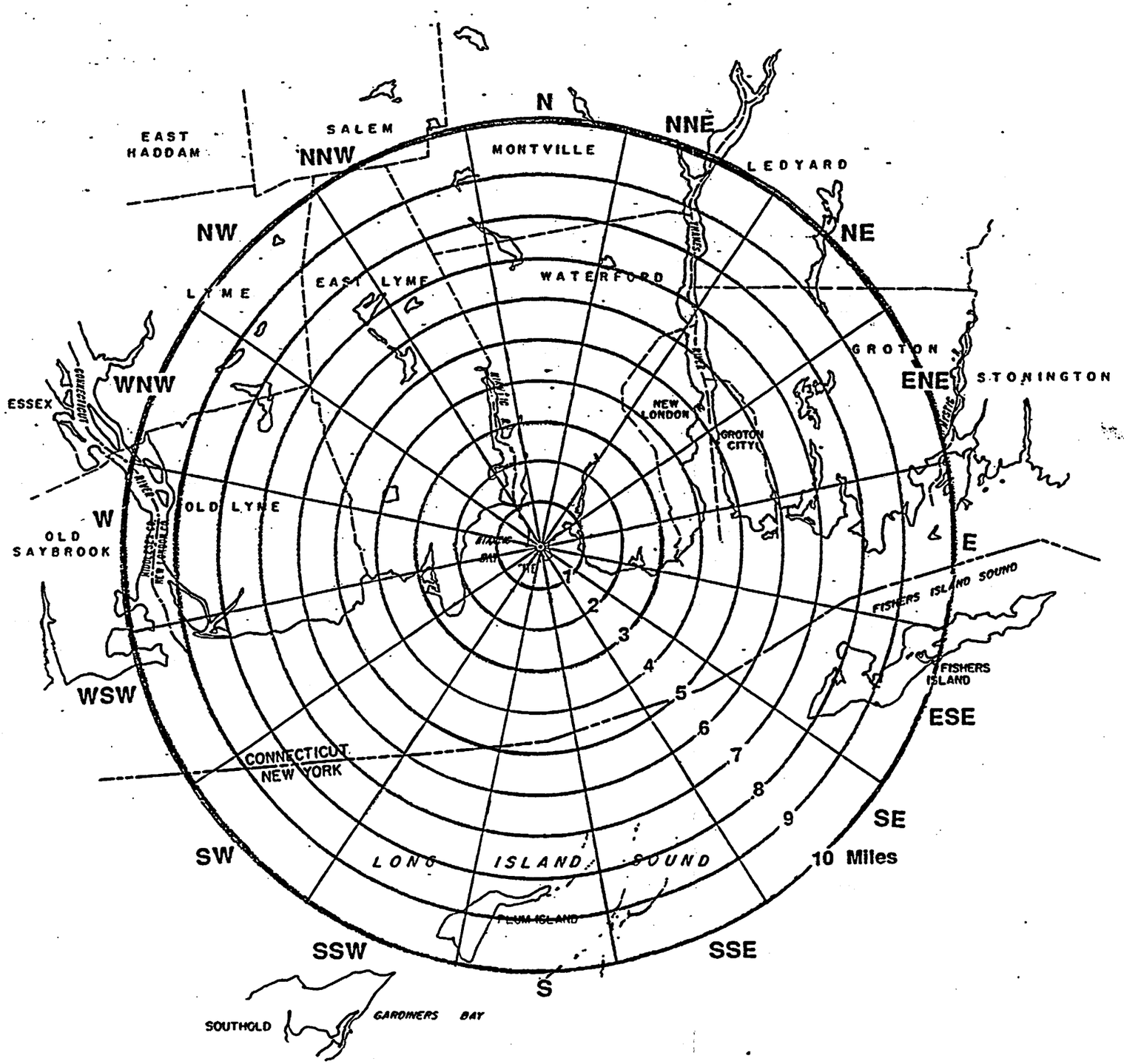


FIGURE 2.1-5
TOWNS WITHIN 10 MILES
MILLSTONE NUCLEAR POWER STATION

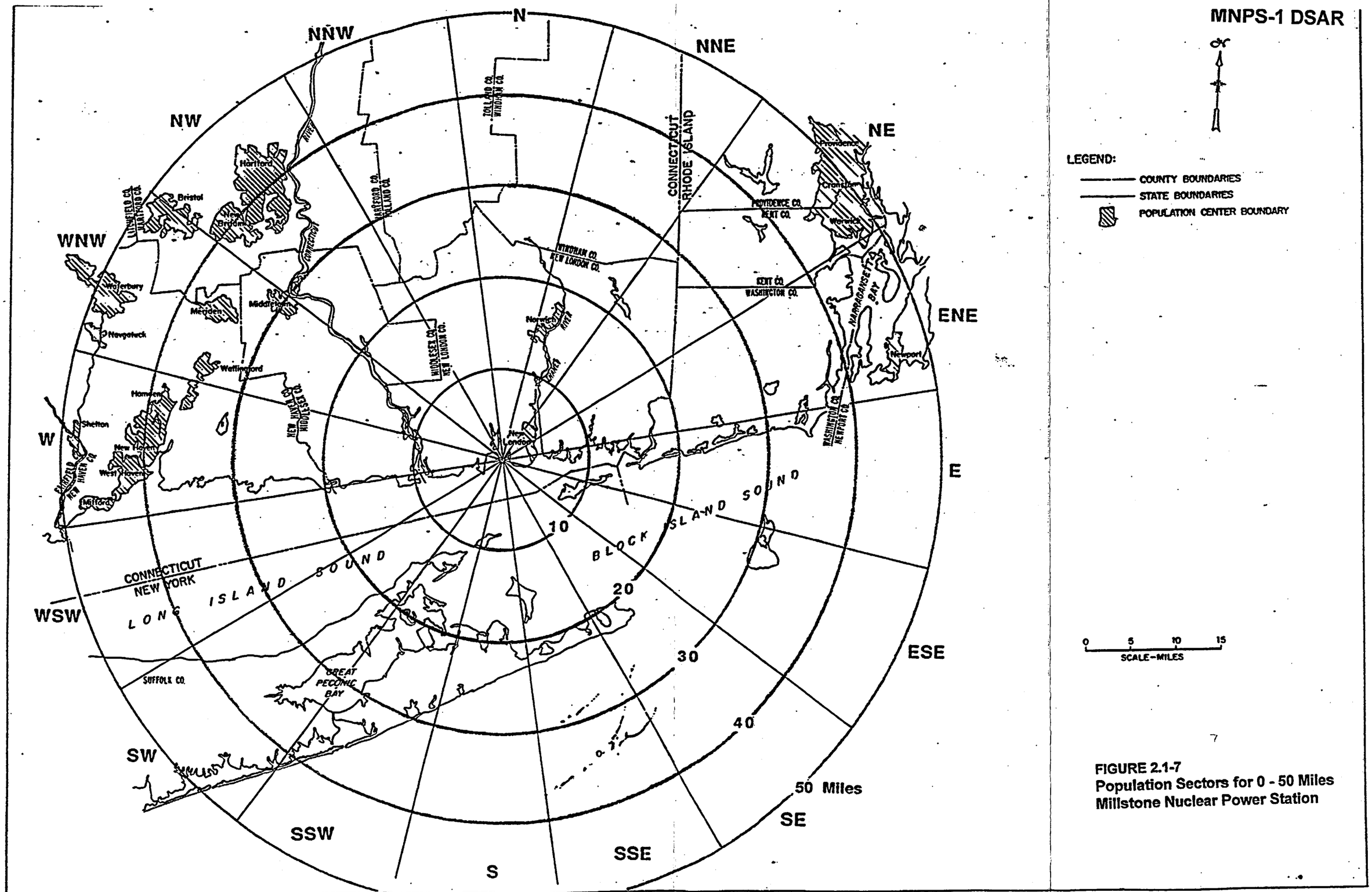


LEGEND

- TOWN BOUNDARY
- COUNTY BOUNDARY
- STATE BOUNDARY

0 2 4
SCALE – MILES

FIGURE 2.1-6
Population Sectors for 0 - 10 Miles
Millstone Nuclear Power Station



LEGEND:

- COUNTY BOUNDARIES
- STATE BOUNDARIES
- POPULATION CENTER BOUNDARY

0 5 10 15
SCALE-MILES

FIGURE 2.1-7
Population Sectors for 0 - 50 Miles
Millstone Nuclear Power Station

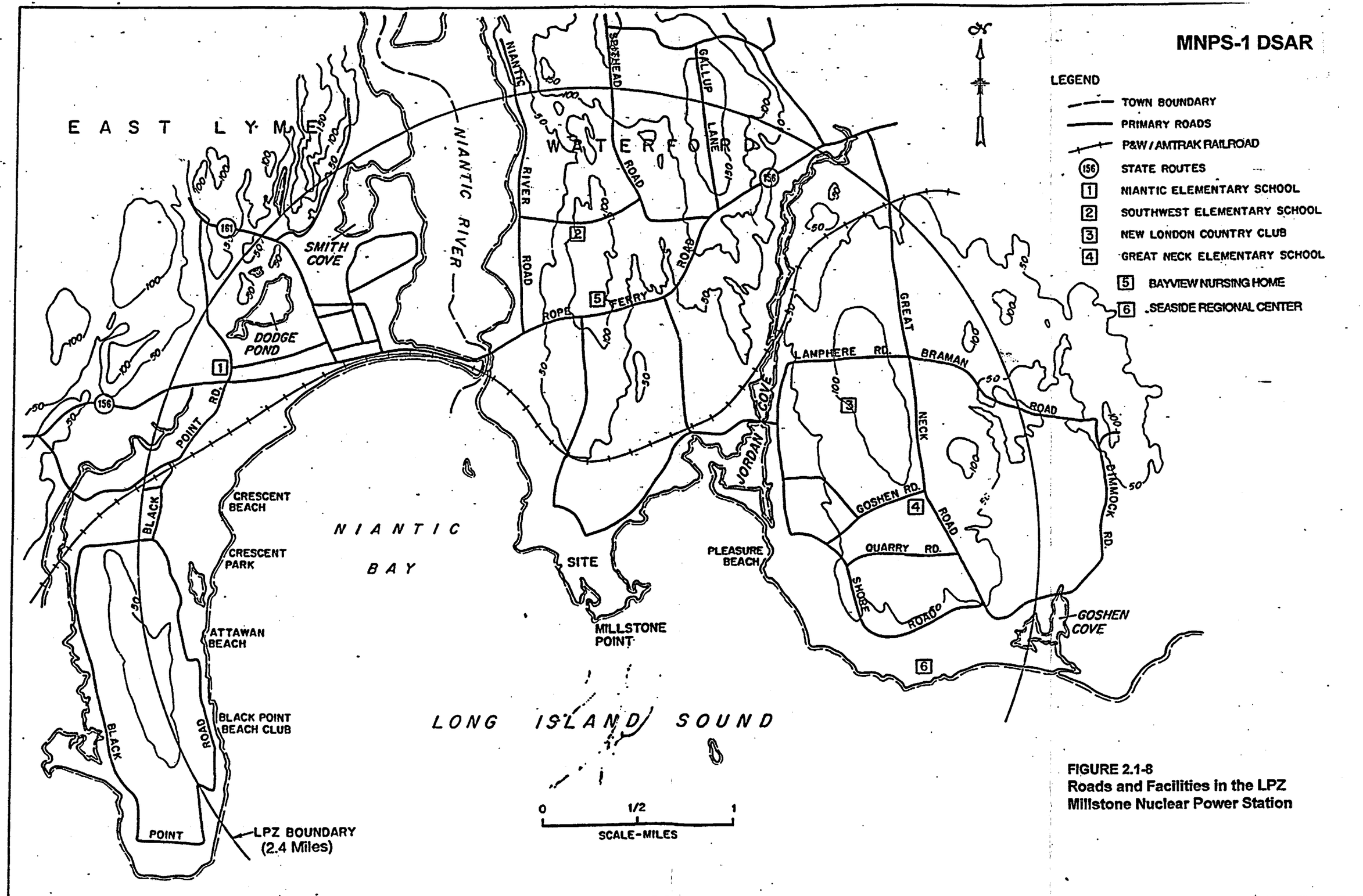


FIGURE 2.1-8
Roads and Facilities in the LPZ
Millstone Nuclear Power Station

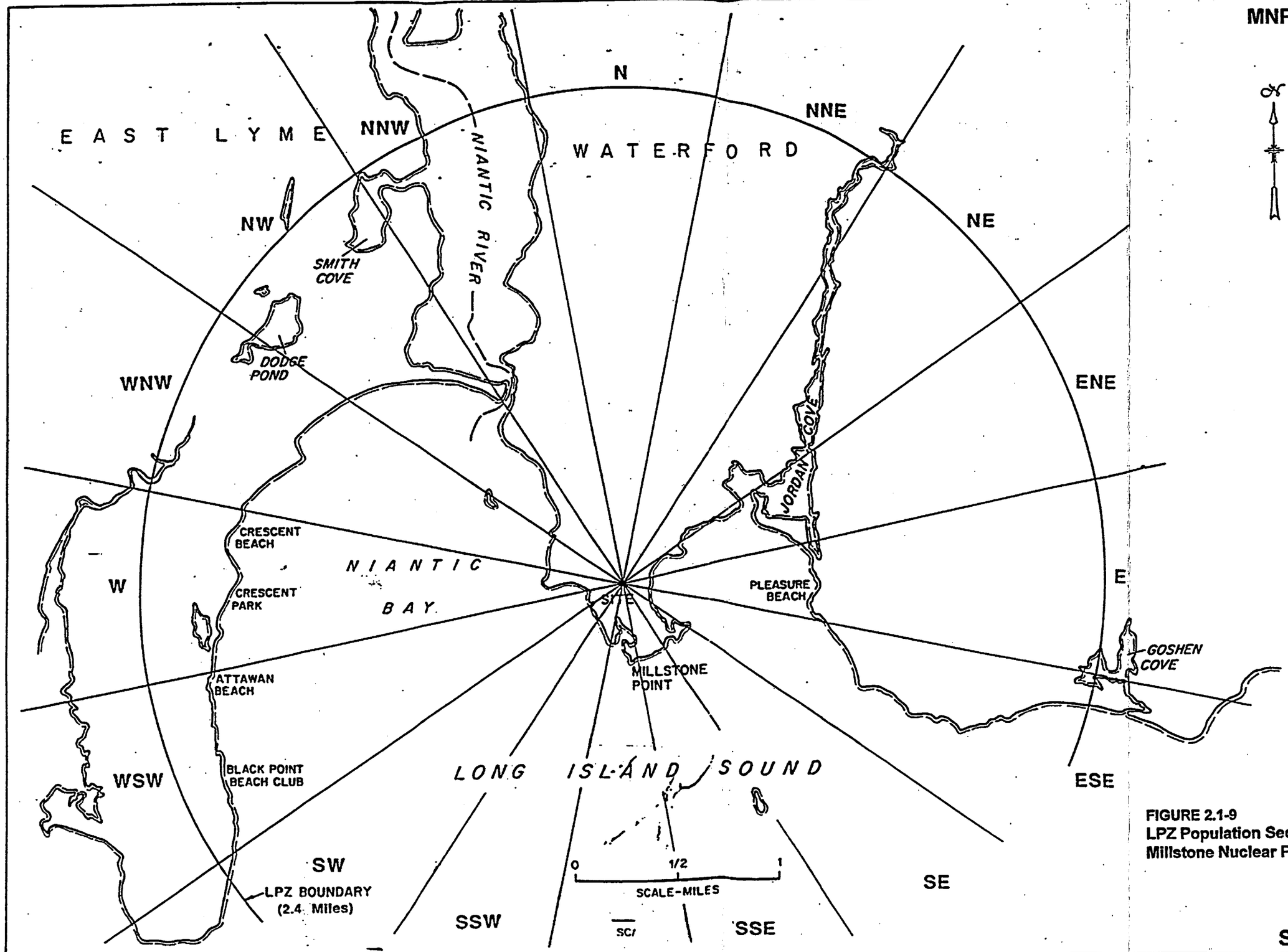
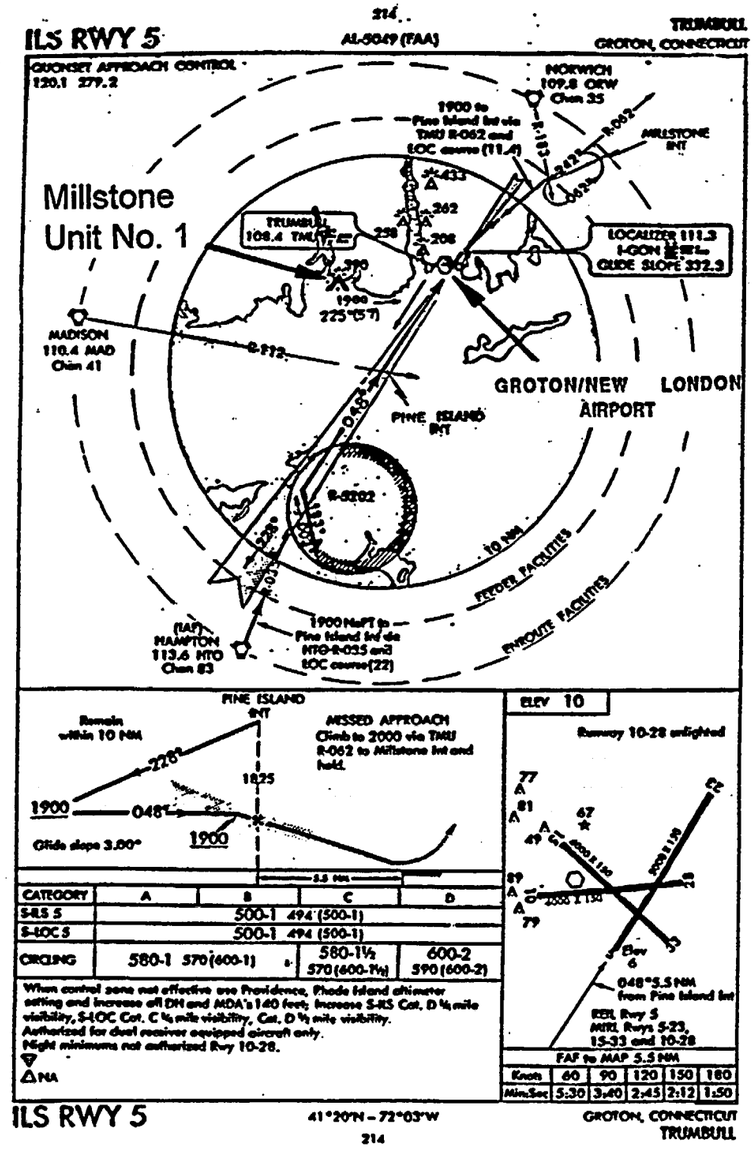
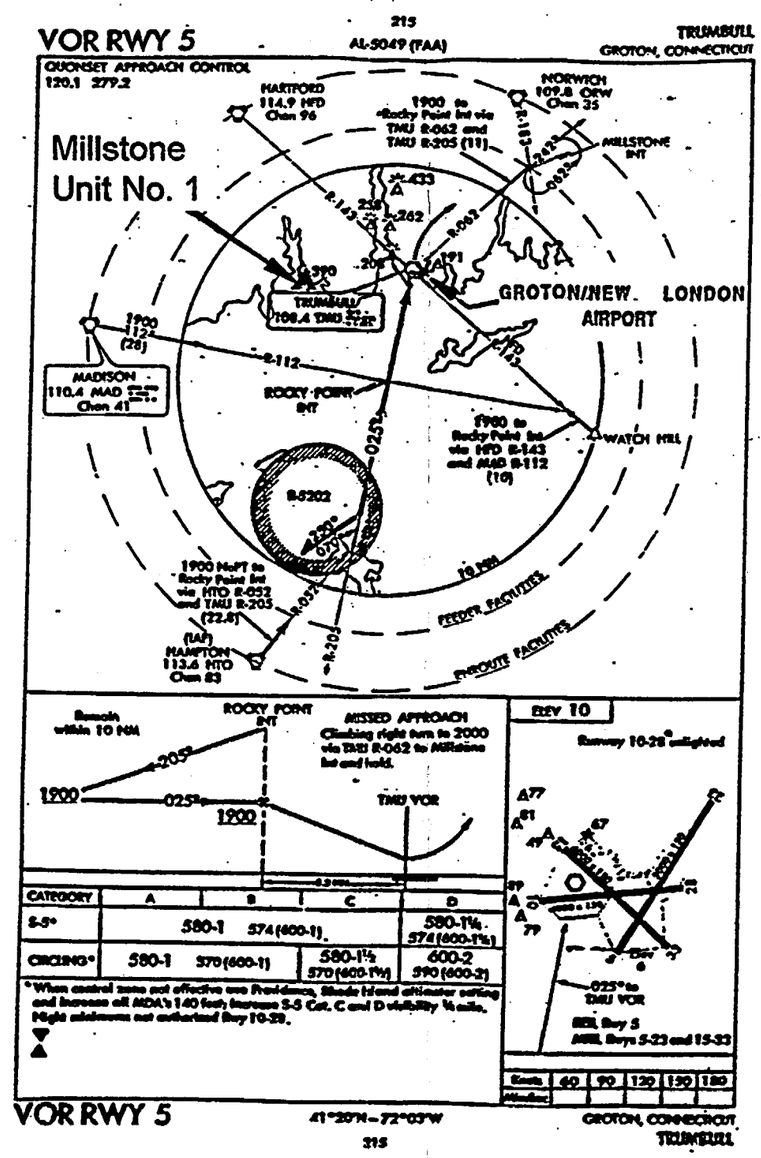
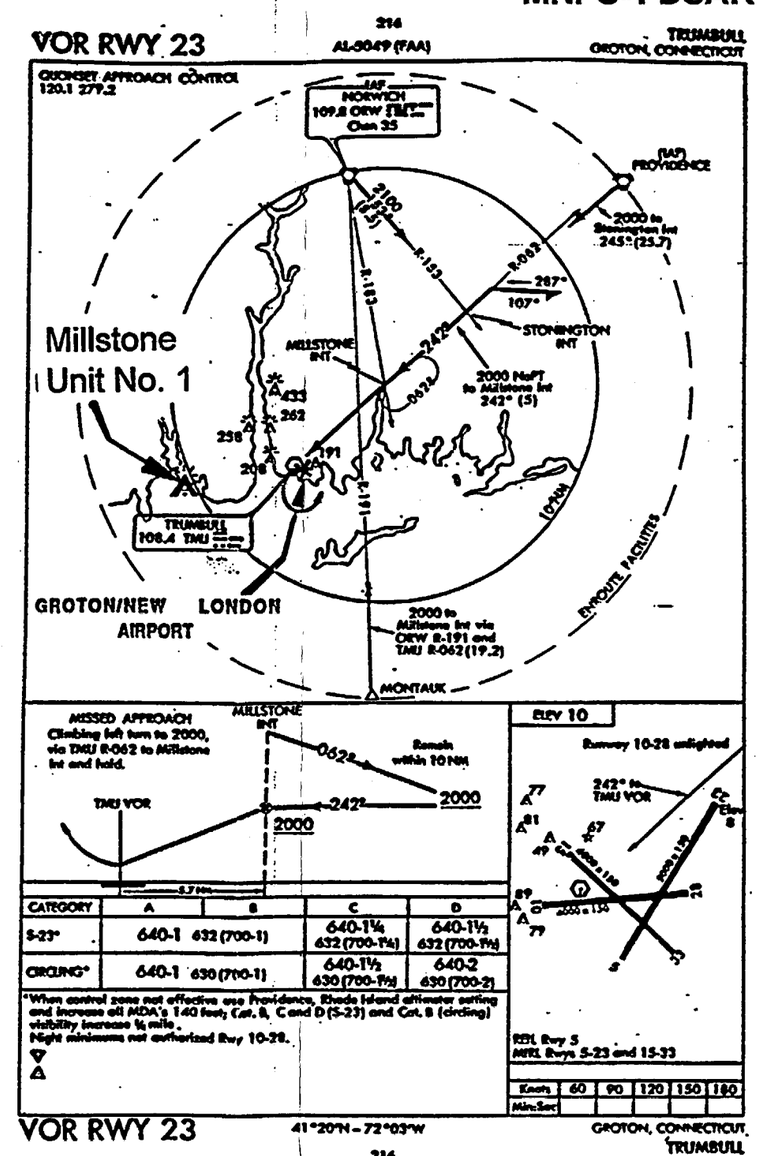


FIGURE 2.1-9
LPZ Population Sectors Distribution
Millstone Nuclear Power Station







NOTE:
PAGES FROM DOD FLIGHT INFORMATION PUBLICATION-
LOW ALTITUDE INSTRUMENT APPROACH PROCEDURES
NORTHEAST UNITED STATES VOL-7

FIGURE 2.1-10
Instrument Landing Patterns
at Trumbull Airport
Millstone Nuclear Power Station

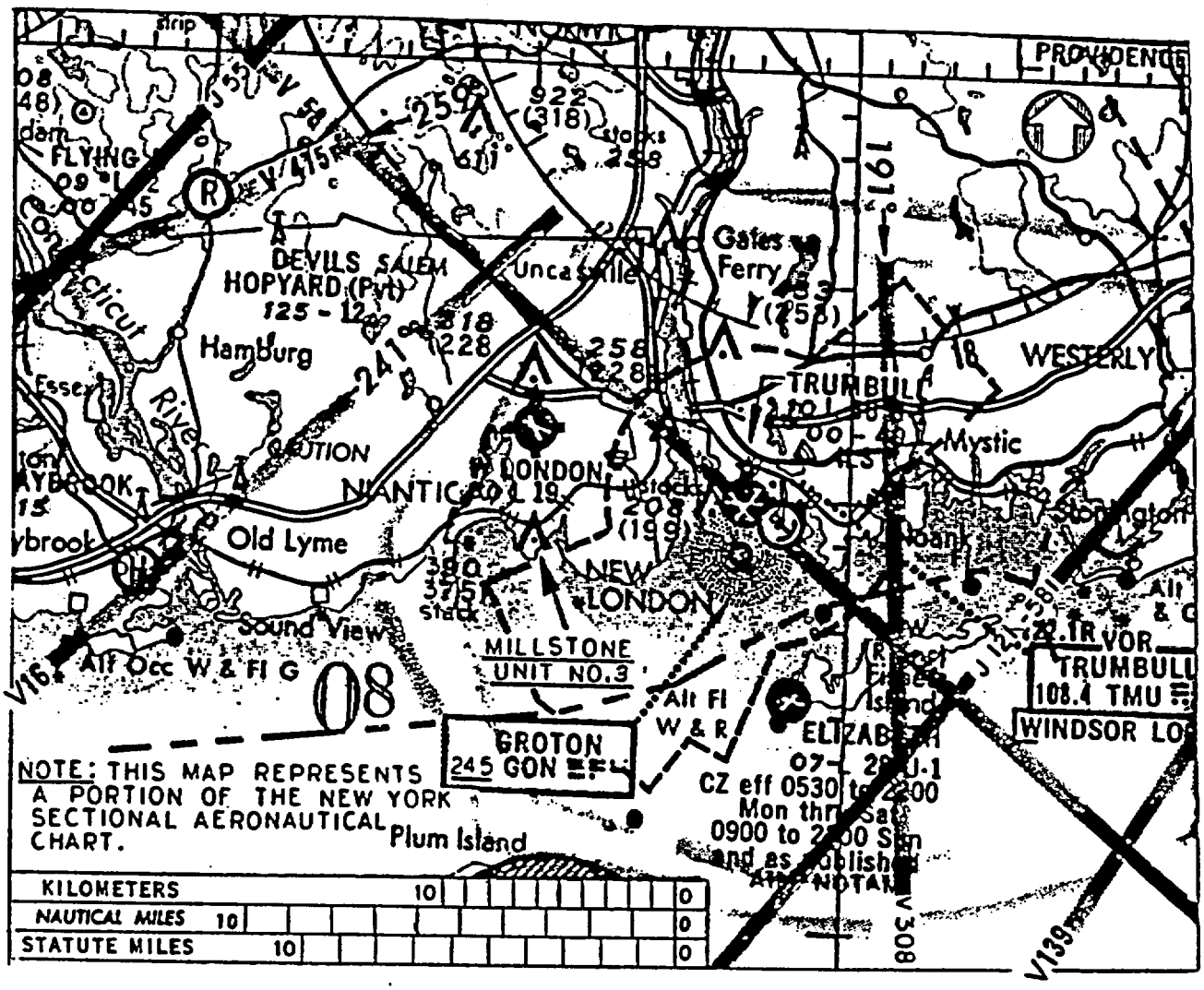


FIGURE 2.1-11
Air Lanes Adjacent to Millstone Point
Millstone Nuclear Power Station

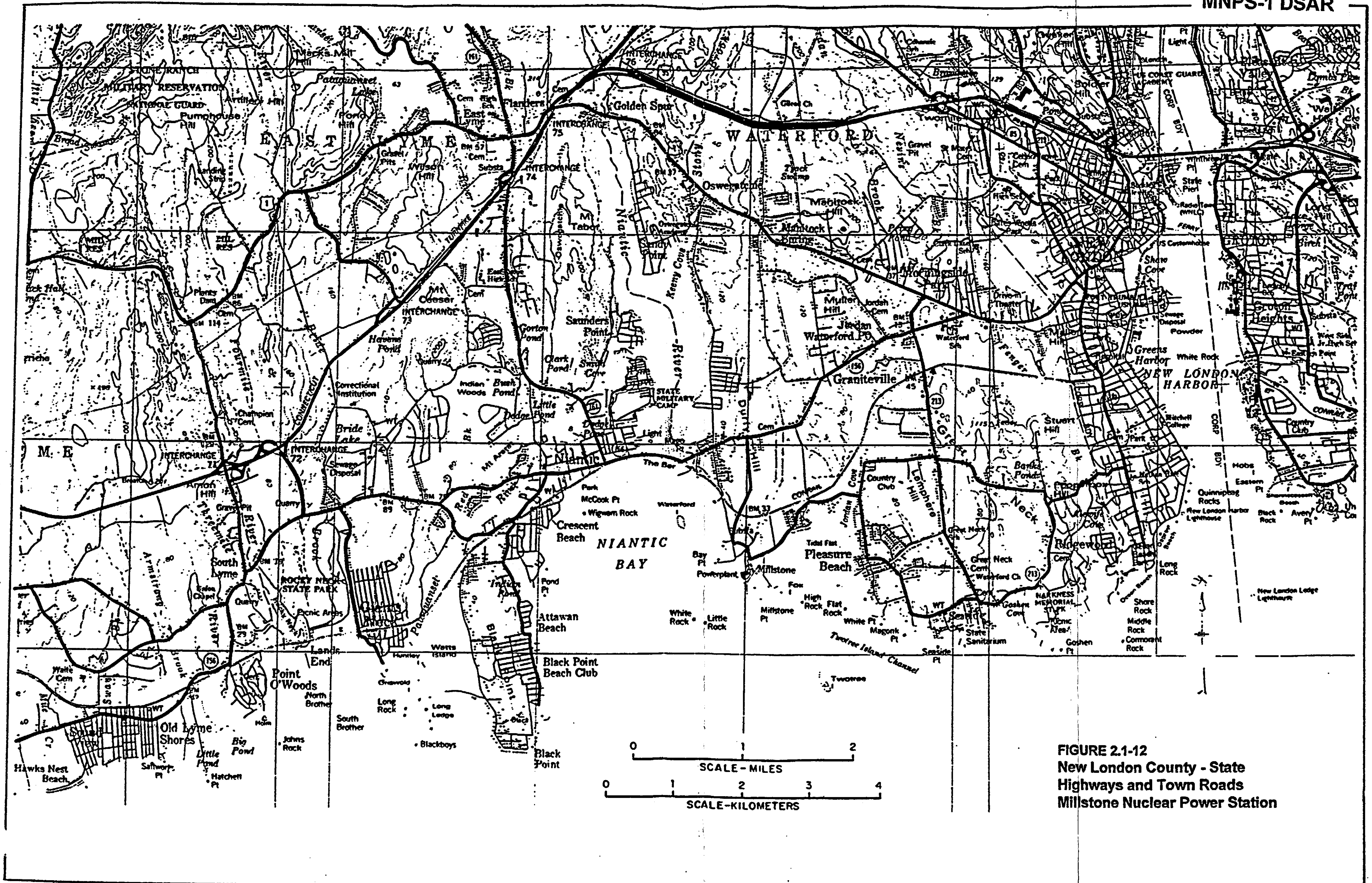


FIGURE 2.1-12
New London County - State Highways and Town Roads
Millstone Nuclear Power Station

2.2 METEOROLOGY

Information regarding meteorology is presented in Section 2.3 of the Millstone Unit 3 Final Safety Analysis Report (Reference 2.3-1). With the exceptions given below, that information is incorporated herein by reference.

2.2.1 Regional Climatology

(See Section 2.3.1 of the Millstone 3 Final Safety Analysis Report of Reference 2.2-1).

2.2.2 Local Meteorology

(See Section 2.3.1 of the Millstone 3 Final Safety Analysis Report of Reference 2.2-1).

2.2.2.1 Potential Influence of the Plant and Its Facilities on Local Meteorology

Millstone Unit No. 1 used a once-through cooling water system, discharging its cooling water into an existing quarry into which Units 2 and 3 also discharge and thence into Long Island Sound. Thin wisps of steam fog occasionally form over the quarry and less frequently over the discharge plume during the winter months, depending on tidal conditions and temperature differences between air and water. This fog dissipates rapidly as it moves away from the warm water area. Because the maximum discharge plume (defined by the 1.5°F isotherm of temperature differential when all three Millstone units were at full power) is approximately an ellipse of 1500 meter by 800 meters, the extent of the steam fog is negligible. With the permanent shutdown of Millstone Unit No. 1, this maximum discharge plume size is further reduced.

2.2.2.2 Local Meteorological Conditions for Design and Operating Bases.

2.2.2.2.1 Design Basis Tornado

The specifications for the Millstone Unit No. 1 design basis tornado are:

Rotational velocity	300 mph
Translational velocity	60 mph
Total pressure drop	2.25 psi
Rate of pressure drop	1.2 psi/sec

2.2.3 On-Site Meteorological Measurements Program

The Millstone Site is served by a common meteorological tower, located south of Millstone Unit No. 1. The meteorological tower is capable of measuring wind speed, direction, and air temperature at various heights. For details regarding the capability of the program, see Section 2.3.3 of the Millstone 3 Final Safety Analyses Report Reference 2.2-1.

2.2.4 Short Term (Accident) Diffusion Estimates

2.2.4.1 Objective

Accidents could result in short-term releases of radioactivity from several possible venting points. Atmospheric diffusion factors (X/Q) based on site metorological data are calculated at the exclusion area boundary (EAB) and low population zone (LPZ) for each downwind sector for each release point. The diffusion factors are calculated for different release time periods depending on the length of the release. These diffusion factors are used in the calculation of radiological consequences of the releases.

2.2.4.2 Calculations

2.2.4.2.1 Venting Point and Receptor Locations

The distance from the various release points to the EAB in each sector are listed in Table 2.3-1. The LPZ is taken to be 3860 m in all sectors from any release point.

2.2.4.2.2 Models

Accident X/Q's were calculated using the basic methods of Regulatory Guide 1.145. For elevated releases, the X/Q's for the first four hours are calculated using a sea breeze fumigation model adapted from Regulatory Guide 1.3. X/Q values for the control room due to ground level releases were calculated using the methods of Murphy and Campe. (Reference 2.2-2).

2.2.4.3 Results

The calculated X/Q's used in design basis accident (DBA) radiological consequence calculations are presented with the list of assumptions in Chapter 5.

2.2.5 Long-Term (Routine) Diffusion Estimates

2.2.5.1 Objective

Low levels of radioactivity are routinely released on a continuous basis only from the Millstone Unit No. 1 stack. Atmospheric diffusion factors (X/Q) based on site meteorological data are calculated for various downwind receptor locations of interest. The meteorological data is used to calculate the dose consequences to the public from routine airborne effluents. The calculated doses are submitted periodically to the Nuclear Regulatory Commission (NRC).

2.2.5.2 Calculations

2.2.5.2.1 Venting Point and Receptor Locations

Routine releases of gaseous waste streams are vented from the Millstone Unit No. 1 stack. Releases from the Millstone Unit No. 1 stack are considered elevated. The distances from the stack to the nearest site boundary, the nearest land, and to the nearest residence in each downwind sector are listed in Table 2.2-1, and used in X/Q calculations.

2.2.5.2.2 Database

Calculations are performed on a periodic basis using the actual meteorology for this period.

2.2.5.2.3 Models

X/Q values are ground level dispersion factors, and releases are modeled using a conventional Gaussian plume model.

2.2.6 References

2.2-1 Millstone Unit 3, Final Safety Analysis Report, Section 2.3-Meterorology.

2.2-2 Murphy, K. G., and Campe, K. M. Nuclear Power Plant Control Room Ventilation System Design for Meeting General Criterion 19, 13th AEC Air Cleaning Conference, 1973.

2.3 HYDROLOGIC ENGINEERING

Information regarding hydrologic engineering is presented in Section 2.4 of the Millstone 3 Final Safety Analysis Report (Reference 2.3-1). With the exceptions given below, that information is incorporated herein by reference.

2.3.1 Hydrologic Description

(See Section 2.4.1 of the Millstone 3 Final Safety Analysis Report, Reference 2.3-1).

2.3.2 Site and Facilities

Millstone Point is located on the north shore of Long Island Sound. To the west of the site is Niantic Bay and to the east is Jordon Cove. Figure 2.3-1 shows the general topography of the Millstone area. The site grade elevation for Millstone Unit No. 1 varies from 14 ft to above 15 ft mean sea level (MSL). Structures including the reactor building, is flood protected to an elevation of 19'-0". The enclosure for Bus 14H is flood protected to an elevation of 21' - 10". The fire pumphouse is flood protected to an elevation of 21'-9". The turbine building is flood protected to an elevation of 19'-0". Section 2.3.3.2 discusses the probable maximum hurricane used to calculate maximum water levels. Flood protection of other structures is discussed in Sections 2.3.3.

2.3.3 Floods

This section reviews the flood history in the vicinity of Millstone Point, flood design considerations, and the effects of local intense precipitation.

2.3.3.1 Flood History

Flooding near the site has historically been caused by hurricanes. The maximum historical flooding was the result of a hurricane on September 21, 1938, which produced a flood level of 9.7 ft MSL at New London, Connecticut.

The only sources of flooding that could affect Millstone Unit No. 1 are direct rainfall and storm surges. The controlling event for flooding that could affect Millstone Unit No. 1 are direct rainfall and storm surges. The controlling event for flooding at the site is the result of a storm surge induced by the probable maximum hurricane (PMH).

2.3.3.2 Flood Design Considerations

The controlling event for flooding at the Millstone site is a storm surge resulting from the occurrence of a PMH (see Section 2.3.6). The maximum still water level is +18.11 ft MSL, and the associated wave run up is +22.3 ft MSL.

Chapter 3 describes the flooding protective features at Millstone Unit No. 1 The intake structure is flood protected to +19 ft MSL and may experience minor in-leakage during the PMH storm surge.

The impact of flooding and wave action on the intake structure may disable the SW system since electrical components located at susceptible elevations.

2.3.3.3 Effect of Local Intense Precipitation

A discussion on the development of the probable maximum precipitation (PMP) for the site may be found in Section 2.3.2 of Reference 2.3-1..

A study was performed to determine the impact of the PMP intensity on the plant roof structures. The radwaste disposal building, intake structure, radwaste/control building, southwest corner of the reactor building, and gas turbine building roofs can support the loads resulting from a PMP without crediting the roof drains.

The turbine building, reactor building, warehouse, and heating/ventilation area roofs credit scuppers to assure that the loads due to a PMP will remain below the roof design live loads.

PMP studies show that the area east of Millstone Unit No. 1, north of the radwaste truck bay, including the semi-enclosed area just east of both control rooms would have maximum ponding on the order of 15.5 to 16.2 ft. MSL . Further, these studies show that areas west of Millstone Unit No. 1 and 2, south of Millstone Unit No. 1, extending around the gas turbine building, to the east side of Millstone Unit No. 1 north of the radwaste truck bay would experience less ponding on the order of 14.6 to 14.9 ft. MSL. Ponding at the intake structure would be negligible since runoff would flow directly to the adjoining Niantic Bay.

Chapter 3 describes the protective flood features installed at Millstone Unit No. 1, however for a PMP scenario there could be little warning before the event, and therefore credit can not be taken for the various flood gate protection features. In-leakage through door openings could occur once the flood depths exceed door sill elevations. Secured external and internal doors will have a tendency to limit or control the amount of in-leakage.

2.3.4 Probable Maximum Flood (PMF) on Streams and Rivers

(See Section 2.4.3 of Reference 2.3-1, the Millstone Unit 3 Final Safety Analysis Report).

2.3.5 Potential Dam Failure, Seismically Induced

(See Section 2.4.4 of Reference 2.3-1, the Millstone Unit 3 Final Safety Analysis Report).

2.3.6 Probable Maximum Surge and Seiche Flooding

2.3.6.1 Probable Maximum Winds and Associated Meteorological Parameters

The meteorologic characteristics used to calculate the probable maximum storm surge at the Millstone Point site are those associated with the PMH as reported by the U.S.

National Oceanic and Atmospheric Administration (NOAA) in their unpublished report HUR 7-97 (30). HUR 7-97 described the PMH as "...a hypothetical hurricane having that combination of characteristics which will make it the most severe that can probably occur in the particular region involved. The hurricane should approach the point under study along a critical path and at an optimum rate of movement." Actually, nine different PMH storm patterns can be constructed using wind speed, storm size and forward speed parameters given in HUR 7-79 in various combinations. The storm, which would cause the maximum surge buildup at the entrance to Long Island Sound is one with a large radius to maximum wind and a slow speed of translation. Pertinent parameters are tabulated below:

Central Pressure Index

The minimum surface atmospheric pressure in the eye of the hurricanes.

Radius to Maximum Wind

(R) at 48 nautical miles. This is the distance from the eye of the storm to the locus of maximum wind.

Forward Speed

(T) 15 knots. This is the rate of forward movement of the hurricane center.

Maximum Wind

(Vx) 115.5 mph. This is the absolute highest surface wind speed in the belt of maximum winds.

Peripheral Pressure

(Pn) 30.56 inches. This is the surface atmospheric pressure at the outer edge of the hurricane where the hurricane circulation ends.

Although other parametric combinations give a higher wind speed, this particular combination yields the highest surge.

2.3.6.2 Surge and Seiche Water Levels

Although frontal storms and squall lines cause tidal flooding in the Millstone Point area, by far the most severe flooding has resulted from hurricanes. For this reason, the PMH as defined in Section 2.3.5.1 was used to compute the design storm surge level at the site. The calculated total surge height or still water level considers the wind setup, the water level rise due to barometric pressure drop, the astronomical tide and forerunner or initial rise.

The maximum still water level is +18.11 ft, and the associated wave run up elevation is +22.3 ft MSL.

2.3.6.3 Wave Action

Wave characteristics are dependent upon wind speed and duration, fetch length, and water depth. Millstone Point is sheltered from the direct onslaught of open ocean waves by Long Island.

At the time of the peak surge, the wind is from the southeast direction and the wave attack would be along the large axis of the point. Thus the intake structure, and the southeast portions of the Reactor, Turbine and Gas Turbine Generator Buildings are primarily involved.

2.3.6.4 Resonance

(See Section 2.4.5 of the Millstone Unit 3 Final Safety Analysis Report Reference 2.3.1).

At the time of the peak surge, the wind is from the southeast direction and the wave attack would be along the large axis of the point. Thus, the southeast portions of the Reactor Building would be primarily involved.

The foundations of the building has reinforced concrete structure flood protection walls to elevation 19 MSL. All openings in the walls are provided with sealed flood gates also to elevation 19 MSL. This includes the railroad tunnel door opening to the Reactor Building at ground level.

2.3.6.6 Probable Maximum Tsunami Flooding

(See Section 2.4.6 of the Millstone Unit 3 Final Safety Analysis Report Reference 2.3-1).

2.3.7 Ice Effects

There is no available history of ice or ice jams in Niantic Bay.

2.3.8 Cooling Water Canals and Reservoirs

See Section 2.4.8 of the Millstone Unit 3 Final Safety Analysis Report Reference 2.3-1.

2.3.9 Channel Diversions

See Section 2.4.9 of the Millstone Unit 3 Final Safety Analysis Report Reference 2.3.1.

2.3.10 Flooding Protection Requirements

Probable minimum low water level at the Millstone Unit No.1 Intake Structure resulting from an occurrence of a PMH, oriented as to cause maximum depression of the water surface (setdown) at the site could result in reduced performance of the Service Water pumps due to cavitation and vortexing.

Reference 2.3-2 states that mean low water at Millstone Point is (-) 0.97 ft. and the lowest recorded water level at New London, Connecticut since 1938 was (-) 4.37 on December 11, 1943. The minimum calculated setdown tide level per Reference 2.3-2 is (-) 6.3 ft. Reference 2.3-3 demonstrated that the SW pumps are expected to be operable down to this minimum tide level.

2.3.11 Low Water Considerations

2.3.11.1 Low Flow in Rivers and Streams

Since Millstone Unit No. 1 does not depend on either rivers or streams as a source of cooling water, this section is not applicable.

2.3.11.2 Low Water Resulting from Surges, Seiches, or Tsunamis

Probable minimum low water level at the Millstone Unit No. 1 intake Structure resulting from an occurrence of a PMH, oriented as to cause maximum depression of the water surface (setdown) at the site could result in nonoperation of the service water pumps.

2.3.12 Dispersion, Dilution, and Travel Times of Accidental Releases of Liquid Effluents Surface Waters.

See Section 2.4.12 of the Millstone Unit 3 Final Safety Analysis Report of Reference 2.3-1 for a general description.

2.3.13 Groundwater

See Section 2.4.13 of the Millstone Unit 3 Final Safety Analysis Report Reference 2.3-1 for a general description.

2.3.14 Technical Specification and Emergency Operation Requirements

Flood design considerations are discussed in Section 2.3.2.2 of Station Procedure ONP 514A, "Natural Occurrences," which addresses necessary precautions and actions to take in the event of anticipated hurricane, tornado, or flood conditions.

2.3.15 References

2.3-1 Millstone Unit 3, Final Safety Analysis Report, Section 2.4—Hydrologic Engineering.

2.3-2 Letter from J. J. Shea to W. G. Counsil, "Millstone Nuclear Power Station, Unit 1 - Safety Evaluation Report on Hydrology SEP Topics II-3.A, II-3.B, II-3.B.1, and II-3.C," dated June 30, 1982.

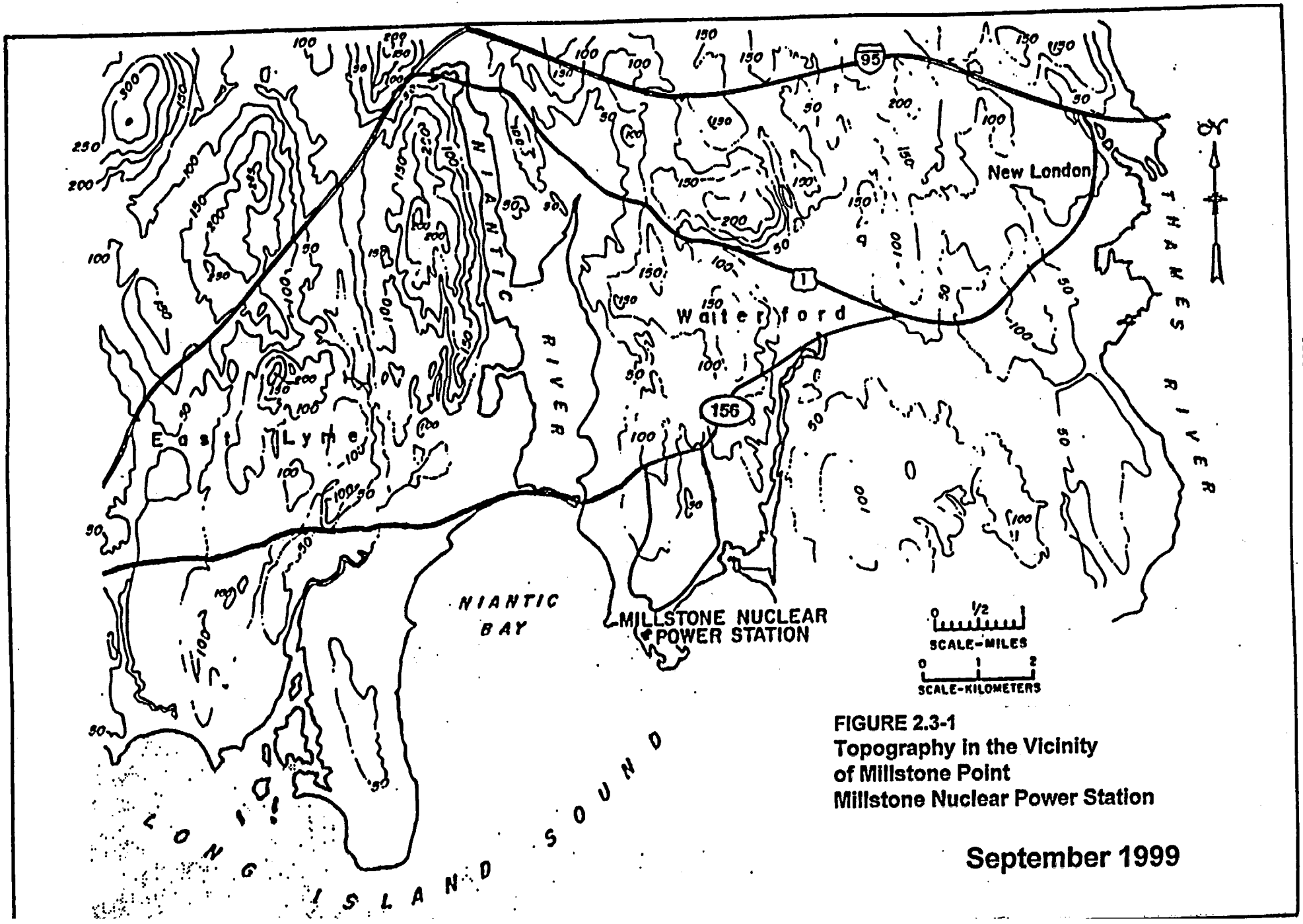


FIGURE 2.3-1
Topography in the Vicinity of Millstone Point
Millstone Nuclear Power Station

September 1999

2.4 GEOLOGY, SEISMOLOGY, AND GEOTECHNICAL ENGINEERING

2.4.1 Basic Geologic and Seismic Information

Information regarding the geologic and seismic qualities of the Millstone site is presented in Section 2.5.1 of the Millstone Unit No. 3 Final Safety Analysis Report (Reference 2.4-1). That information is incorporated herein by reference.

2.4.2 Vibratory Ground Motion

Information regarding vibratory ground motion at the Millstone site is presented in Section 2.5.2 of Reference 2.4-1. With the exceptions given below, that information is incorporated herein by reference.

2.4.2.1 Safe Fuel Storage Earthquake

The design of the plant is such that the spent fuel pool remains intact during a ground motion of 0.17 g.

2.4.3 Surface Faulting

2.4.3.1 Geologic conditions of the Site

Section 2.5.1.2 of Reference 2.4-1 discusses the stratigraphy, structural geology, and geologic history of the site are in detail.

2.4.3.2 Evidence of Fault Offset

The published geologic maps which include the site area do not indicate the presence of faulting. A discussion of faults discovered during excavation of the Millstone Unit No. 3 site can be found in Section 2.5.3.2 of Reference 2.4-1. This discussion can be considered typical for the entire Millstone site.

2.4.3.3 Earthquakes Associated with Capable Faults

There is no evidence of capable faults within the five-mile radius of the site. The majority of the significant seismic activity has been associated with the White Mountain Plutonic Province. Some activity has been associated with the Ramapo fault system (Reference 2.4-2); however, the fault is not considered capable (Reference 2.4-3).

2.4.3.4 Investigation of Capable Faults

There are no capable faults within the site area. The faults uncovered in the excavation are discussed in Section 2.5.3.2 of Reference 2.4-1.

2.4.3.5 Correlation of Epicenters with Capable Faults

There has been no spatial correlation between earthquakes and folds in the site region. Some correlation has been suggested with the Ramapo fault in New York and New Jersey. However, the Ramapo is not considered capable (Reference 2.4-3).

2.4.3.6 Description of Capable Faults

There are no capable faults within five miles of the site.

2.4.3.7 Zone Requiring Detailed Faulting Investigation

Eleven incapable fault zones were uncovered during excavation at the Millstone Unit No. 3 site. These faults have been mapped in detail and are discussed in Section 2.5.3.2 of Reference 2.4-1

2.4.3.8 Results of Faulting Investigation

There is no evidence of capable faulting within the five-mile radius of the site. The faults at the site are related to the rifting associated with the Triassic-Jurassic Period or older, with the last activity occurring approximately 142 million years ago.

2.4.4 Stability of Subsurface Materials and Foundations

No information on the stability of subsurface materials and foundations is available from the excavation for Millstone Unit No. 1. A discussion of this subject for the Millstone Unit No. 3 excavation can be found in Reference 2.4-1. This information can be considered typical for the Millstone site.

2.4.5 Stability of Slopes

The stability of slopes at the Millstone site was evaluated in Reference 2.4-4, wherein it was concluded that there are no natural or man-made slopes at the site that could be or become unstable such as to affect safety-related structures, systems or components.

2.4.6 Embankments and Dams

No embankments or dams have been constructed at the Millstone site.

2.4.7 References

2.4-1 Millstone Unit 3, Final Safety Analysis Report, Section 2.5, Geology, Seismology, and Geotechnical Engineering.

2.4-2 Aggarwal, Y.P. and Sykes, L.R. 1978. Earthquakes, Faults, and Nuclear Power Plants in Southern New York and Northern New Jersey. Science, Vol. 200, No. 430, p 425-429.

2.4-3 Nuclear Regulatory Commission 1977. (6 NRC 547 (1977)) Atomic Safety and Licensing Appeal Board Hearings on Indian Point, Units 1, 2, and 3 (Dockets No. 50-3, 50-247, and 50-285) ALAB-436.

2.4-4 Nuclear Regulatory Commission. Letter from J. Shea to W. G. Counsil dated June 30, 1982, "SEP Review Topic II-4, D, Stability of Slopes, Millstone Nuclear Power Station Unit 1".

CHAPTER 3

FACILITY DESIGN AND OPERATION

3.1 DESIGN CRITERIA

3.1.1 Conformance with 10CFR50 Appendix A General Design Criteria

3.1.1.1 Summary Discussion

The General Design Criteria (GDC) for Nuclear Power Plants as listed in Appendix A to 10CFR50 were effective May 21, 1971 and subsequently amended July 7, 1971.

Millstone Unit No. 1, was issued a provisional operating license (POL) on October 7, 1970, and is not obligated to comply with the GDC (Reference 3.1-3). Therefore, Millstone Unit No. 1, is not required to seek exemptions for those areas where it does not comply with the GDC. An evaluation of the design bases of the Millstone Nuclear Unit No. 1, as compared to the GDCs, was performed in support of the application for a full term operating license (FTOL), see Reference 3.1-1. It was concluded therein that Millstone Unit No. 1 satisfies and is in compliance with the intent of the GDCs. Nevertheless, it should be noted that this comparison and conclusion was not a commitment to meet all of the current GDCs or even to meet the intent of the current GDCs. Instead, the Reference 3.1-1 comparison determined the degree of compliance with the GDCs at that time. Also, compliance is demonstrated based upon those interpretations in effect at the time the specific licensing question, or issue, was being addressed.

3.1.1.2 Systematic Evaluation Program and Three Mile Island Evaluations of General Design Criteria

During the systematic evaluation program (SEP) initiated by the NRC in 1977, a large number of generic and plant-specific safety concerns were addressed and resolved (Reference 3.1-2). Many of these SEP issues, and later issues which arose from the

Three Mile Island (TMI) accident, involved a consideration of the NRC GDC affected by a specific issue and how the plant design compared to the criteria. A compilation of this more recent evaluation of specific safety concerns and the affected GDC are listed in Table 3.1-1.

3.1.2 Classification of Structures, Systems, and Components

3.1.2.1 Seismic Classification

The Code of Federal Regulations requires that structures, systems, and components important to safety shall be designed to withstand the effects of earthquakes without loss of capability to perform necessary safety functions. 10 CFR 100, Appendix A further defines a safe shutdown earthquake (SSE) and the structures, systems and components required to remain functional, as those plant features necessary to ensure:

(1) The integrity of the reactor coolant pressure boundary
(2) The capability to shut down the reactor and maintain it in a safe shutdown condition , and
(3) The capability to prevent or mitigate the consequences of accidents which could result in potential off-site exposures comparable to the guideline exposures of 10 CFR 100.

Regulatory Guide 1.29, Revision 3, describes an acceptable method for identifying and classifying those plant features that should be designed to withstand the effects of an SSE.

The plant structures and equipment, including their foundations and supports, are divided into two structural safety categories:

Seismic Class I: structures and equipment whose failure could cause significant release of radioactivity or which are vital to the removal of decay heat.

Seismic Class II: structures and equipment which are not essential to the containment of radioactivity or removal of decay heat.

Only the Reactor Building, the fuel pool liner and the spent fuel racks remain Seismic Class I in the permanently defueled condition. The Reactor Building houses, protects and supports the spent fuel pool. It supports maintenance of the fuel configuration in the fuel pool, provides protection from external hazards and supports maintenance of water in the fuel pool to a depth necessary to ensure the irradiated fuel is always immersed. The fuel storage racks are designed to assure subcriticality in the fuel pool and are designed to withstand the anticipated earthquake loadings as Class I structures.

Dismantlement of Seismically Designed Structures, Systems and Components

For SSCs designated as Seismic Class I in the permanently defueled condition, the following criteria apply prior to performing dismantlement operations:

(1) Downgrading seismic classification of components shall be performed in accordance with appropriate engineering and design procedures and processes

(2) When downgrading seismic classification of an SSC, a 10 CFR 50.59 evaluation shall be performed if:

a. the seismic classification is described in the DSAR, or
b. it's failure in a seismic event could affect a Seismic Class I component described in the DSAR in such a manner as to cause an unanalyzed incident or an accident with offsite doses exceeding the doses from the design basis accident.

(3) When downgrading seismic classification of an SSC, a 10 CFR 50.54 evaluation shall be performed if the structure classification is described in the Northeast Utilities Quality Assurance Program (NUQAP).

(4) When downgrading seismic classification of an SSC, a 10 CFR 50.59 evaluation shall be performed if, during a seismic event, its failure has the potential to drain the fuel pool water level lower than 9 feet above the active fuel.

3.1.2.2 Safety-Related Classification

Nuclear plant SSC have traditionally been classified as "safety-related" in accordance with 10 CFR 50.2 and in 10 CFR 100, Appendix A, Section III, if they are relied upon to remain functional during and following design basis events to assure:

- The integrity of the reactor coolant pressure boundary,
- The capability to shut down the reactor and maintain it in a safe shutdown condition, or
- The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in 10 CFR 50.34(a)(1) or 10 CFR 100.11.

Clearly, the first two parts of the safety-related definition (reactor coolant pressure boundary, and capability to achieve and maintain safe shutdown) do not apply to a permanently defueled plant, given the license restrictions of 10 CFR 50.82. The third part of the safety-related definition (accident consequences comparable to 10 CFR 100 guidelines) is dependent on the results of new design basis accident analysis assumptions and results developed to address the existing defueled plant condition. SSC that are required to protect workers and the public from the consequences of design basis events may need to remain classified as safety-related.

Types and consequences of potential accidents were reanalyzed and it was concluded that the only remaining accident is a fuel handling accident. This accident was analyzed assuming no secondary containment or standby gas treatment system in operation, with a puff ground level release. The resulting off-site radiological exposure was determined to be significantly less than the guideline exposures set forth in 10 CFR 50.34(a)(1) and

10 CFR 100.11. Therefore, no SSC is required to be safety-related to prevent or mitigate the consequences of the only remaining accident, except to account for assumptions inherent in the analysis.

The only damage assumed in the analysis is damage to a certain number of fuel bundles. Assumptions inherent to this conclusion are that the fuel configuration, other than the direct impact damage, did not change and that the fuel pool water remained in-place. This implies that there is no failure of either the fuel pool structure or the fuel racks. Since these are passive structural items, assumption of failure is not required as long as the items are safety-related and designed to withstand these loads. Therefore, the fuel pool and supporting structure, fuel pool liner, and the fuel racks must be considered as safety-related to support the assumptions made in the accident analysis. No other components, systems or structures meet this criterion.

3.1.2.3 Non-Safety Related Plant Functions Maintained in the Defueled Condition

In addition to the Safety Related criterion above, other non-safety related plant functions must be maintained in the defueled condition. The following criteria were used to determine which SSC were still required:

Criterion 1	Is the SSC associated with storage, control or maintenance of nuclear fuel in a safe condition; or handling of radioactive waste?
Criterion 2	Is the SSC program associated with radiological safety?
Criterion 3	Is the SSC associated with an outstanding commitment to the regulators which remains applicable to storage, control, or maintenance of nuclear fuel in a safe condition; or handling of radioactive waste or radiological safety?

Criterion 4 Does the SSC satisfy a requirement based on regulations governing management of nuclear fuel or radioactive materials, including any SSC which is independently required by the License or (proposed) Technical Specifications?

These criteria were applied to all Millstone Unit No. 1 SSC. A positive response to any criterion, including the Safety Related criterion, results in the group of those SSC which must remain functioning.

3.1.2.4 SSCs Important to the Defueled Condition

All SSC that must remain functional will be maintained in accordance with applicable Millstone Unit No. 1 procedures or quality processes. Commitments exist for augmented quality related to Fire Protection (FPQA), Radwaste (RWQA), Anticipated Transients Without a Scram (ATWS), and Station Blackout (SBOQA). ATWS and SBO are no longer applicable to Millstone Unit No. 1, but the requirements for fire protection and radwaste are essentially unchanged. These requirements would apply to the appropriate portions of the SSC which meet the criteria above.

Non-nuclear safety standards apply to other SSC that do not fall under existing quality processes. However, to provide added assurance of adequate reliability for non-safety related SSC that are important to safeguarding the heath and safety of the public and workers, another augmented quality classification is being developed. This classification, Important to the Defueled Condition (ITDC), implements NU management expectations but does not satisfy any regulatory requirement, and will apply to selected systems and components which perform the following functions:

- Storage, control, maintenance or handling of nuclear fuel
- Storage, control, maintenance or handling of radioactive waste, if not already RWQA
- Radiological safety

Systems and components were reviewed for these functions. Note that application of these functions differs from the 4 criteria in that requirements apply only to the primary SSC and are not extended to supporting systems, equipment or structures. The intent of the ITDC augmented quality is to increase reliable operation of the system(s) primarily responsible for performing each function. Acceptable performance of the supporting SSC are demonstrated during routine operation and/or periodic testing of the ITDC SSC.

Additionally, certain regulatory requirements to which NNECO made a licensing commitment may go beyond the functional scope of an SSC (e.g., Emergency Plan, Security Plan, Quality Assurance Topical Report, etc.). These commitments and legal requirements were also considered in the reclassification process.

Authorizations, Restrictions and Limitations on use of the SSC reclassification criteria

The SSC reclassification criteria is used as a basis to change various Millstone Unit No. 1 procedures and programs, provided that the change involves an SSC that is non-ITDC and, provided that plant procedures contain an acceptable method for approving the change. The following kinds of "soft" changes associated with non-ITDC SSCs are allowed:

- SSC classifications,
- drawings,
- calculations,
- procedures,
- nonconforming items and corrective actions,
- external industry operating experience reports,
- commitments,
- open work orders (in process at the time the decision was made to decommission the plant)
- the application of 10 CFR 50 Appendix B criteria provided it does not represent a reduction in commitment.

Use of these criteria does not authorize:

a. Activities creating new hazards or initiators not already recognized as part of the current license basis (e.g., decontamination or decommissioning of major components defined in 10 CFR 50.82)

b. The physical removal/disassembly of existing SSCs, or the installation of new SSCs. However, it may provide the basis for initiating such a change.

c. Changes to Technical Specification requirements.

d. Changes to regulations, license conditions, rules, and permits until such time that relief is granted by the regulating authority. However, it may provide the basis for requesting relief from the regulations, license conditions, rules, and permits.

e. Changes to commitments. Application of the commitment change process is required to change commitments.

f. Changes to the NUQAP. However, it may provide the basis for initiating a change to the NUQAP.

g. Changes to the Radiological Effluent Monitoring and Offsite Dose Calculation Manual (REMODCM). However, it may provide the basis for initiating a change to the REMODCM.

h. Changes to the Emergency Plan. However, it may provide the basis for initiating a change to the Emergency Plan.

i. Changes to the Security Plan. However, it may provide the basis for initiating a change to the Security Plan.

j. Changes to the Fire Protection Plan. However, it may provide the basis for initiating a change to the Fire Protection Plan.

k. Changes to the Radiation Protection Program. However, it may provide the basis for initiating a change to the Radiation Protection Program.

Boundaries and Interfaces for ITDC SSCs

SSCs identified as ITDC that require "availability" shall be maintained in a state such that the necessary functional capability is maintained.

Engineered Requirements for ITDC SSCs

A higher level of engineered quality is maintained for ITDC SSCs to assure that the capability exists to reliably meet performance expectations and requirements. However, ITDC SSCs are not safety-related and are not required to satisfy 10 CFR 50 Appendix B requirements. Although not required by regulation, the following criteria is developed and applied, as specified by engineering, to ITDC SSCs to assure continued reliability:

a. Design Control - Measures will be invoked to assure applicable regulatory requirements, license basis, and design basis information is correctly translated into specifications, drawings, procedures and instructions. These measures shall include provisions to assure that appropriate quality standards are specified and included in design documents and that deviations from such standards are controlled. Design changes, including field changes will be subjected to engineered design control measures commensurate with the importance of the SSC.

b. Procurement Document Control - Measures will be invoked to assure that applicable regulatory requirements, design basis, and other requirements which are necessary to assure adequate quality are suitably included or referenced in the documents for procurement of material, equipment, services.

c. Instruction, Procedures, and Drawings - Activities affecting SSCs will be prescribed by documented instructions, procedures, or drawings, of a type appropriate to the circumstances and will be accomplished in accordance with these instructions, procedures, and drawings. Instructions procedures, and drawings will include appropriate quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished.

d. Control of Purchased Material, Equipment, and Services - Measures will be invoked to assure that material, equipment, and services conform to the procurement documents. These measures shall include provisions, as appropriate, for source evaluation and selection, objective evidence of quality furnished, inspection at the source, and examination upon delivery.

e. Inspection - Inspection of activities affecting quality will be invoked and executed to verify conformance with the documented instructions, procedures, and drawings for accomplishing the activity.

f. Handling, Storage, and Shipping - Measures will be invoked to control the handling, storage, shipping, cleaning and preservation of material and equipment in accordance with work and inspection instructions to prevent damage or deterioration.

g. Test Control - Surveillance testing will be established for SSCs to ensure that the SSCs perform satisfactorily commensurate with the importance of their intended function.

h. Measuring and Test Equipment - Appropriate controls will be invoked to assure that measuring and test devices used on SSCs are properly controlled, calibrated and adjusted at specified periods to maintain accuracy within necessary limits.

i. Corrective Action - Measures will be invoked to assure that conditions adverse to quality are promptly identified and corrected. In the case of significant conditions

adverse to quality, the measures will assure that the cause of the condition is determined and corrective action is taken to preclude repetition.

3.1.3 Wind and Tornado Loadings

10 CFR 50 (General Design Criteria 2), as implemented by Standard Review Plan (SRP) Sections 3.3.1 and 3.3.2 and Regulatory Guides (RG) 1.76 and 1.117, requires that the plant be designed to withstand the effects of natural phenomena such as wind and tornadoes.

The Millstone Unit No. 1 capability to withstand wind and tornado loadings was evaluated in the Systematic Evaluation Program (SEP) (Reference 3.1-4) as Topic III-2. Several submittals were made to the U.S. Nuclear Regulatory Commission (NRC) to address issues raised under that topic (References 3.1-6, 3.1-7, 3.1-8, and 3.1-9). In an evaluation dated November 25, 1985 (Reference 3.1-5), the NRC concluded that the proposal will provide adequate protection against tornado events.

3.1.4 Water Level Design

The original design basis water level at Millstone Unit No. 1 is the probable maximum flood (PMF) level of 19.0 ft above mean sea level (MSL). All structures originally designed seismic Class 1 (except the intake structure) which do not have reinforced concrete flood walls are protected to elevation 19.0 ft MSL by providing a reinforced concrete or steel flood wall to this elevation. All external entrances are provided with rubber sealed flood gates to elevation +19 ft MSL, which are suspended at the entrances in such a manner that they can be positioned quickly in the event of impending flooding. The intake structure itself which was originally designed as seismic Class 1, is designed to withstand a water level of elevation 32.4 ft MSL. This level accounts for an assumed 13.4 ft MSL still water level and for non-breaking waves above this level as they strike the structure. For the effects of flooding on the systems within the intake structure, see Section 2.3.3.2.

3.1.5 Missile Protection

Systems and components have been examined to identify and classify potential missiles.

3.1.5.1 Internally Generated Missiles

Two broad categories of systems and components are reviewed to determine the potential for generating missiles; pressurized components and high speed rotating machinery. Only designs where a single failure could lead to a missile ejection were considered.

It was determined there are no highly pressurized components or high speed rotating machines capable of generating significant missile hazards in the permanently defueled condition. Therefore, no internally generated missiles are postulated.

3.1.5.2 Missiles Generated by Natural Phenomena

The effects of missiles generated by natural phenomena has been evaluated (References 3.1-13, 3.1-14, 3.1-15, 3.1-16, and 3.1-17). On the basis of those evaluations, Millstone Unit No. 1 is adequately protected against such missiles inhibiting the ability to maintain safe storage of new and irradiated fuel.

3.1.5.3 Missiles Generated by Events Near the Site

The objective of this assessment (Reference 3.1-19) is to assure that the integrity of the safety-related structures, systems, and components will not be impaired and that they will perform their safety functions in the event of a site proximity missile.

The potential for hazardous activities in the vicinity of the Millstone site are addressed in Chapter 2. NNECO concludes that the generation of missiles at these facilities does not pose a credible threat to the Millstone site. Therefore, no specific protection is required other than that described for tornado-generated missiles.

Therefore, Millstone Unit No. 1 does not present an undue risk to the health and safety of the public as a result of proximity missile hazards.

3.1.5.4 Aircraft Hazards

There is presently one small commercial airport approximately 6 miles east-northeast of the site. Groton/New London Airport handles regularly scheduled commercial passenger flights but is inadequate for handling large jets. NNECO has determined that the probability of an aircraft striking safety-related structures of Millstone Unit No. 1 is sufficiently low that it does not constitute a significant hazard.

3.1.6 Seismic Design

The Millstone Unit No. 1 plant was designed for an earthquake (equivalent to the operating basis earthquake or OBE) with a horizontal peak ground acceleration (HPGA) of 0.07g and reviewed for an earthquake (equivalent to the safe shutdown earthquake or SSE) with a PGA of 0.17 g. A smoothed design response spectrum recommended by John Blume and Associates and the north 69° west component of the 1952 Taft earthquake record normalized to the specified HPGAs were used as seismic input for the analyses and design. The vertical component of ground motion was assumed to be two-thirds of the horizontal components. For the dynamic analyses of seismic Class I structures, the buildings (or structures) were modeled as lumped mass-spring systems with fixed base to simulate the rock founded foundations.

The dynamic responses of the Reactor Building, ventilation stack, and Radwaste Building/Control were analyzed by time-history approach.

Two methods were used for the analysis of safety-related equipment:

(1) the response spectrum analysis approach with smoothed response spectrum recommended by John Blume and Associates as input, and

(2) The equivalent static method using peak structural responses as input.

Chapter 4 of the NRC NUREG/CR-2024 report, "Seismic Review of the Millstone 1 Nuclear Power Plant prepared for the NRC as part of the Systematic Evaluation Program" (Reference 3.1-21), summarizes the details of the original analysis and design.

3.1.6.1 Comparison of Measured and Predicted Responses

Plant procedures have been developed for abnormal operational events such as earthquakes. If the seismic warning light or ground motion is detected, plant walkdowns are initiated to determine plant capability.

3.1.7 Design of Class I and Class II Structures

3.1.7.1 Design Criteria, Applicable Codes, Standards and Specifications

The design of all structures and facilities (Class I and II) conformed to the applicable general codes or specifications in effect at time of design.

3.1.7.2 Loads and Loading Combinations

General requirements for the design of all structures and equipment include provisions for resisting the stresses resulting from dead loads, live loads and wind or seismic loads with impact loads considered as part of the live load. The treatment of equipment stresses are generally limited to those produced by non-operating loads such as the effect of building motion due to earthquake on the anchorage or support for a piece of equipment.

However, the loads resulting from operating pressures or temperatures on equipment are considered where they would increase the stresses.

Thermal gradients in the foundation were not considered in the design.

Selection of materials to resist the expected loads is based on standard practice in the power plant field. The use of these materials is governed by local building codes and the experience and knowledge of the designers and builders.

The loadings of concern are the following:

D = Dead load of structure and equipment plus any other permanent loads contributing stress, such as soil, hydrostatic, temperature loads or operating pressures and live loads expected to be present when the plant is operating.

E = Design earthquake load.

E' = maximum earthquake load.

W = Wind load.

The criteria which have been followed for all Class I structures with respect to stress levels and load combinations for the postulated events are noted below:

Reactor Building and Class I portions of Radwaste

(a) D + E — Normal allowable code stresses are used (AISC for structural steel, ACI for reinforced concrete). The customary increase in design stresses, when earthquake loads are considered, is not permitted.

(b) D + E' — Stresses are limited to the minimum yield point as a general case. However, in a few cases, stresses may exceed yield point. In this case, an analysis, using the Limit-Design approach, will be made to determine that the energy absorption capacity exceeded the energy input. This method has been discussed in the AEC publication TID-7024, "Nuclear Reactor and Earthquakes," Section 5.7. The resulting distortion is limited to assure no loss of function and adequate factor of safety against collapse.

(c) D + W — Normal allowable code stresses (AISC for structural steel, ACI for reinforced concrete) with the customary increases in stresses when wind loads are considered.

The maximum allowable stresses used for various loading conditions are given for Class I structures in Table 3.1-2.

Floor live loads were established based upon equipment and operating loads and applied to the basic building code, which is recommended to the boroughs by the State of Connecticut. Roof live loads are a minimum of 60 psf for Class I buildings and 40 psf for Class II buildings.

All Class I structures will withstand the maximum potential loadings resulting from a wind velocity of 115 miles per hour with gusts up to 140 miles per hour. Although some

damage to these structures could perhaps occur, this damage would under no circumstances impair the functions for the capability of safe storage of irradiated fuel.

Accidental torsion on the structures was not considered in the analyses. The Reactor building is a box-like structure with heavy columns and thick walls which give it a high torsional rigidity. Accidental eccentricity would therefore produce negligible stresses and has been ignored. Although a lack of symmetry applies to the arrangement of Class I structures, it is felt that because the buildings are not generally structurally connected, torsional effects are likely to be of little consequence.

In the analysis of concrete structures, the design modulus of $3x10^6$ psi is in accordance with the ACI building code requirements for reinforced concrete (ACI 318-63), Section 1102, which is standard design practice. However, it is recognized that the modulus of elasticity of concrete increases with age following the 28-day period, but it is difficult to evaluate the amount of increase. The following factors affect the strength of concrete.

(1) Curing temperature

(2) Initial temperature

(3) Variations in mixes

(4) Amount of hydration

The elastic modulus is not directly proportional to the strength of concrete: nevertheless, the effect of increasing the strength causes an increase in the modulus. However, the increase in the modulus due to age is not believed to be significant in the light of all the uncertainties affecting the modulus of concrete.

Whatever the small change in the modulus may be, this effect is partially accounted for by cracks in the concrete structure due to shrinkage and temperature. Such cracks tend to make the structure more flexible, which tends to compensate for the increased modulus. Also, the percent change in the modulus is small compared to other inputs in

the analysis such as dimensions, areas, cross sections, mass grouping, etc. Hence, the effect of a small modulus change on the validity of the dynamic analysis is considered to be negligible.

3.1.7.3 Structural Criteria for Class II Structures

Class II structures and equipment are designed following the normal practice for the design of power plants in the State of Connecticut, but as a minimum, this was not less than given in the "Uniform Building Code" for Zone 2. The usual practice of determining the stress due to earthquakes by applying a static load based on a specified seismic coefficient was followed.

Allowable stresses for building materials in Class II structures are as specified in the Basic Building Code, which is recommended to the boroughs by the State of Connecticut. A one-third increase is allowed for combinations including seismic or wind loads.

3.1.7.4 Seismic Class I and II Structures

3.1.7.4.1 Reactor Building

Function

The functions of the Reactor Building are to enclose the spent fuel pool and associated equipment and protect it from the weather. It supports maintenance of the fuel configuration in the fuel pool, provides protection from external hazards and supports maintenance of water in the fuel pool to a depth necessary to ensure the irradiated fuel is always immersed. The Reactor Building is retained as seismic Class I in the permanently defueled condition.

Description

The Reactor Building completely encloses the spent fuel pool. This building is a cast-in-place reinforced concrete structure. At the 108-foot 6-inch elevation, internal steel frame lateral bracing has been placed to support the crane and the roof of the Reactor Building. The Reactor Building is founded on rock with adequate strength at an elevation of minus 32-feet 0-inches, with a foundation of reinforced concrete 142-feet 6-inches square.

The new fuel storage vault and the spent fuel storage pool are located in the Reactor Building. The reactor service and refueling area is serviced by an overhead bridge crane. A refueling service platform with necessary handling and grappling fixtures services the spent fuel storage pool.

Fuel storage pool is a reinforced concrete structure, completely lined with seam-welded stainless steel plate which is welded to reinforcing members embedded in concrete.

The pool is located between elevations 65-feet 9-inches and 108-feet 6-inches. The fuel pool sits on a 5-feet 4-inch thick reinforced concrete slab which is supported by the reactor building perimeter and the primary containment drywell wall. The pool stainless steel liner prevents leakage even in the unlikely event the concrete develops cracks.

The liner was designed considering thermal stress, and the welds were dye penetrant inspected to ensure leak tight integrity. Construction materials used in the construction of the spent fuel storage facility includes 4000 psi, 28-day strength concrete, 40 ksi deformed bar reinforcing steel, and ASTM, A-167, Type 304 stainless steel.

Reactor Building Seismic Design and Analysis

Based on the recommended earthquake design criteria established for the station, envelopes of maximum acceleration, displacement, shear and overturning moment versus height have been developed and are presented for the two assumed earthquake directions. See Figures 3.1-1 through 3.1-5.

Based on the data developed by John A. Blume and Associates, engineers, the design criteria have been established as follows for computerized analysis: the mathematical model was subjected to an excursion through the north 69° west component of the 1952 Taft earthquake with an applied factor of 7/17. The resulting maximum shears, moments and displacements were used for design.

The maximum envelopes of building design shears, moments and displacements are presented graphically in Figures 3.1-3 through 3.1-5, respectively. These curves have been used in the seismic design of the Reactor Building. Loads and shears from reactor pressure vessel and associated piping and equipment are transferred to the drywell structure and pedestal and then to the foundation mat. Careful grouting between the drywell and mat ensures direct transfer of compressive loads to the mat. Shears are transferred to the mat by friction and bearing.

The Reactor Building was designed to resist the seismic shears and moments presented herein without the usual increase in stress for short-term loadings. In addition, the structure was reviewed to assure that it can resist 2.4 times the postulated seismic shears and moments without causing injury to the structure. In addition to the horizontal accelerations, a vertical building (and equipment) acceleration was used for design.

3.1.7.4.2 Control Room and Radwaste Treatment Building

Description

The waste treatment facility is north of and adjacent to the reactor building. The building includes equipment and tankage space below grade with the plant control room above grade. The area below grade is of reinforced concrete construction with shielded compartments provided for the various pieces of radwaste equipment. The control room above grade is of reinforced concrete walls with a two-foot thick reinforced concrete roof. The control room and radwaste facility are considered seismic Class II. The analytical model used in the seismic analysis of the control room and radwaste building

is shown in Figure 3.1-6 and is similar to those for reactor building and ventilation stack. The radwaste building is seismically analyzed consistent with Regulatory Guide 1.143.

General Structural Features

The building substructure is founded on rock. The maximum bearing pressure on the rock is 10 tons per square foot. The exterior walls are of cast-in-place concrete and designed for an earth pressure per square foot at any depth equal to the depth in feet times 90 pounds. The exterior walls and the base slab are designed to resist hydrostatic pressure and uplift due to exterior flooding to elevation 19 feet 0 inches.

The interior walls of the substructure are of cast-in-place concrete and those for the superstructure are either cast in place or made of concrete masonry units. With minor exceptions, all floors are poured-in-place concrete slabs.

The east half grade floor at elevation 14 feet 6 inches, including the concrete shielding plugs which close hatchways over equipment in the substructure, is designed for a uniform live load of 200 psf.

All tanks are made of ductile metal and all sump pits are lined so that these containers can be subjected to substantial distortion without rupture.

The substructure is massive reinforced concrete, not subject to fracturing. Even in the event fracturing occurred, seepage would be into the building rather than out, since the water table is above basement level.

3.1.7.4.3 Ventilation Stack

Description

The unlined, free-standing, tapered, reinforced concrete stack has the following dimensions:

Overall height above foundation	385'6"
Height above adjacent grade	375'
Inside diameter at top	7'
Outside Diameter at base	27'6"
Thickness at top	7"

The stack configuration is shown on Figure 3.1-7. The ventilation stack was originally designed as seismic Class I.

Maximum stack stresses occur in the first 208 feet above grade, due to load combinations which include maximum wind.

The stack is designed for a maximum exhaust air temperature of 150°F and a minimum ambient temperature of 0°F. Design and construction of the stack is in accordance with applicable requirements of ACI "Standard Specifications for the Design and Construction of Reinforced Concrete Chimneys" (ACI-505) as follows:

Wind Pressures

For normal design conditions, it was designed at specific ACI allowable unit stresses. Wind pressures on projected areas for various height zones above ground conformed to the following requirements for a basic wind pressure area of 30 psf:

Height Pressure	Design Wind Pressure
0-49 ft	32 psf
50-99 ft	39 psf
100-199 ft	45 psf
200-299 ft	48 psf
300-375 ft	51 psf

Tabulated wind pressures include the reduction for the circular shape of stack. The tabular value for pressure of ACI-505 was increased for a gust velocity of 140 mph in accordance with Paragraph 400 of ACI-505.

The stack has a 2.94 factor of safety with regard to overturning or rocking. The maximum overturning moment due to wind on the stack in 52,500 kip feet and the stability moment for the stack is 154,000 kip feet.

Earthquake Loading

In developing a mathematical model, for dynamic analysis, the stack was treated as a flexible cantilever system with the base fixed at the top of the foundation. (The stack base is neither rigid nor can it rotate, but is considered rigid as this assumption results in a shorter period for the stack. This analytical representation gives higher, more conservative response acceleration.) Forty mass points were considered to be supported by weightless elastic columns. The model is depicted by Figure 3.1-8. Subsequent to the formation of mass and stiffness matrices for the cantilever system, the periods and mode shapes were calculated, displacement and inertia force time histories were established and a time history of shears, moments, displacements and accelerations determined.

The top of the stack is at elevation 389 feet or 238 feet above the top of the Reactor Building. The stack is located 416 feet east of the Reactor Building east wall. Thus, the top of the stack could not strike the operating floor of the Reactor Building, even if toppled intact about its base, because the stack height is 385 feet from the base. The ventilation exhaust is brought through breeching which gathers the various exhaust ducts together. The stack is provided with a one-foot by four-foot access opening at the base, three galvanized steel balconies, an outside ladder for the full stack height, aviation obstruction lighting, lightning protection and facilities for the handling of the isokinetic sampler.

3.1.7.4.4 Intake Structure

The intake structure is a reinforced concrete frame supported on a reinforced concrete substructure which is founded on rock. The building has a flat roof consisting of 10 gauge steel with concrete slab covered with insulation and a tar and felt roofing membrane. Hatches are provided in the roof for removal of major pieces of equipment. The front wall of the intake structure is designed to resist the standing wave. Seismic stress levels were calculated using coefficients of 0.07 g at grade and 0.12 g at the roof level for design earthquake and 2.4 times these values for the maximum earthquake. The structure is capable of withstanding 300 mph wind but not the tornado internal pressure of 2.5 psi. However, the large number of hatches in the roof will release this pressure. Although originally design as seismic Class I, the intake is considered seismic Class II in the permanently defueled condition.

The intake structure is located west of the main plant and has five 11-foot 2-inch wide bays. Each bay is provided with manually raked trash racks, stop log guides and traveling screens.

Provision for service and cooling water strainers is made in a separate covered pit adjacent to the intake.

3.1.7.4.5 Turbine Building

The Turbine Building is a Class II structure. The Turbine Building foundation consists of a reinforced concrete mat supported on rolled structural steel H section bearing piles. All piles were driven to rock or to refusal in the dense strata immediately above rock. Reinforced concrete shield walls are provided up to the operating deck at elevation 54 ft 6 in. Portions of the building outside of the shield walls have reinforced concrete flood walls up to elevation 19.0. Door and access apertures in this flood wall are provided with flood gates.

The remaining portions of the building have steel framing and metal siding. The Turbine Building ground floor consists of a reinforced concrete slab supported on sand fill over the foundation mats. The turbine generator pedestal is a massive reinforced concrete pedestal designed to support the turbine generator. It is supported on a six-foot thick mat which forms an integral part of the remaining building mat foundations. The roof is covered with metal decking, insulation and roofing material flashed at the parapet walls. An overhead rolling door at the west end of the building provides rail car access into the building.

3.1.8 Seismic Qualification of Seismic Category I Instrumentation and Electrical Equipment

None of the plant process instrumentation provides safety related functions in conjunction with the storage and handling of irradiated fuel or radioactive waste, or is credited with any function in the safety evaluations performed to ensure that no undue risk to the health and safety of the public exists. No plant instrumentation or electrical systems are required for mitigation of the design basis fuel handling accident. Seismic qualification of plant instrumentation and electrical equipment is not required.

3.1.9 Environmental Design of Electrical Equipment

This section is related to qualification of the electrical portion of the engineered safety features to perform their intended functions in the combined normal, accident and post accident environments. There are no non-structural engineered safety features related to the safe storage and handling of the irradiated fuel or radioactive waste, or credited in the safety evaluations performed to ensure that no undue risk to the health and safety of the public exists. No non-structural engineered safety features are credited in accident analysis to prevent or mitigate the consequences of the current design basis fuel handling accident.

3.1.10 References

3.1-1 Millstone Nuclear Power Station Unit No. 1 Application for Full Term Operating License, September 1, 1972.

3.1-2 NUREG-0824, Integrated Plant Safety Assessment, Systematic Evaluation Program, Millstone Nuclear Power Station, Unit No. 1, February 1983.

3.1-3 Samual J. Chilk (Nuclear Regulatory Commission) memo to J. M. Taylor (Nuclear Regulator Commission), "SECY-92-233 Resolution of Deviations Identified during the Systematic Evaluation Program" dated September 18, 1992.

3.1-4 Integrated Plant Safety Assessment, Systematic Evaluation Program, Millstone Nuclear Power Station, Unit No. 1, NNECO, NUREG-0834, Supplement No. 1, November 1985.

3.1-5 Letter, C.I. Grimes (NRC) to J.F. Opeka (NNECO), subject: IPSAR Sections 4.4 Wind and Tornado Loadings and 4.7 Tornado Missiles.

3.1-6 Letter, February 2, 1984, from W.G. Counsil (NNECO) to D. M. Crutchfield (NRC), Subject: Millstone Nuclear Power Station Unit No. 1, SEP Topics II-3.B Flooding Potential and Protection Requirements, III-2 Wind and Tornado Loadings, III-3.A Effects of High Water Level on Structures, III-7.B Design Codes, Design Criteria and Load Combinations.

3.1-7 Letter, March 16, 1984, from W. G. Counsil (NNECO) to D. M. Crutchfield (NRC), Subject: Millstone Nuclear Power Station Unit No. 1, SEP Topics II-3.B Flooding Potential and protection Requirements, II-4.F Settlement of Foundations and Buried Equipment, III-2 Wind and Tornado Loadings, III-3.A Effects of High Water Level on Structures, III-6 Seismic Design Considerations.

3.1-8 Letter, October 7, 1983, from W. G. Counsil (NNECO) to D. M. Crutchfield (NRC), Subject: Millstone Nuclear Power Station Unit No. 1, SEP Topic III-2 Wind and Tornado Loadings.

3.1-9 Letter, December 3, 1982, from W. G. Counsil (NNECO) to D. M. Crutchfield (NRC), Subject: Millstone Nuclear Power Station Unit No. 1, SEP Topic III-2 Wind and Tornado Loadings.

3.1-10 Letter, February 4, 1986, from J. F. Opeka (NNECO) to C.I. Grimes (NRC), Subject: Millstone Nuclear Power Station Unit No. 1 ISAP Topic 1.19, Integrated Structural Analysis.

3.1-11 Letter, W. G. Counsil (NUSCO) to D. M. Crutchfield (NRC), dated March 16, 1984, Millstone Nuclear Power Station, Unit No. 1, SEP Topic II-3.B, Flooding Potential and protection Requirements, SEP Topic II-4.F, Settlement of Foundations and Buried Equipment, SEP Topic III-2, Wind and Tornado Loadings, SEP Topic III-3.A, Effects of High Water Level on Structures SEP Topic III-6, Seismic Design Considerations.

3.1-12 10CFR50, Appendix A, General Design Criterion 4.

3.1-13 Letter of June 29, 1982, W.G. Counsil to D. M. Crutchfield, :Millstone Nuclear Power Station Unit No. 1, SEP Topic III-4.A, Tornado Missiles."

3.1-14 Letter of March 9, 1982, W.G. Counsil to D. M. Crutchfield, :Millstone Nuclear Power Station Unit No. 1, SEP Topic III-4.A, Tornado Missiles."

3.1-15 Letter of November 19, 1981, W.G. Counsil to D. M. Crutchfield, :Millstone Nuclear Power Station Unit No. 1, SEP Topic III-4.A, Tornado Missiles."

3.1-16 Letter of August 31, 1981, W.G. Counsil to D. M. Crutchfield, :Millstone Nuclear Power Station Unit No. 1, SEP Topic III-4.A, Tornado Missiles."

3.1-17 Letter of October 16, 1985, J. F. Opeka to C. I. Grimes, Millstone Nuclear Power Station Unit No. 1, "Integrated Safety Assessment Program."

3.1-18 Letter of November 25, 1985, C. I. Grimes to J. F. Opeka, Integrated Plant Safety Assessment Report, Section 4.4, Wind and Tornado Loadings, Section 4.7, Tornado Missiles - Millstone Unit No. 1.

3.1-19 Letter of April 29, 1981, W. G. Counsil to D. M. Crutchfield, "Millstone Nuclear Power Station Unit No. 1, SEP Topic III-4.D, Site Proximity Missiles".

3.1.20 Letter of September 17, 1981, W. G. Counsil to D. M. Crutchfield, "Millstone Nuclear Power Station Unit No. 1, SEP Topic III-4.D, Site Proximity Missiles".

3.1-21 NRC NUREG/CR-2024 Report, "Seismic Review of the Millstone-1 Nuclear Power Plant," July 1981.

3.1-22 SEP Safety Topics III-6, Seismic Design Considerations and III-II, Component Integrity - Millstone Nuclear Power Station Unit No. 1, SAR dated 6/30/82.

3.1-23 EDS Report No. 02-0240-1094, "Generation of In-Structure Seismic Response Spectra Millstone Unit No. 1," dated June 1982.

3.1-24 NRC letter, "Site Specific Ground Response Spectra for SEP Plants Located in the Eastern United States," June 17, 1981.

3.1-25 NRC NUREG/CR-1582 Report, "Seismic Hazard Analysis," Vols. 2-4, October 1981.

3.1-26 Letter J. F. Opeka to C.I. Grimes, "Millstone Nuclear Station, Unit No. 1 ISAP Topic 1-19, Integrated Structural Analysis," dated January 6,1986.

3.1-27 Letter from D. G. Eisenhut, NRC, to W. G. Counsil, NEUCo, dated January 1, 1980.

3.1-28 Letter from D. M. Crutchfield, NRC, to W. G. Counsil, NEUCo, dated July 28, 1980.

3.1-29 Letter from W. G. Counsil, NNECo, to D. M. Crutchfield, NRC, dated October 16, 1985.

3.1-30 Millstone Unit 2 Final Safety Analysis Report Section 5.8.6.

3.1-31 Millstone Unit 3 Final Safety Analysis Report Section 3.7.4.2.

TABLE 3.1-1

COMPARISON WITH NRC GENERAL DESIGN CRITERIA

GENERAL DESIGN CRITERIA	SEP AND TMI SAFETY ISSUES WHICH LISTED THE SPECIFIED GDC AS PART OF CONCERN	AFFECTED REGULATORY GUIDE
I OVERALL REQUIREMENTS		
1 QUALITY STANDARDS AND RECORDS	SEP II-3.A, II-3.B, II-3.C, III-3.A AND III-7.B	1.27, 1.59
2 DESIGN BASES FOR PROTECTION AGAINST NATURAL PHENOMENA	SEP II-2.A, II-3.A, II-3.B, II-3.C, II-4.E, II-4.F, II-4.3, III-19 III-2, III-3.A, III-3.B, III-3.C, III-6, III-7.B, III-8.C, III-11, VIII-3.A, VIII-3.B, TMI II.B.1	1,27, 1.,32, 1.59, 1.60, 1.61, 1.68, 1.75, 1.76, 1.92, 1.102, 1.117, 1.120, 122, 1.127, 1.129, 1.132
3 FIRE PROTECTION	(SEE DSAR Section 3.2.9)	
4 ENVIRONMENTAL AND MISSILE DESIGN BASES	SEP II-1.C, II-3.A, II-3.B, II-3.C, III-1, III-4.B, III-5.A, III-5.B, III-7,B, III-11, V-5, VIII-3.A, VIII-3.B, TMI II.B.2, II.B.3, 2.1.6.A, 2.1.8.A, III-4,A	1.3, 1.4, 1.7, 1.20, 1.27, 1.29, 1.32, 1.35, 1.45, 1.46, 1,59, 1.68, 1.75, 1.115, 1.12,
5 SHARING OF STRUCTURES, SYSTEMS AND COMPONENTS	SEP III-1, VIII-3.A AND VIII-3.B	1.32, 1.75, 1.129

TABLE 3.1-1

COMPARISON WITH NRC GENERAL DESIGN CRITERIA

GENERAL DESIGN CRITERIA	SEP AND TMI SAFETY ISSUES WHICH LISTED THE SPECIFIED GDC AS PART OF CONCERN	AFFECTED REGULATORY GUIDE
II PROTECTION BY MULTIPLE FISSION PRODUCT BARRIERS		
10 REACTOR DESIGN	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
11 REACTOR IHERENT PROTECTION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
12 SUPPRESSION OF REACTOR POWER OSCILLATIONS	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
13 INSTRUMENTATION AND CONTROL	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
14 REACTOR COOLANT PRESSURE BOUNDRY	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION

TABLE 3.1-1

COMPARISON WITH NRC GENERAL DESIGN CRITERIA

GENERAL DESIGN CRITERIA	SEP AND TMI SAFETY ISSUES WHICH LISTED THE SPECIFIED GDC AS PART OF CONCERN	AFFECTED REGULATORY GUIDE
15 REACTOR COOLANT SYSTEM DESIGN	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
16 CONTAINMENT DESIGN	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
17 ELECTRIC POWER SYSTEMS	SEP III-1, VII-7, VIII-2, VIII-3.A VIII-3.B, TMI II.E.3.1, II.G.1	1.6, 1.9, 1.32, 1.75, 1.129
18 INSPECTION AND TESTING OF ELECTRIC POWER SYSTEMS	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
19 CONTROL ROOM	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION

TABLE 3.1-1

COMPARISON WITH NRC GENERAL DESIGN CRITERIA

GENERAL DESIGN CRITERIA	SEP AND TMI SAFETY ISSUES WHICH LISTED THE SPECIFIED GDC AS PART OF CONCERN	AFFECTED REGULATORY GUIDE
III PROTECTION AND REACTIVITY CONTROL SYSTEMS		
20 PROTECTION SYSTEM FUNCTIONS	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
21 PROTECTION SYSTEM RELIABILITY AND TESTABILITY	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
22 PROTECTION SYSTEM INDEPENDENCE	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
23 PROTECTION SYSTEM FAILURE MODES	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
24 SEPARATION OF PROTECTION AND CONTROL SYSTEMS	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION

TABLE 3.1-1

COMPARISON WITH NRC GENERAL DESIGN CRITERIA

GENERAL DESIGN CRITERIA	SEP AND TMI SAFETY ISSUES WHICH LISTED THE SPECIFIED GDC AS PART OF CONCERN	AFFECTED REGULATORY GUIDE
25 PROTECTION SYSTEM REQUIREMENTS FOR REACTIVITY CONTROL MALFUNCTIONS	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
26 REACTIVITY CONTROL SYSTEM REDUNDANCY AND CAPABILITY	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
27 COMBINED REACTIVITY CONTROL SYSTEMS CAPABILITY	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
28 REACTIVITY LIMITS	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
29 PROTECTION AGAINST ANTICIPATED OPERATIONAL OCCURRENCES	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION

TABLE 3.1-1

COMPARISON WITH NRC GENERAL DESIGN CRITERIA

GENERAL DESIGN CRITERIA	SEP AND TMI SAFETY ISSUES WHICH LISTED THE SPECIFIED GDC AS PART OF CONCERN	AFFECTED REGULATORY GUIDE
IV FLUID SYSTEMS		
30 QUALITY OF REACTOR COOLANT PRESSURE BOUNDARY	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
31 FRACTURE PREVENTION OF REACTOR COOLANT PRESSURE BOUNDARY	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
32 INSPECTION OF REACTOR COOLANT PRESSURE BOUNDARY	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
33 REACTOR COOLANT MAKEUP	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
34 RESIDUAL HEAT REMOVAL	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION

TABLE 3.1-1

COMPARISON WITH NRC GENERAL DESIGN CRITERIA

GENERAL DESIGN CRITERIA	SEP AND TMI SAFETY ISSUES WHICH LISTED THE SPECIFIED GDC AS PART OF CONCERN	AFFECTED REGULATORY GUIDE
35 EMERGENCY CORE COOLING	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
36 INSPECTION OF EMERGENCY CORE COOLING SYSTEM	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
37 TESTING OF EMERGENCY CORE COOLING SYSTEM	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
38 CONTAINMENT HEAT REMOVAL	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
39 INSPECTION OF CONTAINMENT HEAT REMOVAL SYSTEM	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION

TABLE 3.1-1

COMPARISON WITH NRC GENERAL DESIGN CRITERIA

GENERAL DESIGN CRITERIA	SEP AND TMI SAFETY ISSUES WHICH LISTED THE SPECIFIED GDC AS PART OF CONCERN	AFFECTED REGULATORY GUIDE
40 TESTING OF CONTAINMENT HEAT REMOVAL SYSTEM	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
41 CONTAINMENT ATMOSPHERE CLEANUP	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
42 INSPECTION OF CONTAINMENT ATMOSPHERE CLEANUP SYSTEMS	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
43 TESTING OF CONTAINMENT ATMOSPHERE CLEANUP SYSTEMS	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
44 COOLING WATER	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION

TABLE 3.1-1

COMPARISON WITH NRC GENERAL DESIGN CRITERIA

GENERAL DESIGN CRITERIA	SEP AND TMI SAFETY ISSUES WHICH LISTED THE SPECIFIED GDC AS PART OF CONCERN	AFFECTED REGULATORY GUIDE
45 INSPECTION OF COOLING WATER SYSTEM	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
46 TESTING OF COOLING WATER SYSTEM	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
V REACTOR CONTAINMENT		
50 CONTAINMENT DESIGN BASIS	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
51 FRACTURE PREVENTION OF CONTAINMENT PRESSURE BOUNDARY	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
52 CAPABILITY FOR CONTAINMENT LEAKAGE RATE TESTING	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION

TABLE 3.1-1

COMPARISON WITH NRC GENERAL DESIGN CRITERIA

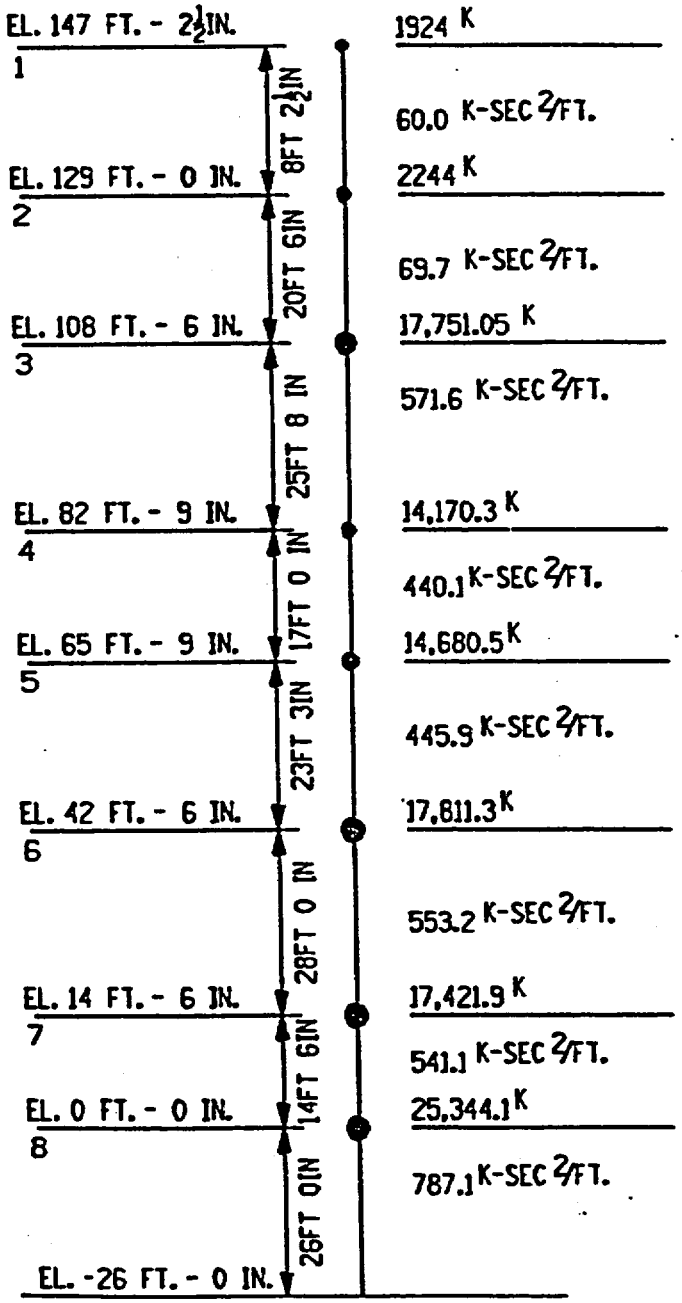
GENERAL DESIGN CRITERIA	SEP AND TMI SAFETY ISSUES WHICH LISTED THE SPECIFIED GDC AS PART OF CONCERN	AFFECTED REGULATORY GUIDE
53 PROVISIONS FOR CONTAINMENT INSPECTION AND TESTING	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
54 SYSTEMS PENETRATING CONTAINMENT	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
55 REACTOR COOLANT PRESSURE BOUNDARY PENETRATING CONTAINMENT	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
56 PRIMARY CONTAINMENT ISOLATION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION
57 CLOSED SYSTEMS ISOLATION VALVES	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION	NOT APPLICABLE TO THE PERMANENTLY DEFUELED CONDITION

TABLE 3.1-1

COMPARISON WITH NRC GENERAL DESIGN CRITERIA

GENERAL DESIGN CRITERIA	SEP AND TMI SAFETY ISSUES WHICH LISTED THE SPECIFIED GDC AS PART OF CONCERN	AFFECTED REGULATORY GUIDE
VI FUEL AND RADIOACTIVITY CONTROL		
60 CONTROL OF RELEASES OF RADIOACTIVE MATERIALS TO THE ENVIRONMENT	SEP II.2.C, XI-1, XI-2, TMI II.B.2, II.B.3, 2.1.6.A, 2.1.8.A	1.3, 1.4
61 FUEL STORAGE AND HANDLING AND RADIOACTIVITY CONTROL	SEP XI-1, XI-2	
62 PREVENTION OF CRITICALITY IN FUEL STORAGE AND HANDLING		
63 MONITORING FUEL AND WASTE STORAGE	SEP XI-1, XI-2	
64 MONITORING RADIOACTIVITY RELEASES	SEP II-2.C, XI-1, XI-2; TMI II.B.2, II.B.3, 2.1.6.A, 2.1.8.A	

BUILDING WEIGHT AND SECTION PROPERTIES



	I_C (FT.^{4})	A_C (FT.^{2})	A (FT.^{2})*
1924 K			
60.0 K-SEC^2/FT.	1,464,266	527.0	271.0
2244 K			
69.7 K-SEC^2/FT.	1,464,266	527.0	271.0
17,751.05 K			
571.6 K-SEC^2/FT.	2,281,875	2842.0	1421.0
14,170.3 K			
440.1 K-SEC^2/FT.	2,856,030	3205.0	1603.1
14,680.5 K			
445.9 K-SEC^2/FT.	2,355,605	2364.0	1182.0
17,811.3 K			
553.2 K-SEC^2/FT.	5,138,000	2925.0	1463.0
17,421.9 K			
541.1 K-SEC^2/FT.	8,063,880	3543	1772
25,344.1 K			
787.1 K-SEC^2/FT.	8,758,388	6275	3138

* EFFECTIVE SHEAR AREA

FIGURE 3.1-1 Reactor Building Seismic Loads

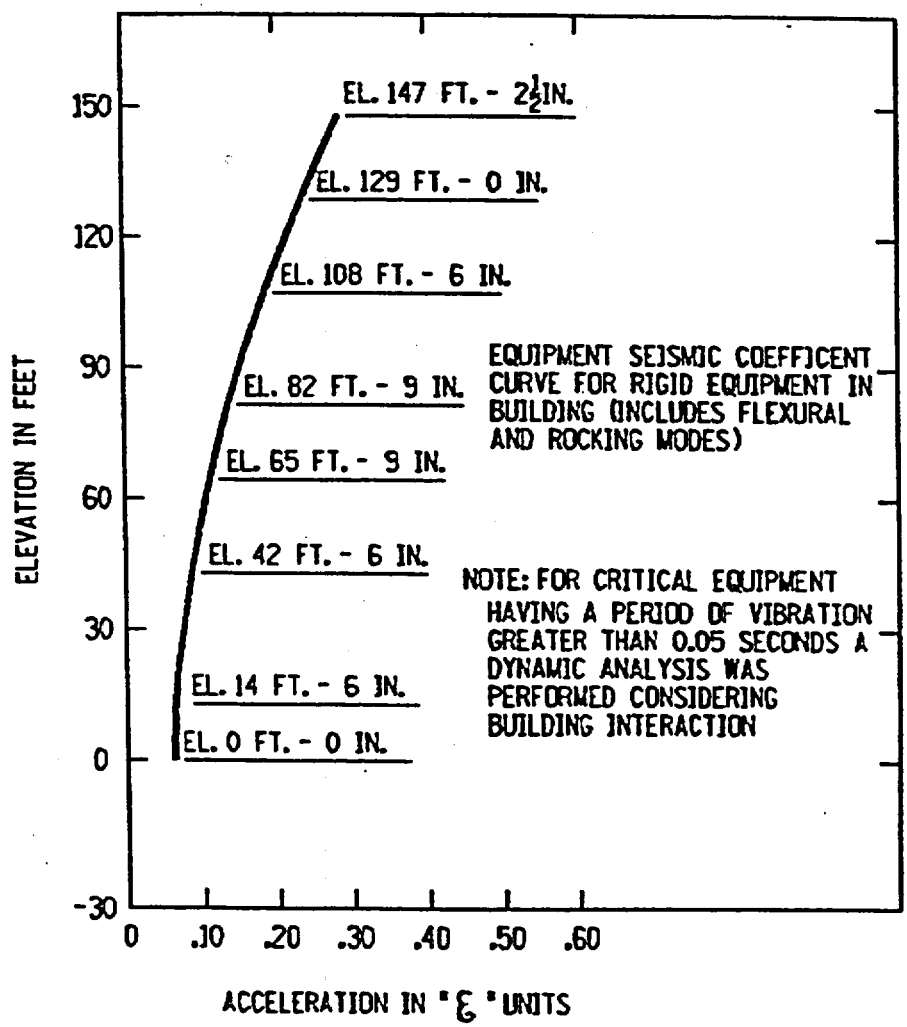


FIGURE 3.1-2 Acceleration Diagram Under Seismic Loads 5 Percent Damping

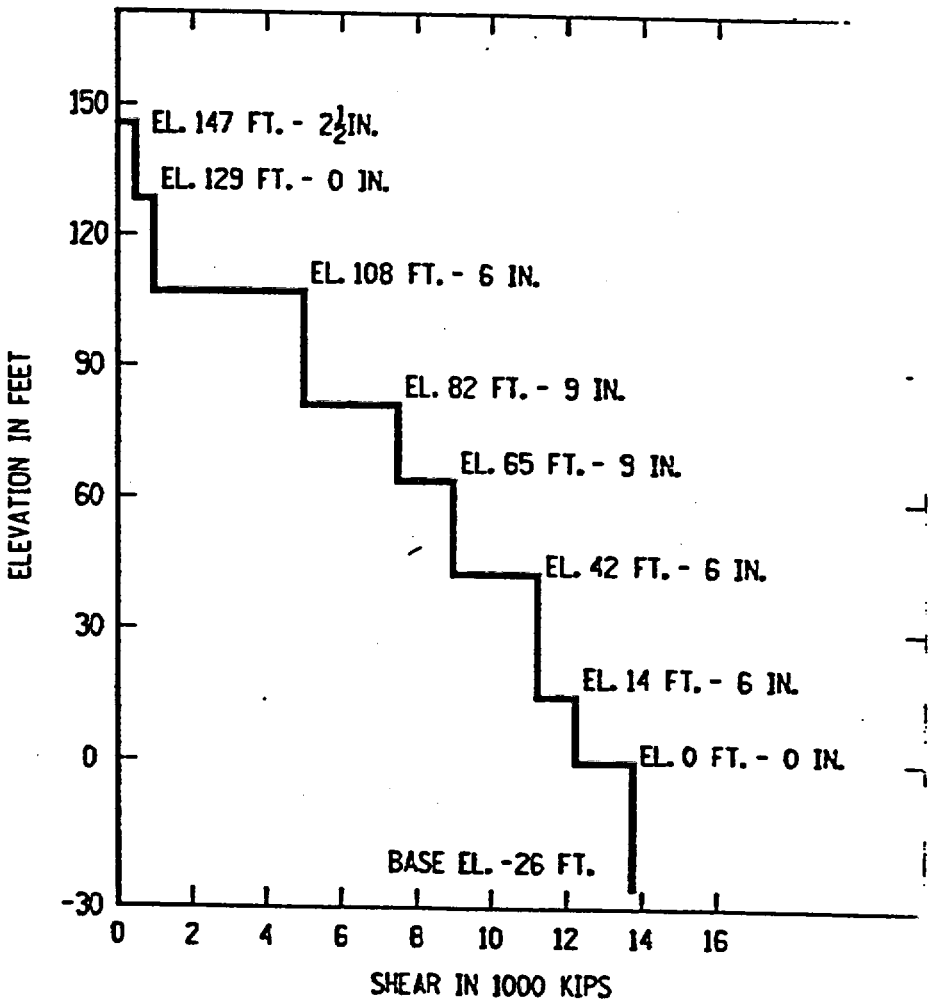


FIGURE 3.1-3 Shear Diagram Under Seismic Loads

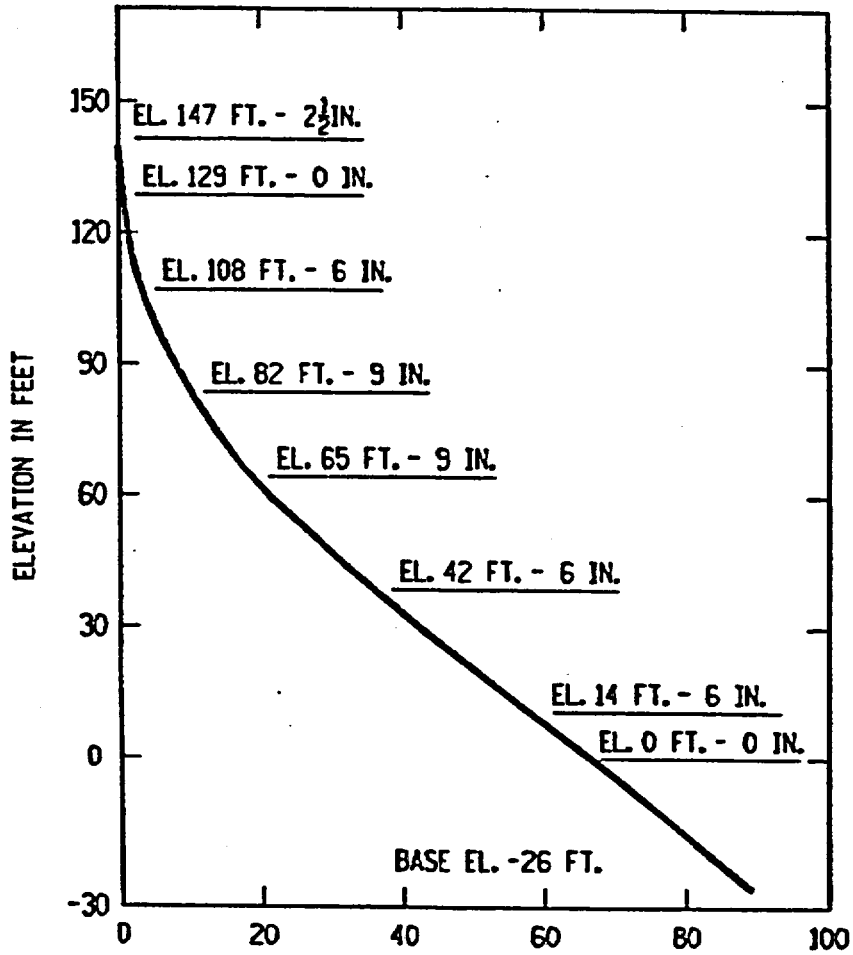


FIGURE 3.1-4 Moment Diagram Under Seismic Loads

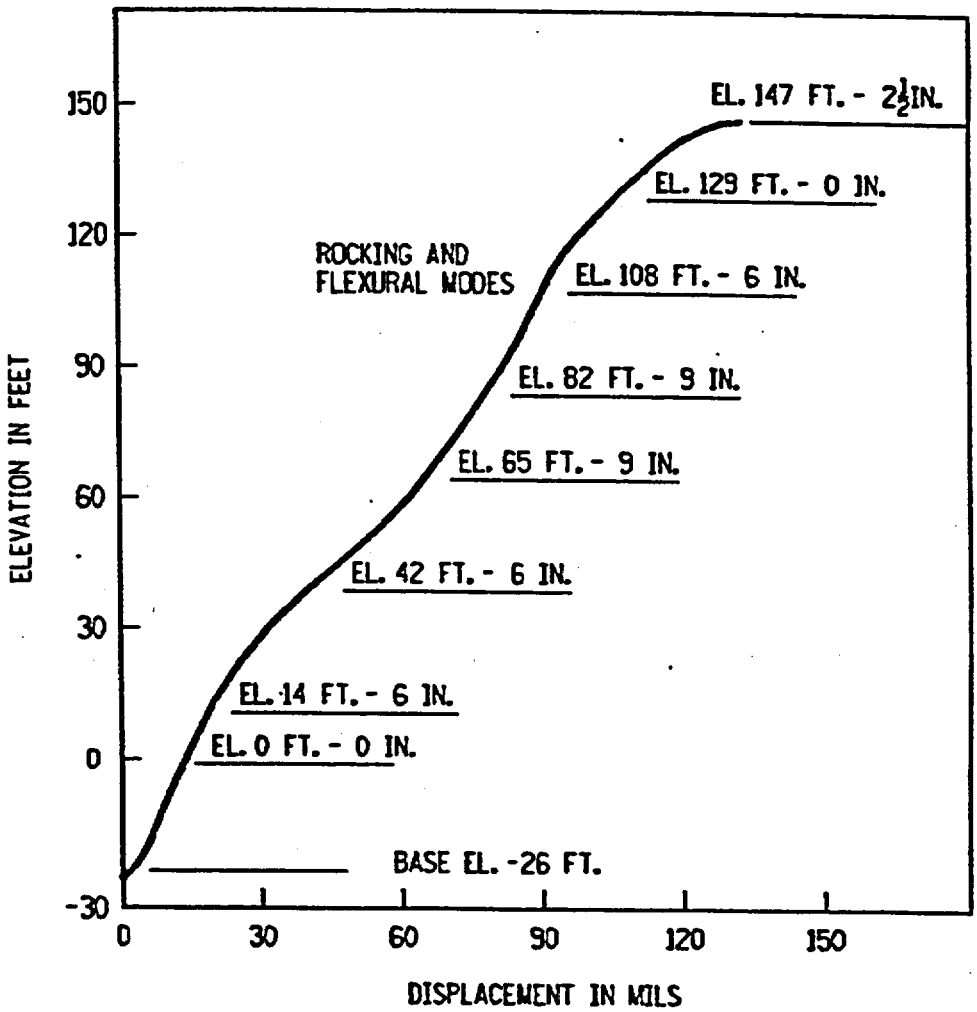


FIGURE 3.1-5 Displacement Diagram Under Seismic Loads

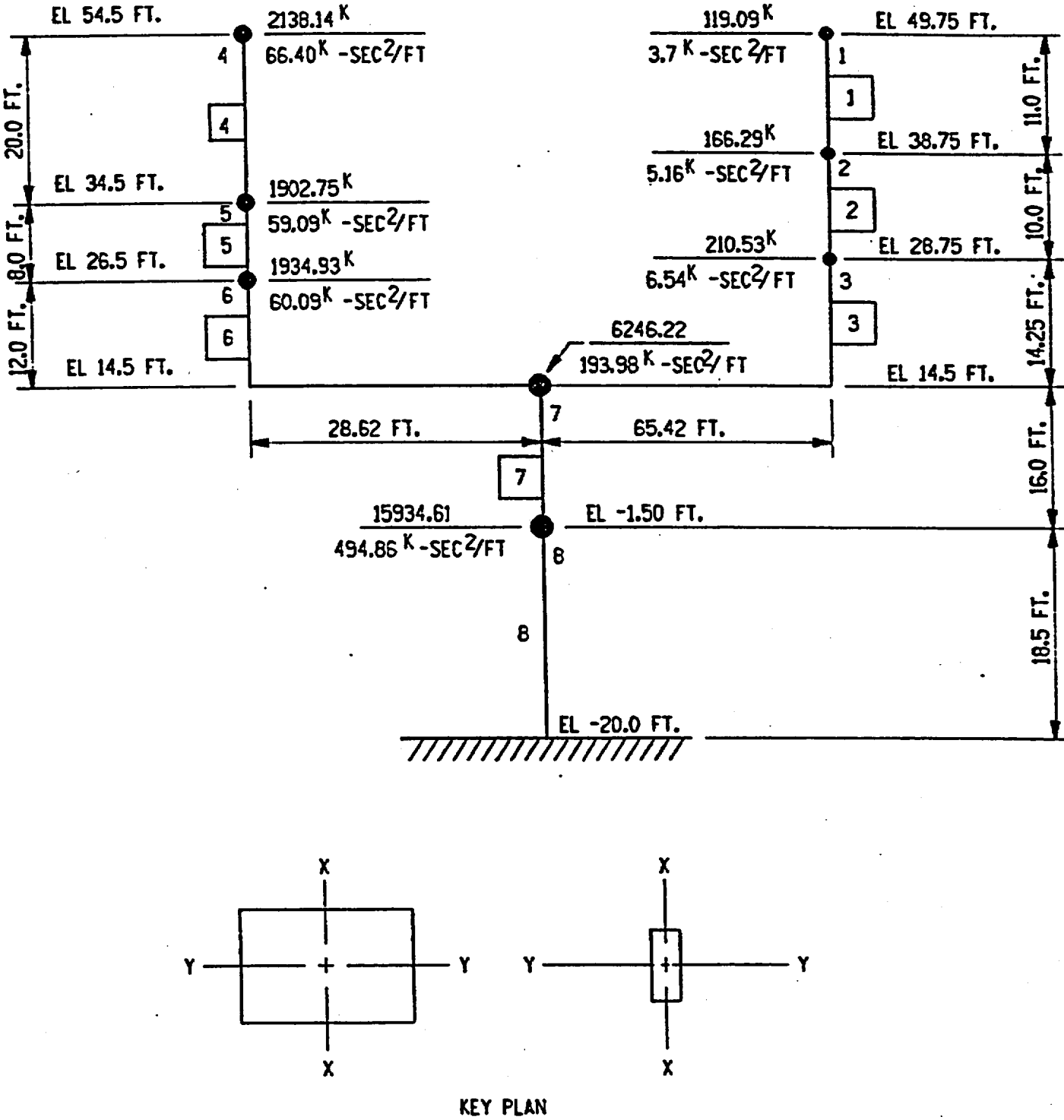


FIGURE 3.1-6 Radwaste Building - Mathematical Model

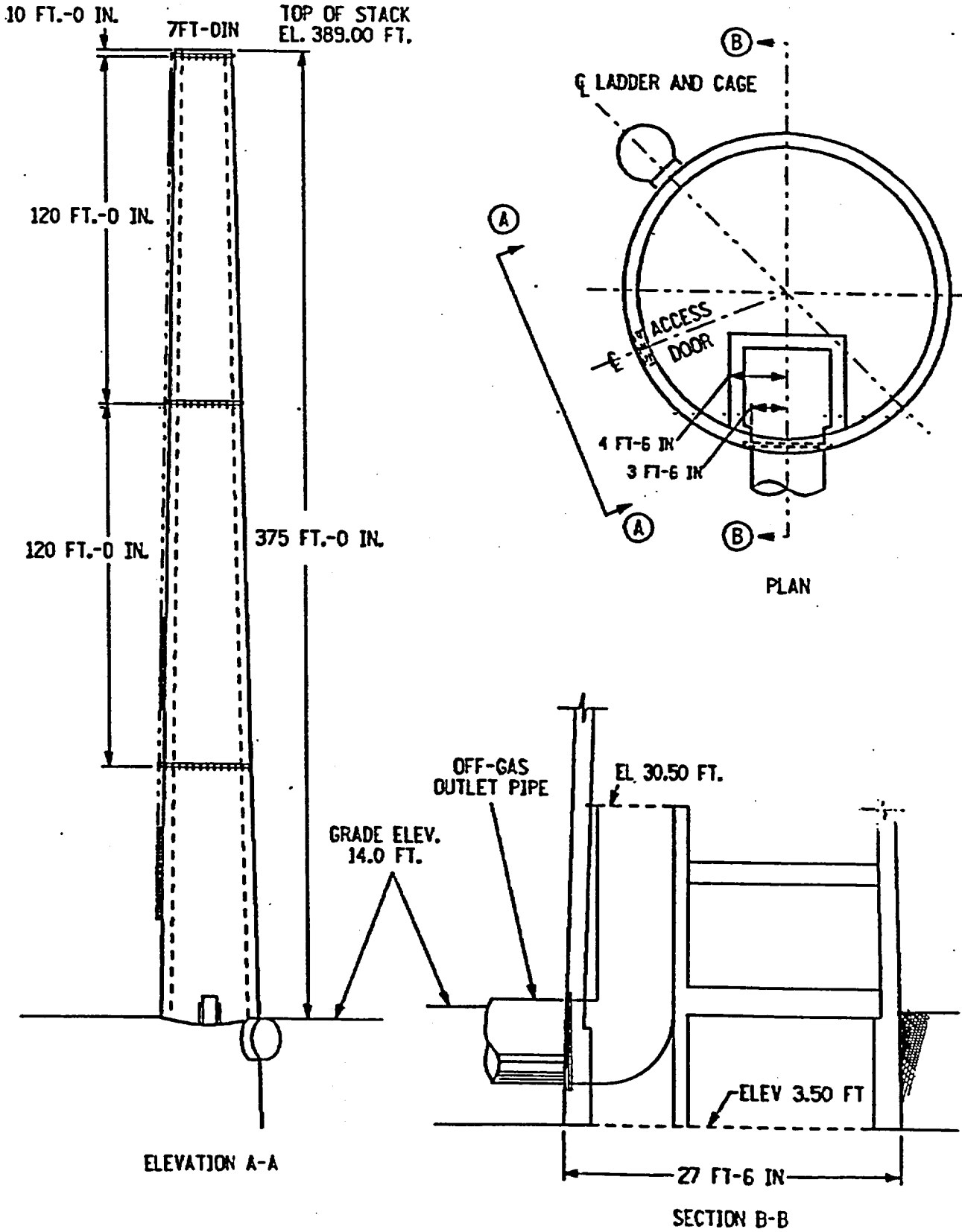
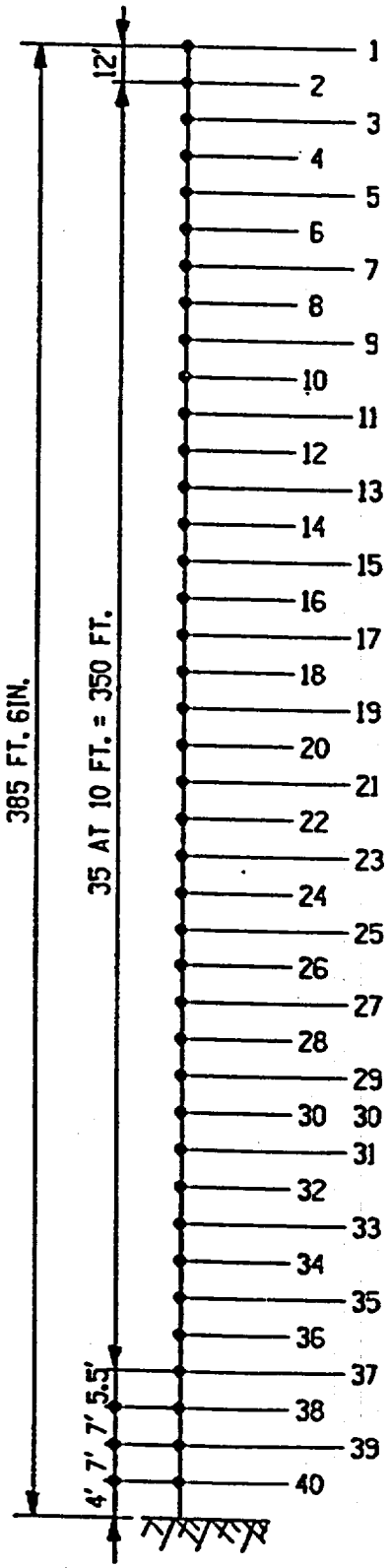


FIGURE 3.1-7 Ventilation Stack Elevations and Sections



MASS	WEIGHT(K)
1	14.68
2	28.07
3	26.82
4	28.08
5	29.32
6	30.57
7	31.83
8	33.07
9	34.27
10	35.58
11	36.82
12	38.70
13	41.28
14	43.29
15	46.64
16	49.47
17	52.38
18	55.35
19	58.41
20	61.56
21	64.79
22	68.08
23	71.48
24	74.96
25	78.35
26	82.12
27	85.83
28	89.61
29	93.49
30	97.46
31	101.49
32	107.76
33	116.33
34	125.12
35	133.90
36	147.70
37	169.96
38	179.35
39	335.20
40	185.09

MEMBER	A (FT^2)	I (FT^4)
1-2	16.56	129
2-3	17.47	152
3-4	18.31	175
4-5	19.14	200
5-2	19.97	227
6-6	20.80	257
7-7	21.64	289
8-8	22.47	324
9-10	23.30	361
10-11	24.14	401
11-12	24.97	444
12-13	26.65	508
13-14	28.39	578
14-15	30.17	656
15-16	32.03	741
16-17	33.94	834
17-18	35.90	935
18-19	37.91	1046
19-20	39.98	1166
20-21	42.10	1296
21-22	44.28	1437
22-23	46.51	1589
23-24	48.79	1752
24-25	51.53	1928
25-26	53.52	2117
26-27	55.98	2319
27-28	58.46	2532
28-29	61.02	2762
29-30	63.63	3009
30-31	66.30	3272
31-32	69.03	3552
32-33	74.66	4017
33-34	80.43	4518
34-35	86.38	5060
35-36	92.15	5648
36-37	104.43	6711
37-38	152.52	10602
38-39	177.86	13350
39-40	195.16	12114
40-BASE	213.82	16423

FIGURE 3.1-8 Ventilation Stack - Mathematical Model