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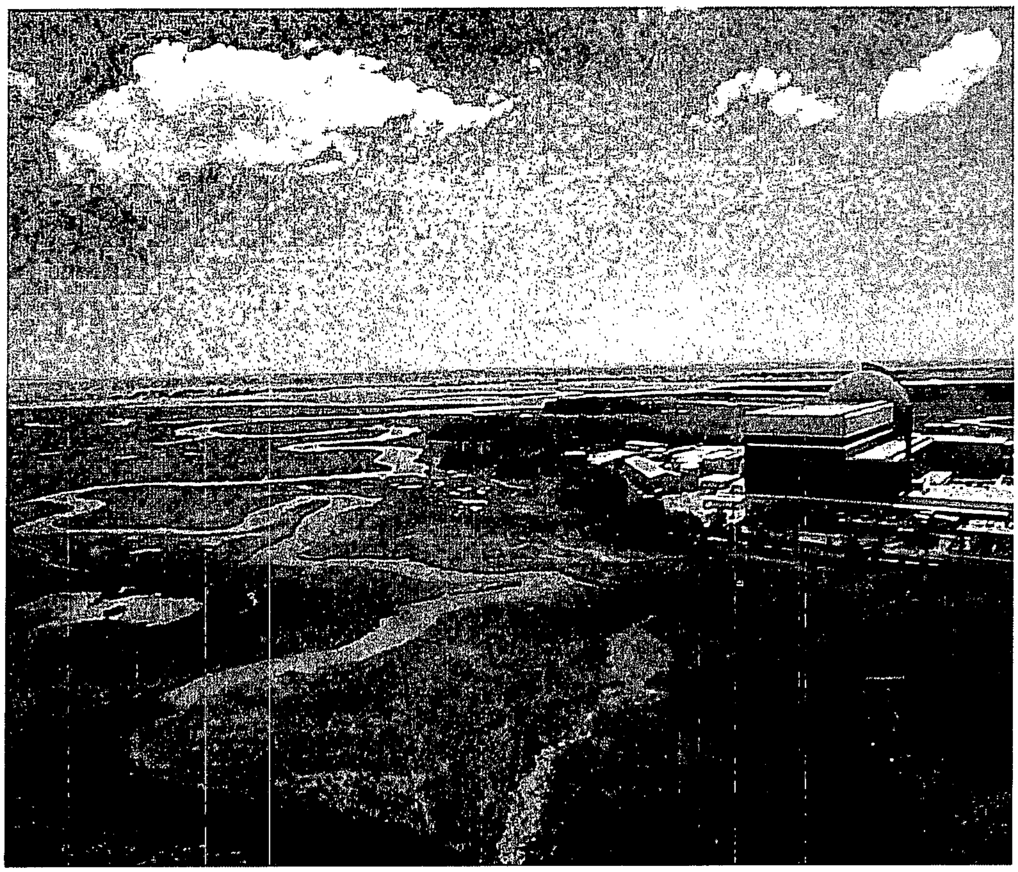

Attachment 2

Vol. 1

SEABROOK STATION

DESIGN BASIS DOCUMENT

METEOROLOGICAL MONITORING SYSTEM

DBD-MET-01

Revision 2

Effective Date:
~~12/31/09~~ URB 1-8-10
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Preparer:	Originator	11/1/09 Date
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1.0 INTRODUCTION

1.1 Purpose

This Design Basis Document (DBD) provides the design bases and descriptive information for the Seabrook Station Meteorological Monitoring System (Met System).

This DBD describes the Met System general and specific functional requirements as well as the design basis for major Met System components. It also lists source references and rationale used to identify these design bases. In addition, the DBD lists or references applicable Codes and Standards, Regulatory Criteria, Key System Calculations, and Technical Specifications pertaining to the Met System.

The DBD is intended to be used as an aide in making decisions on plant modifications, provide background for securing future Technical Specification relief, and to provide background for making 10CFR50.59 evaluations.

1.2 Scope

The scope of this document is limited to those components within the Met and Miscellaneous Instrument (MM) Systems that monitor, process and display meteorological information for use during normal plant operations and emergencies. The Met System consists of the instrumentation shown on loop drawing 1-NHY-506456 and the required support systems and components.

1.3 System Functional Boundaries

1.3.1 Electrical Boundaries

The Primary Met System, including the instrument shelter, receives power from 480 Volt lighting panel EL 32 in the Guardhouse.

The Backup Met System receives power from lighting panel L36 located in Settling Basin Control Panel, Node G22. The Shift Superintendent's Workstation Computer (SSW Computer) is powered from 120 Vac panel ED-PP-5.

1.3.2 Instrumentation Boundaries

The instrumentation boundary is the connection to the Main Plant Computer System's (MPCS) Intelligent Remote Termination Units (IRTU). The Met System specific algorithms are included but the MPCS software is not.

1.3.3 Mechanical Boundaries

The Met System includes: the primary tower and associated foundations, guys, and anchors; the primary tower instrument shelter and ventilating equipment, the backup tower and its attachment to the settling basin outlet structure; and the settling basin outlet instrument shelter, its attachment to the settling basin outlet structure, and its heating and ventilating equipment.

2.0 CODES AND STANDARDS

2.1 NRC Regulations

a. 10 CFR 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors."

b. 10 CFR 50.47b, "Emergency Plans."

c. 10 CFR Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities."

d. 10 CFR Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion `As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."

2.2 FAA Regulations

a. 14 CFR 77.13, "Construction or Alteration Requiring Notice."

b. 14 CFR 77.19, "Acknowledgement of Notice."

2.3 NRC Regulatory Guides

a. 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," Revision 1, June 1974.

b. 1.23, "Onsite Meteorological Programs" (Safety Guide 23), February 17, 1972.

c. 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants," Revision 3, November 1978.

   1. Section 2.3.3, "Onsite Meteorological Measurements Program."

d. 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident" Revision 3, May 1983.

e. 1.101, "Emergency Planning and Preparedness for Nuclear Power Reactors," Revision 2, October 1981.

f. 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977.

g. 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977.

h. 1.118, "Periodic Testing of Electric Power and Protection Systems," Revision 2, June 1978.

i. 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1, November 1982.

j. Draft SS 926-4, "Meteorological Programs in Support of Nuclear Power Plants," Proposed Revision 1 to Regulatory Guide 1.23, September 1980.

k. Draft ES 926-4, "Meteorological Measurement Program for Nuclear Power Plants," Second Proposed Revision 1 to Regulatory Guide 1.23, April 1986.

2.4 FAA Advisory Circulars

a. 70/7460-1G, "Obstruction Marking and Lighting," October 1985.

2.5 Applicable NUREGs

a. NUREG-0654, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," Revision 1, February 1981.

b. NUREG-0696, "Functional Criteria for Emergency Response Facilities," February 1981.

c. NUREG-0737, "Clarification of TMI Action Plan Requirements," November 1980.

d. Supplement 1 to NUREG-0737, "Clarification of TMI Action Plan Requirements," December 17, 1982.

e. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants."

    1. Section 2.3.3, "Onsite Meteorological Measurements Programs," Revision 2, July 1981.

f. NUREG-0896, "Safety Evaluation Report Related to the Operation of Seabrook Station, Units 1 and 2," March 1983.

    1. Section 2.3.3, "Onsite Meteorological Measurements Program."

g. NUREG-0896, "Safety Evaluation Report Related to the Operation of Seabrook Station, Units 1 and 2," Supplement No. 5, July 1986.

1. Section 2.3.3, "Onsite Meteorological Measurements Program."

h. NUREG-1331, "Technical Specifications, Seabrook Station, Unit 1," March 1990.

   1. Section 3/4.3.3.4, "Meteorological Instrumentation."

   2. Section 5.5.1, "Meteorological Tower Location."

   3. Section 6.8.1.4, "Semiannual Radioactive Effluent Release Report."

2.6 Industry Standards

a. American Institute of Steel Construction, Steel Construction Manual, 8th Edition.

b. American National Standards Institute Standard A58.1-1982, "Minimum Design Loads for Buildings and Other Structures."

c. American National Standards Institute/Electronics Industries Association Standard ANSI/EIA-222-D-1986, "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures."

d. American National Standards Institute/American Nuclear Society Standard ANSI/ANS-2.5-1984, "Standard for Determining Meteorological Information at Nuclear Power Sites."

e. Building Officials and Code Administrators, "Basic Building Code," 1975.

f. Electronics Industries Association Standard EIA-RS-222-C (1976), "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures."

g. The Institute of Electrical and Electronic Engineers Standard IEEE 338-1977, "IEEE Standard Criteria of the Periodic Testing of Nuclear Power Generating Station Safety Systems."

3.0 ABBREVIATED SYSTEM DESCRIPTION

3.1 System Functional Description

3.1.1 Primary Met System

The Primary Meteorological Monitoring System (Primary Met System) utilizes a 210-foot high guyed tower located approximately 1700 feet northwest of the Unit 1 Containment Structure at a grade elevation of approximately 10 feet MSL, 10 feet below plant grade. Instrument booms are located approximately 43 feet (13.1 meters), 150 feet (45.7 meters), and 209 feet (63.7 meters) above the base of the tower.

The following parameters are measured on the primary tower:

Parameter	Tower Elevation	Height Above MSL
Wind Speed	43 feet 209 feet	53 feet 219 feet
Wind Direction	43 feet 209 feet	53 feet 219 feet
Temperature	43 feet	53 feet
Temperature Difference	150-43 feet 209-43 feet	160-53 feet 219-53 feet
Solar Radiation	10 feet	20 feet
Precipitation	Ground level	10 feet

All signals from the primary tower's sensors are routed via above-ground conduit to signal translators located in a nearby instrument shelter.

The signal translators convert the sensor signals to a 0-5 Volt dc output over the full instrument range. The translator outputs are monitored directly by strip chart recorders located in the instrument shelter. The translator outputs are also monitored by the Main Plant Computer System (MPCS) which samples each meteorological parameter once every five seconds and compiles the data statistics shown in Table 3-1. The most recent instantaneous data values and the MPCS-compiled data statistics are available for on-demand display on MPCS terminals located in the Control Room (CR) and other locations for emergency response and meteorological-related functions. In addition, every fourth 15-minute data value (e.g., one 15-minute value per hour) is archived for long-term storage by the MPCS. The previous 24 hours of archived data values can also be displayed on-demand in the CR, TSC, and EOF.

3.1.2 Backup Met System

The Backup Meteorological Monitoring System (Backup Met System) utilizes a 30-foot high free-standing tower (with a 7-foot mast) located approximately 200 feet southeast of the primary meteorological tower. The backup tower is mounted atop the Settling Basin Outlet Structure at a grade elevation of approximately 16 feet MSL, 4 feet below plant grade.

The following parameters are measured on the backup tower:

Parameter	Tower Elevation	Height Above MSL
Wind Speed	37 feet	53 feet
Wind Direction	37 feet	53 feet

Signals from the backup tower's sensors are routed to a Data Acquisition System (DAS) located in a nearby instrument shelter. The DAS samples wind speed, wind direction, and ac power status data every three seconds and transmits these data to the Shift Superintendent's Workstation Computer (SSW Computer) in the Control Room. The SSW Computer receives the data transmissions from the DAS and generates and displays the data statistics shown in Table 3-2. These statistics, as well as the latest three-second sample values and the remote site ac power status, are available for display on demand on a video terminal in the Control Room. Wind speed and wind direction averages, wind direction standard deviation, and stability class data from the Backup Met System are also available for display on the MPCS.

3.2 Component Description

3.2.1 Primary Met System

3.2.1.1 Tower

The primary tower is a guyed 210-foot high Rohn Model No. 80 structure constructed in an equilateral triangular open lattice pattern. All members are tubular galvanized steel with bolted cross-bracing connections. The foundations for the tower and guy wire anchors are reinforced concrete.

The tower is designed and constructed in accordance with the requirements of EIA-RS-222-C. It is designed for a 40 lbs/ft^2 basic wind load which corresponds to a 100 mph basic wind speed.

The tower is provided with aircraft obstruction lighting, consisting of a flashing red beacon mounted on-top of the tower and two steady burning red side lights located approximately half-way up the tower. An ammeter located in the instrument shelter monitors the operation of the tower lights. The tower is also painted with seven equal-width alternate bands of aviation orange and white paint.

The tower has three lengths of conduit extending up the tower which contain the cables for the tower's electrical needs and sensors. One conduit contains power cables for the aspirated radiation shield motors, wind system heaters, and outlets at each level of instrumentation. The second conduit contains the wiring for the tower's lighting system. The third conduit contains cables from the tower's sensors. Cable pull boxes and electrical boxes for the sensor cables are located at different levels on the tower.

Protection of the tower against lightning is provided by means of a 6-foot copper lightning rod mounted on the tower beacon plate. A 4/0 copper cable connects the lightning rod to the tower grounding system. The guy wires of the tower are grounded by means of a copper cable connected to a ground rod. The tower grounding system is connected to the station grounding system.

3.2.1.2 Instrumentation

a. Wind Speed

The wind speed sensors consist of Climatronics anemometer cup sets attached to Climatronics F460 transducers. The transducer/cup combination has the following operating characteristics:

accuracy	±0.15 mph or ±1.0% of true air speed, whichever is greater
threshold	0.5 mph
distance constant	5.0 ft of air maximum
operating range	0 to 100 mph
operating temperature	-40 to +140 deg F

The transducers are mounted on Climatronics F460 cross-arms which are located on booms extending approximately 10 feet (2.9 tower widths) away from the tower. The booms extend from the tower in the west-southwest direction, which is the same side of the tower as the annual prevailing wind direction (west-northwest). The cross-arms are oriented along the true north/south axis. External thermostatically-controlled 20 Watt, 110 Volt ac heaters are used to minimize sensor shaft freeze-up in cold weather.

Signals from the wind speed transducers are provided to Climatronics wind speed/wind direction translators located in the instrument shelter. These translators convert the signals from the wind speed and direction transducers into a 0 to 5 Volt dc signal for output to the MPCS and the strip chart recorders. Operating characteristics of the wind translators are as follows:

wind speed accuracy	±0.03 mph or ±0.2% of measured air speed, whichever is greater
wind direction accuracy	±0.2%
temperature coefficient	±0.005% per deg F
operating temperature	-4 to +140 deg F
time constant	3 sec

b. Wind Direction

The wind direction sensors consist of Climatronics light-weight vanes attached to Climatronics F460 transducers. The transducer/vane combination has the following operating characteristics:

accuracy	±2 deg
threshold	0.5 mph
distance constant	3.7 ft of air maximum
damping ratio	0.4 at 10 deg initial angle of attack
operating range	0 to 360 deg
operating temperature	-40 to +140 deg F

The wind direction transducers are mounted on the same cross-arms as the wind speed transducers. External thermostatically-controlled 20 Watt, 110 Volt ac heaters are used to minimize sensor shaft freeze-up in cold weather.

Signals from the wind direction transducers are provided to the same Climatronics wind speed/wind direction translators used to process the wind speed data. These translators convert the signals from the wind direction transducers into a 0 to 5 Volt dc signal for output to the MPCS and the strip chart recorders. Operating characteristics of the wind translators were provided previously.

c. Temperature

Ambient temperature is measured using a platinum, 4 wire, 100 S resistance temperature sensor mounted in a Climatronics TS-10 motor-aspirated temperature shield. The temperature sensor has the following operating characteristics:

accuracy	±0.09 deg F over full range
range	-58 to +122 deg F
time constant	5.5 sec

The temperature shield has the following operating characteristics:

effectiveness	measurement errors due to radiation will not exceed 0.18 deg F under radiation intensities of 1.6 cal/cm^2-min

operating temperature	-40 to +130 deg F

A Climatronics temperature translator located in the instrument shelter converts the non-linear resistance versus temperature relationship of the sensor into a 0 to 5 Volt dc signal for output to the MPCS and the strip chart recorder. Operating characteristics of the temperature translators are as follows:

accuracy	±0.07%
temperature coefficient	±0.025% per deg F
operating temperature	-4 to +140 deg F
humidity	0 to 95% without condensation

d. Temperature Difference

Temperature difference (delta-temperature) is measured using the ambient temperature sensor and a second platinum resistance temperature sensors mounted in a second Climatronics TS-10 motor-aspirated temperature shield. A Climatronics temperature difference translator located in the instrument shelter converts the non-linear resistive output of the second temperature sensor into a voltage which is linearly proportional to the measure temperature. This temperature is compared with the reference temperature signal from the ambient temperature translator to derive a 0 to 5 Volt dc signal for output to the MPCS and the strip chart recorder.

The temperature sensor and temperature shield operating characteristics have been provided previously. Operating characteristics of the temperature-difference translators are as follows:

accuracy	±0.2%
temperature coefficient	±0.035% per deg F
operating temperature	-4 to +140 deg F
humidity	0 to 95% without condensation

e. Precipitation

Precipitation is measured using a heated tipping bucket rain gauge. Each tip of the bucket mechanism equals 0.01 in of water. The rain gauge has the following operating characteristics:

accuracy	±1% of rainfall rate of 1-3 in/hr
	±3% of rainfall rate of 0-6 in/hr
sensitivity	0.01 in
min operating temperature	-22 deg F

A Climatronics precipitation translator located in the instrument shelter converts the switch inputs from the rain gauge to a stepped analog voltage for output to the MPCS and the strip chart recorder.

f. Solar Radiation

Solar radiation is measured using an Eppley 8-48 pyranometer with the following characteristics:

temperature dependence	±1.5% from -4 to +104 deg F
linearity	±1% from 0 to 2 Langley/min
response time	3 to 4 seconds
cosine response	±2% from normalization 0-70 deg zenith angle, ±5% 70-80 deg zenith angle

A solar radiation translator located in the instrument shelter converts the solar radiation sensor's millivolt signal into a 0 to 5 Volt dc signal for output to the MPCS and strip chart recorder. Operating characteristics of the solar radiation sensor are as follows:

conversion accuracy	±0.2%
temperature coefficient	±0.005% per deg F
operating temperature	-4 to +140 deg F

g. Mainframe

Two Climatronics mainframes (module racks) provide mechanical support and electrical connections for the system's translators. One mainframe contains the translators for the Technical Specification parameters (e.g., the two wind speed/wind direction translators, the one temperature translator, and the two temperature difference translators; the second mainframe contains the translators for the remaining parameters (e.g., the dew point, precipitation, and solar radiation translators).

Each mainframe has its own 12 Volt dc power supply which supplies power for both the sensors and translators plugged into it. The power supplies have the following operating characteristics:

power input	117 Volts ac $\pm$10%, 1 amp max, 50/60 Hz with surge suppression
operating temperature	-40 to +140 deg F

h. Strip Chart Recorders

The level of wind speed and direction data is continuously recorded on a Chessel 4250C recorder with the following operating characteristics:

accuracy	$\pm$0.1%
operating temperature	32 to 122 deg F

The remaining parameters (temperature, temperature difference, dew point, precipitation, and solar radiation) are recorded on an Chessel 4250M multipoint recorder with the following operating characteristics:

accuracy	$\pm$0.1%
operating temperature	32 to 122 deg F
humidity	10 to 90% without condensation

3.2.1.3 Power Supply

A 15 kVA transformer and distribution panel located in the instrument shelter supplies the power requirements for the instrument shelter (e.g., lighting, HVAC, instruments, etc.) as well as the instrumentation and lighting located on the tower. The transformer including distribution panel is powered from 480 Volt lighting panel EL 32 in the Guardhouse, which is fed from 480 Volt MCC-E523. MCC-E523 is supplied from off-site power during normal operation through Bus E5 and backed up by the station's Train A diesel generator (DG-1A) during loss-of-offsite-power.

An alternative power supply to lighting panel EL 32 is provided from panel PP-172 by a manual transfer switch in the Guardhouse. PP-172 is supplied power from 480 Volt unit substation US-21 which is supplied from off-site power through Bus-2. This will provide an alternative method for powering the Primary Met System when Bus E5/US-E52/MCC-E523 are taken out of service for maintenance.

3.2.1.4 Instrument Shelter

The instrument shelter is a single story reinforced concrete and concrete masonry block structure with a concrete slab foundation. The shelter is finished on the outside with metal siding and an elastomeric roof. The shelter was designed and constructed in accordance with the requirements of BOCA Basic Building Code - 1975, per discussion with Bill Brecknock of PSNH's Civil Engineering Department.

The ability of structures supporting operation of the Primary Met System (including the instrument shelter) to withstand winds in excess of 50 mph was demonstrated during hurricane Gloria in September 1985 when a peak gust wind speed of 65 mph was measured by the Primary Met System upper level.

The HVAC system consists of a wall-mounted electric heating/cooling unit and a baseboard electric heater. The wall-mounted unit has a cooling capacity of 15,000 Btus/hr and a heating capacity of 16,700 Btus/hr. Both the wall-mounted unit and baseboard heaters are controlled by thermostats internal to the units. Operating experience has shown that this equipment can maintain the temperature in the range of 68 to 82 deg F.

3.2.2 Backup Met System

3.2.2.1 Tower

The backup tower is a self-supporting 30-foot high Universal Manufacturing Corporation Model No. C-33 HD structure constructed in a triangular open lattice pattern. A 7-foot aluminum mast extends above the top of the tower. The main structural members are tubular aluminum. The bracing is circular aluminum bar welded to the main structural tubes. The tower is a tilt-down design, i.e., the base incorporates a hinge to allow lowering of the tower for instrument mounting and maintenance. The base for the tower is mounted on top of a 2-foot thick concrete wall which is part of the outlet structure for the settling basin.

The tower is designed in accordance with EIA-RS-222-C. It is designed for a minimum 85 mph wind load which is the minimum basic wind speed requirement of ANSI A58.1-1982.

Protection of the tower against lightning is provided by means of a lightning point (rod) mounted on top of the tower. A #2 AWG copper cable connects the lightning point to the station ground grid.

The signal and sensor heater cables are connected to the DAS by a prefabricated vendor supplied signal cable. The cables on the tower are tie-wrapped to the tower structure. From the base of the tower, the cables are routed in conduit to the instrument shelter.

3.2.2.2 Instrumentation

a. Wind Speed

The wind speed sensor consists of a Climatronics anemometer cup set attached to a Climatronics F460 transducer. This is the same sensor used to measure wind speed on the primary tower. The transducer/cup combination has the following operating characteristics:

accuracy	±0.15 mph or ±1.0% of true air speed, whichever is greater
threshold	0.5 mph
distance constant	5.0 ft of air maximum
operating range	0 to 125 mph
operating temperature	-40 to +140 deg F

The wind speed transducer is mounted on a Climatronics F460 cross-arm attached to the top of the tower's 7-foot mast. The cross-arm is oriented along the true north/south axis. An external thermostatically-controlled 20 Watt, 110 Volt ac heater is used to minimize sensor shaft freeze-up in cold weather. An ac current meter in the instrument shelter provides indication of ac heater current.

b. Wind Direction

The wind direction sensor consists of a Climatronics light-weight vane attached to Climatronics F460 transducer. This is the same sensor used to measure wind direction on the primary tower. The transducer/vane combination has the following operating characteristics:

accuracy	±2 deg
threshold	0.5 mph
distance constant	3.7 ft of air maximum
damping ratio	0.4 at 10 deg initial angle of attack
operating range	0 to 360 deg
operating temperature	-40 to +140 deg F

The wind direction transducer is mounted on the same cross-arms as the wind speed transducer. An external thermostatically-controlled 20 Watt, 110 Volt ac heater is used to minimize sensor shaft freeze-up in cold weather. An ac current meter in the instrument shelter provides indication of ac heater current.

c. Data Acquisition System (DAS)

Signals from the wind speed and wind direction transducers are provided to a Climatronics IMP-850 datalogger DAS located in the instrument shelter. The DAS converts the wind speed sensor output to mph and the wind direction sensor output to degrees. These data are digitally transmitted every three seconds to SSW Computer in the Control Room via a 1200 Baud half-duplex FSK (Frequency Shift Keying) modem over a singe pair of telephone wires. Special circuit protectors and special cross wires were used in the Operational Support Building telephone room and in room 100 of the Administration Building to identify these as special circuits, not normal telephone circuits. Surge suppression is provided on the signal and power lines.

Operating characteristics of the DAS are as follows:

wind speed accuracy	$\pm$0.015 mph or $\pm$0.1% of true air speed, whichever is greater
wind direction accuracy	$\pm$0.4 deg

d. Shift Superintendent's Workstation Computer (SSW Computer)

The Control Room SSW Computer consists of a Dell System 310 IBM-compatible personal computer with monitor and keyboard and an analog output board. (The monitor is shared with the secondary plant supervisory control workstation monitor located at that location). The SSW Computer receives data from the DAS every three seconds. The 15-minute data statistics shown in Table 3-2 are generated every fifteen minutes and are available for display on demand on the SSW Computer's video monitor. The SSW Computer also displays the date, time, time of sunrise/sunset, time of calculation (all in Eastern Standard Time), data validity, and ac power status. In addition, analog outputs of wind speed and wind direction averages, wind direction standard deviation, and stability class are provided for input to the MPCS.

3.2.2.3 Power Supply

The AC power supply for the instrumentation and heaters located on the tower and in the instrument shelter is from Lighting Panel L36 circuits and is independent of the normal power supply for the Primary Met System instrumentation. Panel L36 is located in Settling Basin Control Panel, Node G22, and is supplied from 480 Volt distribution panel LC1 (ED-PP-9A) in the Sewage Treatment Building. Panel LC1 is supplied from the Exeter-Hampton off-site power system. A battery is provided to supply the DAS if ac power is lost.

The Control Room SSW Computer power supply is from 120 Volt ac panel ED-PP-5 which is supplied by nonsafety-related Inverter ED-I-4.

3.2.2.4 Instrument Shelter

The instrument shelter is a prefabricated fiberglass enclosure manufactured by Plastic-Fab, Inc. The enclosure is mounted on a steel grating platform on the settling basin structure. The shelter and its anchorage are designed for 85 mph wind loads calculated in accordance with the Uniform Building Code - 1985, Section 2311. The ability of other structures supporting operation of the Backup Met System to withstand winds in excess of 50 mph was demonstrated during hurricane Gloria in September 1985 when a peak gust wind speed of 65 mph was measured by the Primary Met System upper level.

The shelter's heating system consists of a Singer wall-mounted 500-watt (1707 Btus/hr), 120 Volt electric heater. An integral thermostat/off-on switch controls the heater. The shelter is also equipped with 115 Volt dual exhaust fans. Fan capacity is 220 cfm free air and is controlled with a thermostat/off-on switch.

TABLE 3-1

List of Primary Met System Data Statistics
Compiled and Displayed by the MPCS

Parameter	Statistic[a]	Range	Accuracy
Wind Speed	instantaneous	0 to 100 mph	±0.29 mph @ 5 mph
	3-minute average	"	±0.29 mph @ 15 mph
	15-minute average	"	±0.36 mph @ 25 mph
Wind Direction	instantaneous	0 to 540 deg	±2.9 deg
	3-minute average	0 to 360 deg	
	15-minute average	"	
	15-minute standard deviation	0 to 99 deg	
Temperature	instantaneous	-30 to +110 deg F	±0.45 deg F
	15-minute average	"	
Temperature Difference	instantaneous	-10 to +18 deg F	±0.18 deg F
	15-minute average	"	
Solar Radiation	instantaneous	0 to 2 Langley/min	±0.05 Langley /min[c]
	15-minute average	"	"
Precipitation	15-minute total	0 to 0.99 in	±0.01 in @ 1 in/hr

(a) Each 3-minute data value is updated on-the-hour and every 3 minutes thereafter; each 15-minute data value is updated on-the-hour and every 15 minutes thereafter.

(b) Deleted

(c) For zenith angles between 0 and 70 deg.

TABLE 3-2

List of Backup Met System Data Statistics
Compiled and Displayed by the SSW Computer

Parameter	Statistic[(a)]	Range	Accuracy
Lower Wind Speed	instantaneous 15-minute average	0 to 100 mph "	±0.15 mph @ 5 mph ±0.15 mph @ 15 mph ±0.25 mph @ 25 mph
Lower Wind Direction	instantaneous 15-minute average 15-minute standard deviation	0 to 360 deg " 0 to 100 deg	±2.0 deg
Upper Wind Speed	15-minute average[(b)]	0 to 100 mph	NA
Upper Wind Direction	15-minute average[(c)]	0 to 360 deg	NA
Stability Class	15-minute value[(d)]	A to G	NA
Equivalent 150'-43' Temperature Difference	15-minute average[(e)]	-1.2 to +4.0 deg F	NA
Equivalent 209'-43' Temperature-Difference	15-minute average[(e)]	-1.8 to +4.0 deg F	NA

(a) Each 15-minute data value is updated on-the-hour and every 15 minutes thereafter.

(b) The upper wind speed is estimated as a function of lower wind speed and equivalent delta-temperature.

(c) The upper wind direction is estimated as a function of lower wind direction.

(d) Atmospheric stability class is estimated as a function of wind speed, wind direction standard deviation, and time-of-day (daytime versus nighttime).

(e) The equivalent 150'-43' and 209'-43' delta-temperatures are estimated as a function of stability class.

4.0 SYSTEM DESIGN BASIS

The intent of the on-site meteorological monitoring program is to provide the meteorological data needed to estimate potential radiation doses resulting from the routine or accidental release of radioactive material to the atmosphere. The meteorological monitoring program also provides information for supporting the operation of the Cooling Tower during normal plant operating conditions and for identifying high wind speeds for initiating Emergency Action Levels.

The system is classified as nonsafety related containing non-Class 1E equipment and is non-seismically qualified. Regulatory Guide 1.97 classifies the Primary Meteorological Monitoring System wind speed, wind direction, and temperature difference parameters as Design Category 3, Type E variables.

4.1 Primary Met System

The design requirements applicable to the Primary Meteorological Monitoring System (Primary Met System) were derived primarily from the following documents:

Regulatory Guide 1.23 (Safety Guide 23)

Regulatory Guide 1.97

Supplement 1 to NUREG-0737

ANSI/ANS-2.5-1984

Post-TMI documents NUREG-0654 (Appendix 2) and NUREG-0737 (Item III.A.2) specified additional meteorological monitoring system requirements and endorsed Proposed Revision 1 to Regulatory Guide 1.23 (Draft SS 926-4). Subsequently, however, Supplement 1 to NUREG-0737 provided clarification on certain basic post-TMI requirements, including the meteorological items discussed in NUREG-0654 and NUREG-0737. Supplement 1 to NUREG-0737 called for providing reliable indication of the meteorological variables specified in Regulatory Guide 1.97 (e.g., wind speed, wind direction, and temperature difference) in the Control Room, Technical Support Center, and the Emergency Operations Facility. No changes to existing meteorological monitoring systems were necessary if they had historically provided reliable indication of meteorological conditions in the vicinity (up to about 10 miles) of the plant site. ANSI/ANS-2.5-1984 subsequently reiterated the meteorological-related items in Supplement 1 to NUREG-0737 and Regulatory Guide 1.97, and the Second Proposed Revision 1 to Regulatory Guide 1.23 (Draft ES 926-4) subsequently endorsed ANSI/ANS-2.5-1984.

4.1.1 Tower

a. A tower or mast approximately 60 meters (197 feet) high is required in order to obtain the necessary meteorological measurements. ANSI/ANS-2.5-1984 specifies that the tower site should represent as closely as possible the same meteorological characteristics as the region into which any airborne material will be released. Both Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 specify that the tower should be sited at approximately the same elevation as finished plant grade and should be located in an area where natural or man-made obstructions and the plant's heat dissipation system will have little or no influence on meteorological measurements. Where practical, the tower should be located over level, open terrain covered with short grass or natural earth at a distance of at least ten times the height of any nearby obstruction. Technical Specification Item 5.5.1 specifies the location of the primary meteorological tower.

4.1.2 Instrumentation

a. Regulatory Guide 1.97 specifies that the instrumentation should be of high-quality commercial grade and should be selected to withstand its specified service environment.

b. ANSI/ANS-2.5-1984 specifies that to minimize the impact of damage due to direct lightning strike or electrical power surges, the instrumentation should be protected by grounding and be provided with surge protection devices on the incoming power lines and signal lines.

c. Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 specify that in order to obtain the basic meteorological information required for estimates of atmospheric transport and diffusion, wind speed and wind direction measurements at a minimum of two levels and a least one measurement of air temperature difference should be provided on one tower.

d. Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 specify that the lower set of wind speed, wind direction, and temperature difference instrumentation should be mounted at an elevation of approximately 10 meters (33 feet) above the ground (interpreted to be ground elevation near the release point). The 10-meter level is generally accepted as a standard meteorological reference measurement level. Because Seabrook's primary meteorological tower is located at elevation 10 ft MSL (10 feet below plant grade of 20 ft MSL), the lower level wind and temperature data are collected at a tower elevation of 13.1 meters (43 feet) in order to be representative of meteorological conditions at approximately 10 meters (33 feet) above plant grade. The wind data from this lower level are used to analyze atmospheric transport and diffusion characteristics of ground-level radiological releases.

e. Regulatory Guide 1.23 specifies that the upper set of wind speed, wind direction, and temperature difference instrumentation should be mounted at the height of release of radioactive material (e.g., plant vent height) but should be positioned not less than 30 meters (98 feet) above the lower sensor set. ANSI/ANS/2.5-1984 specifies that the upper set of wind and temperature difference sensors should be monitored at approximately 60 meters (197 feet) to coincide with the normal light-water-reactor release level (Seabrook Station's Primary Vent Stack release point is approximately 58 meters above plant grade). Because Seabrook's primary meteorological tower is located at elevation 10 ft MSL (10 feet below plant grade of 20 ft MSL), the upper level wind and temperature data are collected at a tower elevation of 63.7 meters (209 feet) in order to be representative of meteorological conditions at approximately 60 meters (197 feet) above plant grade. The wind data from this upper level are used to analyze atmospheric transport and diffusion characteristics of primary-vent-stack radiological releases.

f. Temperature difference data provide an estimate of atmospheric stability (e.g., the amount of air turbulence available to disperse a plume). One set of temperature difference data is collected between the tower elevations of 13.1 meters (43 feet) and 63.7 meters (209 feet) to correspond to Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 specifications; a second set of temperature difference data is collected between the tower elevations of 13.1 meters (43 feet) and 45.7 meters (150 feet) in order to correspond with the temperature difference data set collected during the plant's construction licensing phase.

g. Technical Specification Item 3.3.3.4 requires: (i) wind speed and wind direction be measured at nominal tower elevations of 43 feet and 209 feet; and (ii) temperature difference be measured between tower elevations 43 ft and 150 ft and between tower elevations 43 ft and 209 ft.

h. Regulatory Guide 1.23 specifies that temperature and dew point (or humidity) should be measured at sites where there is a potential for fogging or icing due to an increase in atmospheric moisture content caused by plant operation. ANSI/ANS-2.5-1984 specifies that ambient temperature and ambient moisture (e.g., relative humidity, dew point, or wet bulb) should be monitored when cooling towers or spray ponds are used. Both Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 specify that temperature and humidity should be measured at approximately 10 meters. Because the primary meteorological tower is located at elevation 10 ft MSL (10 feet below plant grade), Seabrook's temperature data is collected at an tower elevation of 13.1 meters (43 feet) to be representative of meteorological conditions at 10 meters (33 feet) above plant grade. The routine collection of humidity (dew point) data has been discontinued since the infrequent operation of the cooling tower minimizes the potential for fog or ice formation. The data required to support operation of the cooling tower during normal plant operation is now collected manually through the use of a psychrometer.

i. ANSI/ANS-2.5-1984 specifies that precipitation should be measured at or within one-half mile of the primary meteorological tower. Precipitation data are used to quantify the effects of washout on airborne radionuclide concentrations.

j. Although not specified by any guidance documents, solar radiation data are collected to quantify the effects of certain meteorological phenomena associated with coastal sites on atmospheric transport and diffusion.

k. Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 specify that the basic reduced data should be hourly averaged. A continuous 15-minute average may be utilized to represent the hourly average. ANSI/ANS-2.5-1984 states that if a 15-minute average is utilized, the same 15-minute period each hour should be used.

l. Technical Specification Item 6.8.1.4 requires that an annual summary of hourly meteorological data collected over each year be compiled within 60 days of the end of each year. Consequently, long-term continuous archiving of the hourly wind speed, wind direction, and temperature difference database is required.

m. Three-minute average wind speed and direction data are available via the Main Plant Computer System (MPCS) per request of the Emergency Operations Facility Response Manager to allow early detection of rapidly changing meteorological conditions during radiological emergencies.

n. Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 both specify that dual recording systems should be utilized for data acquisition. Regulatory Guide 1.23 specifies that either redundant digital recorders or a digital recorder supplemented by analog (e.g., strip chart) recorders may be used; ANSI/ANS-2.5-1984 specifies that both a digital and an analog system should be used.

o. Regulatory Guides 1.23 and 1.97, Supplement 1 to NUREG-0737, and ANSI/ANS-2.5-1984 specify that data from the Primary Met System should be available for monitoring by Control Room (CR) personnel during plant operation. Regulatory Guide 1.97 specifies that the data may be displayed on an individual device or they may be processed for display on-demand. To the extent practicable, the same instruments should be used for accident monitoring as are used for the normal operations of the plant to enable the operators to use, during accident situations, instruments with which they are familiar.

p. Supplement 1 to NUREG-0737 and ANSI/ANS-2.5-1984 specify that following an accident, wind speed, wind direction, and atmospheric stability (e.g., temperature difference) data should be available for monitoring at the Technical Support Center (TSC) and Emergency Operations Facility (EOF). Supplement 1 to NUREG-0737 specifies that the TSC and EOF should be capable of reliable collection, storage, analysis, display, and communication of meteorological information. ANSI/ANS-2.5-1984 specifies that the data available to the CR, TSC, and EOF should include a time history record (e.g., either analog charts or digital printout) of wind speed and direction as well as a measure of atmospheric stability (e.g., temperature difference).

q. Regulatory Guide 1.23 specifies that the instrumentation should be inspected and serviced at a frequency which will assure at least a 90% data recovery and minimize extended outages. ANSI/ANS-2.5-1984 specifies that the instrumentation should be inspected and serviced at a frequency to assure at least an annual 90 percent joint data recovery of wind speed, wind direction, and atmospheric stability (e.g., temperature difference) for each level which represents an effluent release point. Annual data recovery for other individual parameters should be at least 90 percent for each parameter. Both Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 specify that the system should be calibrated at least semi-annually and as frequently as necessary to ensure meeting specified parameter accuracies. Regulatory Guide 1.97 specifies that periodic checking, testing, calibration, and calibration verification should be in accordance with the applicable portions of Regulatory Guide 1.118. Seabrook Station Technical Specifications require daily channel checks and semi-annual calibration of the wind speed, wind direction and temperature difference channels.

4.1.3 Power Supply

a. Regulatory Guide 1.97 specifies that the meteorological monitoring system is Design Category 3 and only requires off-site power. However, a December 1985 NRC Emergency Plan Implementation Appraisal (Open Item 50-443/85-32-20) requested that backup power be provided to the instrument shelter (e.g., signal translators, recorders, aspirated temperature shields, wind sensor heaters, precipitation gauge heater, lighting and HVAC systems). Momentary power interruptions are acceptable, but the backup power supply should be available for a minimum duration of twelve hours after the loss of off-site power.

4.1.4 Instrument Shelter

a. An instrument shelter having an adequately controlled environment for the system's electronics should be provided.

4.2 Backup Met System

There are no regulatory requirements or industry standards requiring a backup to a reliable Primary Met System. However, considering the importance of meteorological information in the implementation of the Seabrook Station Radiological Emergency Plan and the fact that the loss of all meteorological information constitutes an initiating condition for a notification of an Unusual Event per Appendix 1 of NUREG-0654, an independent Backup Meteorological Monitoring System (Backup Met System) has been installed. The Backup Met System is intended to provide data in the Control Room when data from the Primary Met System is not available, assuring that basic meteorological information will be available to generate plume transport and dispersion estimates during and immediately following an accidental airborne radioactivity release.

The design requirements applicable to the Backup Met System were derived primarily from Proposed Revision 1 to Regulatory Guide 1.23 (Draft SS 926-4).

4.2.1 Tower

a. A tower or mast approximately 10 meters (33 feet) high is required in order to obtain the necessary meteorological measurements. The tower site should represent as closely as possible the same meteorological characteristics as the Primary Met System tower site. The backup tower should be sited at approximately the same elevation and should be located in an area where natural or man-made obstructions and the plant's heat dissipation system will have little or no influence on the meteorological measurements. Where practical, the tower should be located over level, open terrain covered with short grass or natural earth at a distance of at least ten times the height of any nearby obstruction.

4.2.2 Instrumentation

a. The instrumentation should be of high-quality commercial grade and should be selected to withstand its specified service environment.

b. To minimize the impact of damage due to direct lightning strike or electrical power surges, the instrumentation should be protected by grounding and be provided with surge protection devices on the incoming power lines and signal lines.

c. In order to assure that basic meteorological data will be available to generate atmospheric transport and diffusion estimates during and immediately following an accidental airborne radioactivity release, wind speed, wind direction, and an indication of atmospheric stability (e.g., wind direction standard deviation) representative of 10 meters (33 feet) above plant grade should be monitored.

d. The basic reduced data should be 15-minute average for input into the emergency response dose assessment codes. The Backup Met System should provide data to the Control Room in a real-time mode in the event necessary parameters from the Primary Met System are not available.

e. The instrumentation should be inspected and serviced at a frequency to assure at least an annual 90 percent joint data recovery of wind speed, wind direction, and atmospheric stability (e.g., wind direction standard deviation). The system should be calibrated as frequently as necessary to ensure meeting specified parameter accuracies. Periodic checking, testing, calibration, and calibration verification should be in accordance with the applicable portions of Regulatory Guide 1.118.

4.2.3 Power Supply

a. The instrumentation and heaters located on the backup tower and in the Backup Met System instrument shelter require only off-site power; however, this power should be independent from the normal power supply for the Primary Met System instrumentation.

4.2.4 Instrument Shelter

a. An instrument shelter having an adequately controlled environment for the Backup Met System's field electronics should be provided.

5.0 COMPONENT DESIGN BASIS

5.1 Primary Met System

5.1.1 Tower

a. The top of the primary meteorological tower structure should extend approximately 60 meters (197 ft) above plant grade to assure the specified meteorological measurements can be taken.

b. To avoid the influence of the tower structure on measurements, the use of a open-lattice tower is preferred. Closed towers, stacks, cooling towers, and similar solid structures should not be used to support sensors.

c. Tower structure design loads which require consideration are wind and ice loads, including the effect of increased sail area due to ice. Applicable minimum design loads from ANSI A58.1-1982 include a basic wind speed of 85 mph coincident with an ice thickness of 0.5 in. In order to be able to monitor the required wind speed range, the tower design wind speed should be at least 50 mph.

d. 14 CFR 77 states that to assure aeronautical conspicuousness, any temporary or permanent object that exceeds an overall height of 200 feet above ground level should normally be marked and/or lighted in accordance with the standards described in FAA 70/7460-1G. This document requires that a 210-foot tall tower be painted with seven equal-width bands of paint alternating between aviation orange and white. These bands should be perpendicular to the tower's vertical axis, with the bands at the top and bottom colored orange. At least one flashing red beacon should be mounted at the top and two or more steady burning red lights should be installed half-way up the tower on diagonally or diametrically opposite positions. The lights may remain on continuously or may be operated by a satisfactory control device (e.g., photo cell, timer, etc.) adjusted so the lights will be turned on when the northern sky illuminance reaching a vertical surface falls below a level of approximately 35 footcandles.

The FAA recommends use of only those paint materials and lighting systems which meet the minimum technical standards established by the FAA. Further details on paint and lighting standards are described in FAA 70/7460-1G.

5.1.2 Instrumentation

a. In order to preclude the tower structure from substantially influencing measurements, ANSI/ANS-2.5-1984 specifies that the sensors should be located on instrument booms oriented into the prevailing wind direction and at a minimum distance of two tower widths from the tower. Wind instruments installed on top of a tower structure should be mounted at least one tower diameter/diagonal above the top of the tower structure to preclude the tower structure from substantially influencing measurements.

b. Regulatory Guide 1.97 specifies the following instrument ranges for the following parameters:

Parameter	Range
Wind Speed	0 to 50 mph
Wind Direction	0 to 360 deg
Temperature Difference	-9 deg F to +18 deg F

A 100 mph span was selected for the original system as this was standard industry practice. National Weather Service observations and projections are used for wind speeds near or in excess of the plant design basis wind speed of 110 mph for use in classifying Emergency Action Levels (EALs) in ER 1.1, "Classification of Emergencies". Met System monitoring of wind speeds above 50 mph can be used in classifying EALs but is not a design basis.

c. Parameter accuracies as specified by Regulatory Guides 1.23 and 1.97 and ANSI/ANS-2.5-1984 are presented in Table 5-1. Some of the accuracies specified in the various documents differ from each other. Licensing commitments have been made to meet the Regulatory Guide 1.23 and 1.97 monitoring criteria. ANSI/ANS-2.5-1984 is the more recent and detailed document and has been endorsed by the Second Proposed Revision 1 to Regulatory Guide 1.23 (Draft ES 926-4); consequently, ANSI/ANS-2.5-1984 monitoring criteria are also used as guidance. In case of conflict, the Regulatory Guide 1.97 criteria should be considered controlling.

d. Regulatory Guides 1.23 and 1.97 and ANSI/ANS-2.5-1984 specify the following wind speed transducer and cup characteristics:

Characteristic	Reg Guide 1.23	Reg Guide 1.97	ANSI/ANS 2.5-1984
starting threshold	< 1.0 mph	< 1.0 mph	< 1.0 mph
distance constant	NA	≤ 6.6 ft	NA

e. Regulatory Guide 1.97 and ANSI/ANS-2.5-1984 specify the following wind direction transducer and vane characteristics:

Characteristic	Reg Guide 1.97	ANSI/ANS-2.5-1984
starting threshold	< 1.0 mph	< 1.0 mph
damping ratio	≥ 0.4	0.4 - 0.6
delay distance	≤ 6.6 ft	≤ 6.6 ft

f. Temperature sensors should be placed in aspirated temperature shields to protect them from the influences of direct and reflected solar radiation and precipitation. The shields should be efficient enough to ensure the specified temperature and temperature difference system accuracies can be achieved. For temperature difference measurements, sensors should be housed in identical shields. ANSI/ANS-2.5-1984 states that the shields should be pointed either downward or laterally towards the north.

g. ANSI/ANS-2.5-1984 specifies that precipitation should be measured with a recording rain gauge with a resolution of 0.01 in. Precipitation collectors should be located so that obstructions do not interfere with the collection of precipitation and should be placed on level ground so that the mouth is horizontal and open to the sky. A heated collector should be provided to ensure proper measurement of frozen precipitation.

h. Solar radiation measurements should be taken in open areas free of obstructions to avoid obstructions from casting shadows on the sensor at any time.

i. Regulatory Guide 1.23 specifies that the wind, temperature, and humidity data should be averaged over a period of at least 15 minutes at least once an hour. ANSI/ANS-2.5-1984 specifies that the basic reduced data should be hourly averaged. A continuous 15-minute average may be utilized to represent the hourly average if the same 15-minute period each hour is used.

j. ANSI/ANS-2.5-1984 specifies that the wind speed and direction analog recorders should be of the continuous strip chart recording type. Multipoint strip chart recorders are sufficient for recording all other parameters.

k. ANSI/ANS-2.5-1984 specifies that all digital recording (except for precipitation and wind direction standard deviation) should consist of a sampling of data at intervals no longer than 60 seconds and the mean values for the accumulated data shall be determined using no less than 30 instantaneous values or equivalent spaced equally over not less than a 15-minute period. Precipitation should be recorded on a cumulative basis at least once per hour. If wind direction standard deviation is calculated, it should be determined by statistical analysis of samples from no less than 180 instantaneous values of lateral wind direction during the sampling period, with a maximum sampling period of one hour.

l. The wind speed, temperature, temperature difference, and solar radiation averages calculated by the digital system should be scalar averages (e.g., the sum of the valid samples during the sampling period divided by the number of samples summed). The wind direction average should be a unit vector mean wind direction and the wind direction standard deviation should be calculated utilizing Yarmartino's algorithm as described in YNSD memorandum REG 119/89. Total precipitation is determined by subtracting the previous precipitation gauge counter reading from the current precipitation gauge counter reading.

m. In order to provide appropriate input to the emergency response dose assessment models, 15-minute wind speed, wind direction, temperature difference, and solar radiation averages and 15-minute total precipitation accumulation values should be compiled on-the-hour and at 15, 30, and 45 minutes past the hour. These data should be available for display with at least the following measurement resolution:

Parameter	Measurement Resolution
Wind Speed	0.1 mph
Wind Direction	1 deg
Temperature Difference	0.1 deg F
Precipitation	0.01 in
Solar Radiation	0.01 Langle/min

5.1.3 Power Supply

a. The instrumentation for the Primary Met System as recommended in Regulatory Guide 1.97 is Design Category 3 and requires only off-site power. However, the need for a backup (reliable) power source for the Primary Met System during loss-of-offsite-power events was documented as an open item during an NRC Emergency Plan Implementation Appraisal (Open Item 50-443/85-32-20). The Primary Met System power supply was designed to resolve this NRC open item.

b. The cables and equipment should be installed in accordance with the separation criteria as established in the FSAR Chapter 8.

5.1.4 Instrument Shelter

a. The instrument shelter should have an adequately controlled environment for the system's field electronics. Because of the stringent accuracy requirements specified for the temperature difference measurements and the impact of temperature changes on the temperature difference translator accuracy, the instrument shelter temperature should remain within $\pm$7.2 deg F from the time of each calibration.

b. The current governing building code should be used in the design of any future modifications for this structure. In order to be able to monitor the required wind speed range, the instrument shelter design wind speed should be at least 50 mph.

5.2 Backup Met System

5.2.1 Tower

a. The top of the backup meteorological tower structure should extend approximately 10 meters (33 ft) above plant grade to assure the specified meteorological measurements can be taken.

b. To avoid the influence of the tower structure on measurements, the use of a open-lattice tower is preferred. Closed towers, stacks, cooling towers, and similar solid structures should not be used to support sensors.

c. A free-standing aluminum tower with tilt-down base was chosen to hold the Backup Met System instrumentation because of its low price and the ability to access the instrumentation without climbing the tower or using a bucket truck.

d. Tower structure design loads which require consideration are wind and ice loads, including the effect of increased sail area due to ice. Applicable minimum design loads from ANSI A58.1-1982 include a basic wind speed of 85 mph coincident with an ice thickness of 0.5 in. In order to be able to monitor the wind speed range specified in Regulatory Guide 1.97, the tower design wind speed should be at least 50 mph.

e. The backup tower's location on top of the settling basin was chosen because: (i) it is near the primary tower; (ii) it represents good exposure without nearby obstructions causing turbulence; and (iii) ac power, conduit, and an instrument shelter were available nearby. The loads imposed on the settling basin structure are negligible, per YNSD Calculation SBC-326.

f. Since the top of the backup tower is just outside the nominal 45 deg cone-of-protection from the primary tower, a separate lightning protection system is provided to the backup tower.

5.2.2 Instrumentation

a. In order to preclude the tower structure from substantially influencing measurements, the sensors should be located on instrument booms oriented into the prevailing wind direction and at a minimum distance of two tower widths from the tower. Wind instruments installed on top of a tower structure should be mounted at least one tower diameter/diagonal above the top of the tower structure to preclude the tower structure from substantially influencing measurements.

b. The wind speed transducer and cup characteristics, the wind direction transducer and vane characteristics, and wind speed and direction parameter accuracies specified in Section 5.1.2 for the Primary Met System are applicable to the Backup Met System. The wind speed and wind direction instrument ranges specified in Regulatory Guide 1.97 (0 to 50 mph and 0 to 360 deg) are also applicable to the Backup Met System.

c. Digital data transmission from the instrument shelter to the Control Room via modems and telephone cables was selected because of high cost of pulling new cable if analog signals were utilized instead.

d. The digital system should calculate scalar mean lower wind speeds, unit vector mean lower wind directions, and lower wind direction standard deviations utilizing the algorithms described in YNSD memorandum REG 119/89. Stability classes and the resulting 150'-43' and 209'-43' temperature differences should be determined as a function of average lower wind speed, wind direction standard deviation, and time-of-day (daytime versus nighttime). Upper wind speed averages should be estimated as a function of lower wind speed averages and stability class, and the upper wind direction averages should be represented by the lower wind direction averages. The algorithms needed to implement the above calculations are described in YNSD memorandum REG 151/86.

e. In order to provide appropriate meteorological data for the emergency response dose assessment models, 15-minute wind speed and direction averages and 15-minute wind direction standard deviation values should be compiled on-the-hour and at 15, 30, and 45 minutes past the hour. These data should be available for display on-demand in the Control Room with at least the following display resolution:

Parameter	Display Resolution
Wind Speed	0.1 mph
Wind Direction	1 deg
Wind Direction Standard Deviation	0.1 deg

The 15-minute average wind speed and wind direction data, along with an equivalent temperature difference data value (derived from the 15-minute wind speed average and wind direction standard deviation data and the time-of-day), can be used as input into the emergency response dose assessment models if data from the Primary Met System are not available.

f. Control Room digital data displays were chosen in lieu of analog indicators because the digital displays can provide a better precision readout and simplify the data gathering process. A video display was chosen in lieu of digital indicators because of the potential to: (i) interface with the Primary Met System to display the Primary Met System data in the Control Room if the Main Plant Computer System (MPCS) is inoperative; and (ii) run the emergency response dose assessment codes on the same equipment.

5.2.3 Power Supply

a. To assure Met System data availability, the power supply to the Backup Met System should be provided from a source which is independent of the on-site power source.

b. The cables and equipment should be installed in accordance with the separation criteria as established in FSAR Section 8.

5.2.4 Instrument Shelter

a. The instrument shelter should have an adequately controlled environment for the system's field electronics. The DAS located in the backup shelter has a specified operating range of -13 to +122 deg F.

b. The shelter should be designed to withstand the wind loading requirements of ANSI A58.1-1982. In order to be able to monitor the wind speed range specified in Regulatory Guide 1.97, the shelter design wind speed should be at least 50 mph.

TABLE 5-1
Parameter Accuracies Specified by
Guidance Documents

Parameter	Reg Guide 1.23	Reg Guide 1.97	ANSI/ANS-2.5-1984 Digital System	ANSI/ANS-2.5-1984 Analog System
Wind Speed	±0.5 mph	±0.5 mph for speeds less than 5 mph, ±10% of measured value for speeds in excess of 5 mph	±0.5 mph for speeds less than 5 mph, ±10% of measured value for speeds in excess of 5 mph	±0.75 mph for speeds less than 5 mph, ±15% of measured value for speeds in excess of 5 mph
Wind Direction	±5 deg	±5 deg	±5 deg	±7.5 deg
Wind Direction Standard Deviation	NA	NA	±5% of true statistical value	±5% of true statistical value
Temperature	±0.9 deg F	NA	±0.9 deg F	±0.9 deg F
Temperature Difference	±0.18 deg F	±0.3 deg F per 164-ft interval	±0.27 deg F per 164-ft interval	±0.27 deg F per 164-ft interval
Precipitation	NA	NA	±10% of total accumulated catch for amounts in excess of 0.2 in	±10% of total accumulated catch for amounts in excess of 0.2 in
Solar Radiation	NA	NA	NA	NA
Time	NA	NA	±5 min	±10 min

1. The Regulatory Guide 1.23 specified parameter accuracies are for time averaged values, except for wind direction accuracies which are for instantaneous recorded values.

2. The ANSI/ANS-2.5-1984 specified parameter accuracies are for time averaged values and refer to the composite accuracy reflecting the errors introduced by sensor, cable, signal conditioning, temperature environment for signal conditioning and recording, recorders, and data reduction process.

6.0 TECHNICAL SPECIFICATION AND LICENSING COMMITMENTS

6.1 Technical Specifications

a. Technical Specification 3.3.3.4 requires that the primary tower meteorological monitoring instrumentation channels listed below shall be OPERABLE at all times:

Instrument	Location	Minimum Operable
1. Wind Speed		
a. Lower Level	Nominal Elev. 43 ft	1
b. Upper Level	Nominal Elev. 209 ft	1
2. Wind Direction		
a. Lower Level	Nominal Elev. 43 ft	1
b. Upper Level	Nominal Elev. 209 ft	1
3. Air Temperature - DT		
a. Lower Level	Between Elev. 43 ft and 150 ft	1
b. Upper Level	Between Elev. 43 ft and 209 ft	1

With one or more required meteorological monitoring channels inoperable for more than seven days, a Special Report to the Commission pursuant to Specification 6.8.2 must be prepared and submitted within the next ten days outlining the cause of the malfunction and the plans for restoring the channel(s) to OPERABLE status.

b. Technical Specification 4.3.3.4 requires that each of the primary tower meteorological monitoring instrument channels shown in Item (a) above be demonstrated OPERABLE by performance of a Daily CHANNEL CHECK and a semiannual CHANNEL CALIBRATION.

c. Technical Specification 5.5.1 requires that the primary meteorological tower be located as shown on Technical Specification Figure 5.1-1.

d. Technical Specification 6.8.1.4 requires that the Semiannual Radioactive Effluent Release Report to be submitted within 60 days after January 1 of each year include an annual summary of hourly meteorological data collected over the previous year. This annual summary may be either in the form of an hour-by-hour listing on magnetic tape of wind speed, wind direction, atmospheric stability, and precipitation (if measured), or in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability. In lieu of submission with the Semiannual Radioactive Effluent Release Report, the licensee has the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request.

6.2 FSAR Commitments

a. Section 1.8 addresses the degree of conformance of the Meteorological Monitoring System (Met System) to guidance provided in Regulatory Guides 1.21 (Rev. 1), 1.23 (Rev. 0), 1.97 (Rev. 3), and 1.101 (Rev. 2).

b. Section 2.3.3.3 describes the Operational Meteorological Monitoring Program and states that a meteorological monitoring program commensurate with the final plant design and consistent with NRC requirements for on-site meteorological programs will be maintained throughout the life of the plant.

c. Section 7.5.4 discusses the Accident Monitoring Instrumentation (including the wind speed, wind direction, and temperature difference meteorological parameters) implemented to comply with Regulatory Guide 1.97.

6.3 Other Licensing Commitments

a. Section 6.2.3.1 of the Seabrook Station Radiological Emergency Plan briefly describes the Met System as used to support the station's Radiological Emergency Plan.

b. NRC Emergency Plan Implementation Appraisal No. 50-443/85-32 (December 9-13, 1985) identified the following open item (50-443/85-32-20): "Provide for backup meteorological measurements representative of conditions in the vicinity of the site and provide for backup power to the instrument building."

This item was addressed by revising the Seabrook Station Radiological Emergency Plan (SSREP) to indicate that an arrangement between YNSD and Weather Services International (WSI) provides for backup meteorological data, including a terminal in the Emergency Operations Facility (EOF). The plan also provides for backup weather data from National Weather Service (NWS) offices and hourly data from Pease Air Force Base through WSI, Portland, ME, and Concord, NH NWS stations. The plan was also revised to provide for corporate meteorological support available on a 24-hr emergency call basis.

This item was also addressed by committing to evaluate and take actions to enhance the Met System reliability by December 31, 1986. An Engineering Review of the Met System was performed (SBE-86-055) and the resulting actions included: (i) providing the Primary Met System backup power from the station's Train A diesel generator (DCR 86-425); (ii) replacing the primary tower's guy wire anchors (DCR 86-120); and (iii) refurbishing the Primary Met System's instrumentation (ECA 03/117088D).

Consequently, this item was closed via Inspection Report No. 50-443/86-30 Addendum based on the provision for multiple off-site backup sources of meteorological data (one of which, Pease AFB, was considered representative of conditions in the vicinity of the site) and Seabrook's commitment to resolve the on-site Met System reliability by December 31, 1986.

c. NRC Emergency Plan Implementation Appraisal No. 50-443/85-32 (December 9-13, 1985) also identified the following open item (50-443/85-32-24): "Provide the basic data required for atmospheric dispersion calculations (15 minute averages), which includes a time history (analog or digital printout) of wind direction and speed at each level and temperature difference with height in the control room and EOF."

   This item was address by having the Main Plant Computer System (MPCS) sample and 15-minute average the Primary Met System wind speed, wind direction, and temperature difference parameters for on-demand display in the Control Room (CR) and on MPCS Emergency Response Facility Workstation terminals located in the Technical Support Center (TSC), and Emergency Operations Facility (EOF). In addition, a "Meteorological 24-hour History Report" listing archived 15-minute averages (one per hour for 24 hours) was implemented on the MPCS for printout in the CR, TSC, and EOF.

   This item was closed via Inspection Report No. 50-443/86-46.

d. The FAA-approved 'Notice of Proposed Construction or Alteration' for the primary meteorological tower requires the tower to be obstruction marked and lighted with aviation red obstruction lights in accordance with the current version of FAA/7460-1. FAA/7460-1G requires any failure or malfunction of the top flashing red beacon which will last more than 30 minutes be immediately reported by telephone or telegraph to the nearest Flight Service Station.

7.0 CALCULATION SUMMARY

a. Ehresmann Engineering Inc. Report J.O. 1180, "Anchor Design for Tower Specialist Inc.", dated April 26, 1986 (attached to Foreign Print 4924D).

b. Yankee Nuclear Services Division Calculation No. SBC-148, "System Accuracy of Meteorological Instruments for Operational Monitoring Program," Revision 1, dated July 6, 1990.

c. Yankee Nuclear Services Division Calculation No. SBC-176, "Selection of Cable Size for Meteorological Tower Power Supply," Revision 0, dated September 23, 1986.

d. Yankee Nuclear Services Division Calculation No. SBC-326, "Backup Met Tower Design, DCR 89-035," Revision 0, dated June 29, 1989.

e. United Engineers & Constructors Inc. Calculation No. 9763-3-ED-00-20-F, "Non-Class 1E UPS Loading Calculation," Revision 3.

8.0 REFERENCES

8.1 FSAR

a. Section 1.8, "Conformance to NRC Regulatory Guides."

b. Section 2.3.3.3, "On-Site Meteorological Measurement Program - Operational Program."

c. Section 7.5.4, "Accident Monitoring Instrumentation."

d. Section 8, "Electric Power."

8.2 Radiological Emergency Plan

a. Section 6.2.3.1, "Geophysical Phenomena Monitors - Meteorological."

b. Emergency Response Procedure ER 1.1, "Classification of Emergencies."

c. Emergency Response Procedure ER 5.1, "HP-41 Dose Projection Determination."

d. Emergency Response Procedure ER 5.3, "Operation of the METPAC System."

8.3 NRC Regulations

a. 10 CFR 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors."

b. 10 CFR 50.47b, "Emergency Plans."

c. 10 CFR 50, Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities."

d. 10 CFR 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."

8.4 FAA Regulations

a.14 CFR 77.13, "Construction or Alteration Requiring Notice."

b. 14 CFR 77.19, "Acknowledgement of Notice."

8.5 NRC Regulatory Guides

a. 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," Revision 1, June 1974.

b. 1.23, "Onsite Meteorological Programs" (Safety Guide 23), February 17, 1972.

c. 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants," Revision 3, November 1978.

 1. Section 2.3.3, "Onsite Meteorological Measurements Program."

d. 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident," Revision 3, May 1983.

e. 1.101, "Emergency Planning and Preparedness for Nuclear Power Reactors," Revision 2, October 1981.

f. 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977.

g. 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977.

h. 1.118, "Periodic Testing of Electric Power and Protection Systems," Revision 2, June 1978.

i. 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1, November 1982.

j. Draft SS 926-4, "Meteorological Programs in Support of Nuclear Power Plants," Proposed Revision 1 to Regulatory Guide 1.23, September 1980.

k. Draft ES 926-4, "Meteorological Measurement Program for Nuclear Power Plants," Second Proposed Revision 1 to Regulatory Guide 1.23, April 1986.

8.6 <u>FAA Advisory Circulars</u>

a. 70/7460-1G, "Obstruction Marking and Lighting," October 1985.

8.7 <u>Codes and Standards</u>

a. American Institute of Steel Construction, <u>Steel Construction Manual</u>, 8th Edition.

b. American National Standards Institute Standard A58.1-1982, "Minimum Design Loads for Buildings and Other Structures."

c. American National Standards Institute/Electronics Industries Association Standard ANSI/EIA-222-D-1986, "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures."

d. American National Standards Institute/American Nuclear Society Standard ANSI/ANS-2.5-1984, "Standard for Determining Meteorological Information at Nuclear Power Sites."

e. Building Officials and Code Administrators, "Basic Building Code," 1975.

f. Electronics Industries Association Standard EIA-RS-222-C (1976), "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures."

g. The Institute of Electrical and Electronic Engineers Standard IEEE 338-1977, "IEEE Standard Criteria of the Periodic Testing of Nuclear Power Generating Station Safety Systems."

8.8 Calculations

a. Ehresmann Engineering Inc. Report J.O. 1180, "Anchor Design for Tower Specialist Inc.", dated April 26, 1986 (attached to Foreign Print 4924D).

b. Yankee Nuclear Services Division Calculation No. SBC-148, "System Accuracy of Meteorological Instruments for Operational Monitoring Program," Revision 1, dated July 6, 1990.

c. Yankee Nuclear Services Division Calculation No. SBC-176, "Selection of Cable Size for Meteorological Tower Power Supply," Revision 0, dated September 23, 1986.

d. Yankee Nuclear Services Division Calculation No. SBC-326, "Backup Met Tower Design, DCR 89-035," Revision 0, dated June 29, 1989.

e. United Engineers & Constructors Inc. Calculation No. 9763-3-ED-00-20-F, "Non-Class 1E UPS Loading Calculation," Revision 3.

8.9 System Drawings

8.9.1 NHY Drawings

a. 1-NHY-301602 Temporary Power & Light 480 V One Line Diagram

b. 1-NHY-301619, Sh. L36/7 Backup Met System-Cable Schematic

c. 1-NHY-310046 460 V Motor Control Center 1-E523 One Line Diagram

d. 1-NHY-310050 480 V Unit Substation Bus 1-21 One Line Diagram

e. 1-NHY-310104, Sh. C1Ha 460 V MCC 1-E523 & Alternate Feed to Essential LTG PNL MM-212C - 3 Line dia. & Cable Schematic

f. 1-NHY-310105, Sh. EJ9a UPS ED-I-4 Non-Vital Distribution Panel ED-PP-5 Schedule

g. 1-NHY-310231 Motor Load List

h. 1-NHY-311496, Sh. L36 Lighting Panel Schedule

i. 1-NHY-350015 Bus Failure Analysis, 120 Vac Non Vital (UPS)

j. 1-NHY-506546 MET-Meteorological Monitoring Loop Diagram

k. 9763-M-301604 Temporary Power & Light 480 V Distribution Schedule

l. EOL-1-SGB-312051 Guardhouse One Line Diagram

8.9.2 Foreign Prints

a. 4924D, Meteorological Tower Anchor Replacement

b. 72687, Auxiliary Panel

c. 72688, Meteorological Cabinet Layout

d. 72689, Wiring Connections, Mainframe No. 2, Seabrook

e. 72690, Wiring Connections, Mainframe No. 1, Seabrook

f. 72691, Meteorological Block Dia., Seabrook

g. 72693, Floor Plan & Elevations, Control House, Meteorological Tower

h. 72694, Site Plan & Elevations, Tower & Control House, Meteorological Tower

i. 72695, Foundation Sect & Details, Meteorological Tower

j. 72696, Fence & Grounding, Plan & Details, Meteorological Tower

k. 72697, Architectural Elevations & Sections for Control House, Meteorological Tower

l. 72698, Section & Details, Control House, Meteorological Tower

m. 72699, A.C. Distribution Panel, Control House, Meteorological Tower

n. 72700, S.A. Meteorological Tower, Seabrook Station

o. 72701, TRC Instrumentation Conn., Meteorological Tower, Seabrook Station

p. 72702, Wiring Diagram, Entry Alarm, Meteorological Tower, Seabrook Station

q. 73728, 210' No. 80 Tower Assembly

r. 74192, Enviroplan/Seabrook 209' J-Box Wiring

s. 74193, Enviroplan/Seabrook 150' J-Box Wiring

t. 74194, Enviroplan/Seabrook 43' J-Box Wiring

u. 74195, Enviroplan/Seabrook Base "J" Box/Slp Wiring

v. 74196, Enviroplan/Seabrook Mainframe Wiring

w. 74197, Modlr Metrl Sys Bk Enviroplan Climatron

x. 74198, Modlr Metrl Sys Bk 2 Enviroplan Climatro

y. 74199, Enviroplan/Seabrook Output Terminal Panel

z. 74200, Auxiliary Panel Rear View

aa. 74201, Enviroplan/Seabrook Tower Site Detail

bb. 74566, PC Workstation Instruction Manual

cc. 74671, Climatronics Instruction Manual

dd. 74672, Campbell Micrologger Instruction Manual

ee. 74673, DDA-06 Instruction Manual

ff. 77499, Chessel 4250M Instruction Manual

gg. 77500, Chessel 4250C Instruction Manual

8.10 Design Change Requests and Engineering Change Authorizations (ECA)

a. DCR 86-425, Seabrook Meteorological Tower Backup Power

b. DCR 87-094, Alternate Power Supply to Sec. Equipment

c. DCR 89-035, Backup Meteorological Monitoring System

d. ECA 03/117088, Conduit and Box Installation Plan for Met Tower Refurbishment

e. ECA 98/118117, Can the Esterline Angus Multipoint Recorder Be Replaced by a Chessel Model 4001

f. DCR 92-004, Moisture Separator Reheater Control System Replacement

g. 03MSE144-00, MET Tower AC and Heating System

h. 95MMOD622, Delete Dewpoint and Precipitation Instruments

i. 99MMOD584, MET Tower Recorder MET-UR-1 Replacement

j. 07MSE148, 1-MET-LE-1 Model Change for Replacement MET Rain Gauge

8.11 <u>Procedures</u>

a. Procedure No. IN0654.510, Backup Met System Calibration

b. Procedure No. IN0654.525, Met System Calibration - Non Tech Spec

c. Procedure No. IX0654.500, Met System Calibration - Tech Spec

d. Procedure No. IX0654.550, Met System Checks/Data Collection

8.12 <u>Miscellaneous</u>

a. NHY Computer Development Department Report, "Meteorological Monitoring System Functional Description," dated June 4, 1986.

b. NHY Computer Development Department Report, "Meteorological Data Link Functional Description," dated February 1988.

c. NHY memorandum, NA Pillsbury to Distribution, "Meteorological Tower and Instrumentation Refurbishment Coordination Meeting," SS# 23699, IRT-86-047, dated March 24, 1986.

d. NRC letter, TT Martin to RJ Harrison, "Inspection Report No. 50-443/85-32," dated February 18, 1986.

e. NRC letter, TT Martin to RJ Harrison, "Inspection Report No. 50-443/86-18," dated May 15, 1986.

f. NRC letter, TT Martin to RJ Harrison, "Inspection Report No. 50-443/86-30 Addendum," dated August 1, 1986.

g. NRC letter, EC Wenzinger to RJ Harrison, "Inspection No. 50-443/86-46," dated October 22, 1986.

h. YNSD memorandum, J DeVincentis to GS Thomas, "Engineering Review of the Meteorological Monitoring System," SBE-86-055, dated January 23, 1986.

i. Deleted

j. YNSD memorandum, RB Harvey/RJ DeLoach to JM Vargas, "Evaluation of the Seabrook Station Meteorological Monitoring System (YSR 89-003)," SBP 89-109, REG 26/89, dated February 16, 1989.

k. YNSD memorandum, RB Harvey to WN Fadden, "Backup Met Tower Data Processing (DCR 89-0035)," REG 119/89, dated June 14, 1989.

l. Climatronics letter (with catalog information), SR Rosten to WN Fadden, dated April 10, 1989.

9.0 SUMMARY OF CHANGES

0	Original Issue
1	Incorporate DCR 92-004, Partial Incorporation of UFSAR 94-009 (Delete Dewpoint Sensor Requirements)
2	Reformatted to EDI 30020 Rev. 4 Chg 2. Incorporated 03MSE144-00, 07MSE148, 95MMOD622-00 and 99MMOD584-00

SEABROOK STATION

DESIGN BASIS DOCUMENT

METEOROLOGICAL MONITORING SYSTEM

DBD-MET-01

Revision 3

Effective Date:

10/19/10

Preparer:	Originator	9/27/10 Date
Reviewed By:	R.W. Madea Independent Reviewer	9/27/10 Date
Reviewed By:	Engineering Supervisor	9/28/10 Date
Reviewed By:	Engineering Manager	9/28/10 Date
Approved By:	Director of Nuclear Engineering	9/28/10 Date

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1.0 INTRODUCTION

1.1 Purpose

This Design Basis Document (DBD) provides the design bases and descriptive information for the Seabrook Station Meteorological Monitoring System (Met System).

This DBD describes the Met System general and specific functional requirements as well as the design basis for major Met System components. It also lists source references and rationale used to identify these design bases. In addition, the DBD lists or references applicable Codes and Standards, Regulatory Criteria, Key System Calculations, and Technical Requirements pertaining to the Met System.

The DBD is intended to be used as an aide in making decisions on plant modifications, provide background for future Technical Requirement evaluations, and to provide background for making 10CFR50.59 evaluations.

1.2 Scope

The scope of this document is limited to those components within the Met and Miscellaneous Instrument (MM) Systems that monitor, process and display meteorological information for use during normal plant operations and emergencies. The Met System consists of the instrumentation shown on loop drawing 1-NHY-506456 and the required support systems and components.

1.3 System Functional Boundaries

1.3.1 Electrical Boundaries

The Primary Met System, including the instrument shelter, receives power from 480 Volt lighting panel EL 32 in the Guardhouse.

The Backup Met System receives power from lighting panel L36 located in Settling Basin Control Panel, Node G22. The Shift Superintendent's Workstation Computer (SSW Computer) is powered from 120 Vac panel ED-PP-5.

1.3.2 Instrumentation Boundaries

The instrumentation boundary is the connection to the Main Plant Computer System's (MPCS) Intelligent Remote Termination Units (IRTU). The Met System specific algorithms are included but the MPCS software is not.

1.3.3 Mechanical Boundaries

The Met System includes: the primary tower and associated foundations, guys, and anchors; the primary tower instrument shelter and ventilating equipment, the backup tower and its attachment to the settling basin outlet structure; and the settling basin outlet instrument shelter, its attachment to the settling basin outlet structure, and its heating and ventilating equipment.

2.0 CODES AND STANDARDS

2.1 NRC Regulations

a. 10 CFR 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors."

b. 10 CFR 50.47b, "Emergency Plans."

c. 10 CFR Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities."

d. 10 CFR Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion `As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."

2.2 FAA Regulations

a. 14 CFR 77.13, "Construction or Alteration Requiring Notice."

b. 14 CFR 77.19, "Acknowledgement of Notice."

2.3 NRC Regulatory Guides

a. 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," Revision 1, June 1974.

b. 1.23, "Onsite Meteorological Programs" (Safety Guide 23), February 17, 1972.

c. 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants," Revision 3, November 1978.

   1. Section 2.3.3, "Onsite Meteorological Measurements Program."

d. 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident" Revision 3, May 1983.

e. 1.101, "Emergency Planning and Preparedness for Nuclear Power Reactors," Revision 2, October 1981.

f. 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977.

g. 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977.

h. 1.118, "Periodic Testing of Electric Power and Protection Systems," Revision 2, June 1978.

i. 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1, November 1982.

j. Draft SS 926-4, "Meteorological Programs in Support of Nuclear Power Plants," Proposed Revision 1 to Regulatory Guide 1.23, September 1980.

k. Draft ES 926-4, "Meteorological Measurement Program for Nuclear Power Plants," Second Proposed Revision 1 to Regulatory Guide 1.23, April 1986.

2.4 FAA Advisory Circulars

a. 70/7460-1G, "Obstruction Marking and Lighting," October 1985.

2.5 Applicable NUREGs

a. NUREG-0654, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," Revision 1, February 1981.

b. NUREG-0696, "Functional Criteria for Emergency Response Facilities," February 1981.

c. NUREG-0737, "Clarification of TMI Action Plan Requirements," November 1980.

d. Supplement 1 to NUREG-0737, "Clarification of TMI Action Plan Requirements," December 17, 1982.

e. NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants."

   1. Section 2.3.3, "Onsite Meteorological Measurements Programs," Revision 2, July 1981.

f. NUREG-0896, "Safety Evaluation Report Related to the Operation of Seabrook Station, Units 1 and 2," March 1983.

   1. Section 2.3.3, "Onsite Meteorological Measurements Program."

g. NUREG-0896, "Safety Evaluation Report Related to the Operation of Seabrook Station, Units 1 and 2," Supplement No. 5, July 1986.

1. Section 2.3.3, "Onsite Meteorological Measurements Program."

h. NUREG-1331, "Technical Specifications, Seabrook Station, Unit 1," March 1990.

1. Section 6.8.1.4, "Annual Radioactive Effluent Release Report."

2.6 Industry Standards

a. American Institute of Steel Construction, Steel Construction Manual, 8th Edition.

b. American National Standards Institute Standard A58.1-1982, "Minimum Design Loads for Buildings and Other Structures."

c. American National Standards Institute/Electronics Industries Association Standard ANSI/EIA-222-D-1986, "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures."

d. American National Standards Institute/American Nuclear Society Standard ANSI/ANS-2.5-1984, "Standard for Determining Meteorological Information at Nuclear Power Sites."

e. Building Officials and Code Administrators, "Basic Building Code," 1975.

f. Electronics Industries Association Standard EIA-RS-222-C (1976), "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures."

g. The Institute of Electrical and Electronic Engineers Standard IEEE 338-1977, "IEEE Standard Criteria of the Periodic Testing of Nuclear Power Generating Station Safety Systems."

3.0 ABBREVIATED SYSTEM DESCRIPTION

3.1 System Functional Description

3.1.1 Primary Met System

The Primary Meteorological Monitoring System (Primary Met System) utilizes a 210-foot high guyed tower located approximately 1700 feet northwest of the Unit 1 Containment Structure at a grade elevation of approximately 10 feet MSL, 10 feet below plant grade. Instrument booms are located approximately 43 feet (13.1 meters), 150 feet (45.7 meters), and 209 feet (63.7 meters) above the base of the tower.

The following parameters are measured on the primary tower:

Parameter	Tower Elevation	Height Above MSL

Wind Speed	43 feet 209 feet	53 feet 219 feet
Wind Direction	43 feet 209 feet	53 feet 219 feet
Temperature	43 feet	53 feet
Temperature Difference	150-43 feet 209-43 feet	160-53 feet 219-53 feet
Solar Radiation	10 feet	20 feet
Precipitation	Ground level	10 feet

All signals from the primary tower's sensors are routed via above-ground conduit to signal translators located in a nearby instrument shelter.

The signal translators convert the sensor signals to a 0-5 Volt dc output over the full instrument range. The translator outputs are monitored directly by strip chart recorders located in the instrument shelter. The translator outputs are also monitored by the Main Plant Computer System (MPCS) which samples each meteorological parameter once every five seconds and compiles the data statistics shown in Table 3-1. The most recent instantaneous data values and the MPCS-compiled data statistics are available for on-demand display on MPCS terminals located in the Control Room (CR) and other locations for emergency response and meteorological-related functions. In addition, every fourth 15-minute data value (e.g., one 15-minute value per hour) is archived for long-term storage by the MPCS. The previous 24 hours of archived data values can also be displayed on-demand in the CR, TSC, and EOF.

3.1.2 Backup Met System

The Backup Meteorological Monitoring System (Backup Met System) utilizes a 30-foot high free-standing tower (with a 7-foot mast) located approximately 200 feet southeast of the primary meteorological tower. The backup tower is mounted atop the Settling Basin Outlet Structure at a grade elevation of approximately 16 feet MSL, 4 feet below plant grade.

The following parameters are measured on the backup tower:

Parameter	Tower Elevation	Height Above MSL
Wind Speed	37 feet	53 feet
Wind Direction	37 feet	53 feet

Signals from the backup tower's sensors are routed to a Data Acquisition System (DAS) located in a nearby instrument shelter. The DAS samples wind speed, wind direction, and ac power status data every three seconds and transmits these data to the Shift Superintendent's Workstation Computer (SSW Computer) in the Control Room. The SSW Computer receives the data transmissions from the DAS and generates and displays the data statistics shown in Table 3-2. These statistics, as well as the latest three-second sample values and the remote site ac power status, are available for display on demand on a video terminal in the Control Room. Wind speed and wind direction averages, wind direction standard deviation, and stability class data from the Backup Met System are also available for display on the MPCS.

3.2 Component Description

3.2.1 Primary Met System

3.2.1.1 Tower

The primary tower is a guyed 210-foot high Rohn Model No. 80 structure constructed in an equilateral triangular open lattice pattern. All members are tubular galvanized steel with bolted cross-bracing connections. The foundations for the tower and guy wire anchors are reinforced concrete.

The tower is designed and constructed in accordance with the requirements of EIA-RS-222-C. It is designed for a 40 lbs/ft^2 basic wind load which corresponds to a 100 mph basic wind speed.

The tower is provided with aircraft obstruction lighting, consisting of a flashing red beacon mounted on-top of the tower and two steady burning red side lights located approximately half-way up the tower. An ammeter located in the instrument shelter monitors the operation of the tower lights. The tower is also painted with seven equal-width alternate bands of aviation orange and white paint.

The tower has three lengths of conduit extending up the tower which contain the cables for the tower's electrical needs and sensors. One conduit contains power cables for the aspirated radiation shield motors, wind system heaters, and outlets at each level of instrumentation. The second conduit contains the wiring for the tower's lighting system. The third conduit contains cables from the tower's sensors. Cable pull boxes and electrical boxes for the sensor cables are located at different levels on the tower.

Protection of the tower against lightning is provided by means of a 6-foot copper lightning rod mounted on the tower beacon plate. A 4/0 copper cable connects the lightning rod to the tower grounding system. The guy wires of the tower are grounded by means of a copper cable connected to a ground rod. The tower grounding system is connected to the station grounding system.

3.2.1.2 Instrumentation

a. Wind Speed

The wind speed sensors consist of Climatronics anemometer cup sets attached to Climatronics F460 transducers. The transducer/cup combination has the following operating characteristics:

accuracy	±0.15 mph or ±1.0% of true air speed, whichever is greater
threshold	0.5 mph
distance constant	5.0 ft of air maximum
operating range	0 to 100 mph
operating temperature	-40 to +140 deg F

The transducers are mounted on Climatronics F460 cross-arms which are located on booms extending approximately 10 feet (2.9 tower widths) away from the tower. The booms extend from the tower in the west-southwest direction, which is the same side of the tower as the annual prevailing wind direction (west-northwest). The cross-arms are oriented along the true north/south axis. External thermostatically-controlled 20 Watt, 110 Volt ac heaters are used to minimize sensor shaft freeze-up in cold weather.

Signals from the wind speed transducers are provided to Climatronics wind speed/wind direction translators located in the instrument shelter. These translators convert the signals from the wind speed and direction transducers into a 0 to 5 Volt dc signal for output to the MPCS and the strip chart recorders. Operating characteristics of the wind translators are as follows:

wind speed accuracy	±0.03 mph or ±0.2% of measured air speed, whichever is greater
wind direction accuracy	±0.2%
temperature coefficient	±0.005% per deg F
operating temperature	-4 to +140 deg F
time constant	3 sec

b. Wind Direction

The wind direction sensors consist of Climatronics light-weight vanes attached to Climatronics F460 transducers. The transducer/vane combination has the following operating characteristics:

accuracy	±2 deg

threshold	0.5 mph
distance constant	3.7 ft of air maximum
damping ratio	0.4 at 10 deg initial angle of attack
operating range	0 to 360 deg
operating temperature	-40 to +140 deg F

The wind direction transducers are mounted on the same cross-arms as the wind speed transducers. External thermostatically-controlled 20 Watt, 110 Volt ac heaters are used to minimize sensor shaft freeze-up in cold weather.

Signals from the wind direction transducers are provided to the same Climatronics wind speed/wind direction translators used to process the wind speed data. These translators convert the signals from the wind direction transducers into a 0 to 5 Volt dc signal for output to the MPCS and the strip chart recorders. Operating characteristics of the wind translators were provided previously.

c. Temperature

Ambient temperature is measured using a platinum, 4 wire, 100 Ω resistance temperature sensor mounted in a Climatronics TS-10 motor-aspirated temperature shield. The temperature sensor has the following operating characteristics:

accuracy	±0.09 deg F over full range
range	-58 to +122 deg F
time constant	5.5 sec

The temperature shield has the following operating characteristics:

effectiveness	measurement errors due to radiation will not exceed 0.18 deg F under radiation intensities of 1.6 cal/cm^2-min
operating temperature	-40 to +130 deg F

A Climatronics temperature translator located in the instrument shelter converts the non-linear resistance versus temperature relationship of the sensor into a 0 to 5 Volt dc signal for output to the MPCS and the strip chart recorder. Operating characteristics of the temperature translators are as follows:

accuracy	±0.07%

temperature coefficient	±0.025% per deg F
operating temperature	-4 to +140 deg F
humidity	0 to 95% without condensation

d. Temperature Difference

Temperature difference (delta-temperature) is measured using the ambient temperature sensor and a second platinum resistance temperature sensor mounted in a second Climatronics TS-10 motor-aspirated temperature shield. A Climatronics temperature difference translator located in the instrument shelter converts the non-linear resistive output of the second temperature sensor into a voltage which is linearly proportional to the measure temperature. This temperature is compared with the reference temperature signal from the ambient temperature translator to derive a 0 to 5 Volt dc signal for output to the MPCS and the strip chart recorder.

The temperature sensor and temperature shield operating characteristics have been provided previously. Operating characteristics of the temperature-difference translators are as follows:

accuracy	±0.2%
temperature coefficient	±0.035% per deg F
operating temperature	-4 to +140 deg F
humidity	0 to 95% without condensation

e. Precipitation

Precipitation is measured using a heated tipping bucket rain gauge. Each tip of the bucket mechanism equals 0.01 in of water. The rain gauge has the following operating characteristics:

accuracy	±1% of rainfall rate of 1-3 in/hr
	±3% of rainfall rate of 0-6 in/hr
sensitivity	0.01 in
min operating temperature	-22 deg F

A Climatronics precipitation translator located in the instrument shelter converts the switch inputs from the rain gauge to a stepped analog voltage for output to the MPCS and the strip chart recorder.

f. Solar Radiation

Solar radiation is measured using an Eppley 8-48 pyranometer with the following characteristics:

temperature dependence	±1.5% from -4 to +104 deg F
linearity	±1% from 0 to 2 Langley/min
response time	3 to 4 seconds
cosine response	±2% from normalization 0-70 deg zenith angle, ±5% 70-80 deg zenith angle

A solar radiation translator located in the instrument shelter converts the solar radiation sensor's millivolt signal into a 0 to 5 Volt dc signal for output to the MPCS and strip chart recorder. Operating characteristics of the solar radiation sensor are as follows:

conversion accuracy	±0.2%
temperature coefficient	±0.005% per deg F
operating temperature	-4 to +140 deg F

g. Mainframe

Two Climatronics mainframes (module racks) provide mechanical support and electrical connections for the system's translators. One mainframe contains the translators for the Technical Requirement parameters (e.g., the two wind speed/wind direction translators, the one temperature translator, and the two temperature difference translators); the second mainframe contains the translators for the remaining parameters (e.g., the dew point, precipitation, and solar radiation translators).

Each mainframe has its own 12 Volt dc power supply which supplies power for both the sensors and translators plugged into it. The power supplies have the following operating characteristics:

power input	117 Volts ac ±10%, 1 amp max, 50/60 Hz with surge suppression
operating temperature	-40 to +140 deg F

h. Strip Chart Recorders

The level of wind speed and direction data is continuously recorded on a Chessel 4250C recorder with the following operating characteristics:

accuracy	±0.1%
operating temperature	32 to 122 deg F

The remaining parameters (temperature, temperature difference, dew point, precipitation, and solar radiation) are recorded on an Chessel 4250M multipoint recorder with the following operating characteristics:

accuracy	±0.1%
operating temperature	32 to 122 deg F
humidity	10 to 90% without condensation

3.2.1.3 Power Supply

A 15 kVA transformer and distribution panel located in the instrument shelter supplies the power requirements for the instrument shelter (e.g., lighting, HVAC, instruments, etc.) as well as the instrumentation and lighting located on the tower. The transformer including distribution panel is powered from 480 Volt lighting panel EL 32 in the Guardhouse, which is fed from 480 Volt MCC-E523. MCC-E523 is supplied from off-site power during normal operation through Bus E5 and backed up by the station's Train A diesel generator (DG-1A) during loss-of-offsite-power.

An alternative power supply to lighting panel EL 32 is provided from panel PP-172 by a manual transfer switch in the Guardhouse. PP-172 is supplied power from 480 Volt unit substation US-21 which is supplied from off-site power through Bus-2. This will provide an alternative method for powering the Primary Met System when Bus E5/US-E52/MCC-E523 are taken out of service for maintenance.

3.2.1.4 Instrument Shelter

The instrument shelter is a single story reinforced concrete and concrete masonry block structure with a concrete slab foundation. The shelter is finished on the outside with metal siding and an elastomeric roof. The shelter was designed and constructed in accordance with the requirements of BOCA Basic Building Code - 1975, per discussion with Bill Brecknock of PSNH's Civil Engineering Department.

The ability of structures supporting operation of the Primary Met System (including the instrument shelter) to withstand winds in excess of 50 mph was demonstrated during hurricane Gloria in September 1985 when a peak gust wind speed of 65 mph was measured by the Primary Met System upper level.

The HVAC system consists of a wall-mounted electric heating/cooling unit and a baseboard electric heater. The wall-mounted unit has a cooling capacity of 15,000 Btus/hr and a heating capacity of 16,700 Btus/hr. Both the wall-mounted unit and baseboard heaters are controlled by thermostats internal to the units. Operating experience has shown that this equipment can maintain the temperature in the range of 68 to 82 deg F.

3.2.2 Backup Met System

3.2.2.1 Tower

The backup tower is a self-supporting 30-foot high Universal Manufacturing Corporation Model No. C-33 HD structure constructed in a triangular open lattice pattern. A 7-foot aluminum mast extends above the top of the tower. The main structural members are tubular aluminum. The bracing is circular aluminum bar welded to the main structural tubes. The tower is a tilt-down design, i.e., the base incorporates a hinge to allow lowering of the tower for instrument mounting and maintenance. The base for the tower is mounted on top of a 2-foot thick concrete wall which is part of the outlet structure for the settling basin.

The tower is designed in accordance with EIA-RS-222-C. It is designed for a minimum 85 mph wind load which is the minimum basic wind speed requirement of ANSI A58.1-1982.

Protection of the tower against lightning is provided by means of a lightning point (rod) mounted on top of the tower. A #2 AWG copper cable connects the lightning point to the station ground grid.

The signal and sensor heater cables are connected to the DAS by a prefabricated vendor supplied signal cable. The cables on the tower are tie-wrapped to the tower structure. From the base of the tower, the cables are routed in conduit to the instrument shelter.

3.2.2.2 Instrumentation

a. Wind Speed

The wind speed sensor consists of a Climatronics anemometer cup set attached to a Climatronics F460 transducer. This is the same sensor used to measure wind speed on the primary tower. The transducer/cup combination has the following operating characteristics:

accuracy	±0.15 mph or ±1.0% of true air speed, whichever is greater
threshold	0.5 mph
distance constant	5.0 ft of air maximum
operating range	0 to 125 mph
operating temperature	-40 to +140 deg F

The wind speed transducer is mounted on a Climatronics F460 cross-arm attached to the top of the tower's 7-foot mast. The cross-arm is oriented along the true north/south axis. An external thermostatically-controlled 20 Watt, 110 Volt ac heater is used to minimize sensor shaft freeze-up in cold weather. An ac current meter in the instrument shelter provides indication of ac heater current.

b. Wind Direction

The wind direction sensor consists of a Climatronics light-weight vane attached to Climatronics F460 transducer. This is the same sensor used to measure wind direction on the primary tower. The transducer/vane combination has the following operating characteristics:

accuracy	±2 deg
threshold	0.5 mph
distance constant	3.7 ft of air maximum
damping ratio	0.4 at 10 deg initial angle of attack
operating range	0 to 360 deg
operating temperature	-40 to +140 deg F

The wind direction transducer is mounted on the same cross-arms as the wind speed transducer. An external thermostatically-controlled 20 Watt, 110 Volt ac heater is used to minimize sensor shaft freeze-up in cold weather. An ac current meter in the instrument shelter provides indication of ac heater current.

c. Data Acquisition System (DAS)

Signals from the wind speed and wind direction transducers are provided to a Climatronics IMP-850 datalogger DAS located in the instrument shelter. The DAS converts the wind speed sensor output to mph and the wind direction sensor output to degrees. These data are digitally transmitted every three seconds to SSW Computer in the Control Room via a 1200 Baud half-duplex FSK (Frequency Shift Keying) modem over a singe pair of telephone wires. Special circuit protectors and special cross wires were used in the Operational Support Building telephone room and in room 100 of the Administration Building to identify these as special circuits, not normal telephone circuits. Surge suppression is provided on the signal and power lines.

Operating characteristics of the DAS are as follows:

wind speed accuracy ±0.015 mph or ±0.1% of true air speed, whichever is greater

wind direction accuracy ±0.4 deg

d. Shift Superintendent's Workstation Computer (SSW Computer)

The Control Room SSW Computer consists of a Dell System 310 IBM-compatible personal computer with monitor and keyboard and an analog output board. (The monitor is shared with the secondary plant supervisory control workstation monitor located at that location). The SSW Computer receives data from the DAS every three seconds. The 15-minute data statistics shown in Table 3-2 are generated every fifteen minutes and are available for display on demand on the SSW Computer's video monitor. The SSW Computer also displays the date, time, time of sunrise/sunset, time of calculation (all in Eastern Standard Time), data validity, and ac power status. In addition, analog outputs of wind speed and wind direction averages, wind direction standard deviation, and stability class are provided for input to the MPCS.

3.2.2.3 Power Supply

The AC power supply for the instrumentation and heaters located on the tower and in the instrument shelter is from Lighting Panel L36 circuits and is independent of the normal power supply for the Primary Met System instrumentation. Panel L36 is located in Settling Basin Control Panel, Node G22, and is supplied from 480 Volt distribution panel LC1 (ED-PP-9A) in the Sewage Treatment Building. Panel LC1 is supplied from the Exeter-Hampton off-site power system. A battery is provided to supply the DAS if ac power is lost.

The Control Room SSW Computer power supply is from 120 Volt ac panel ED-PP-5 which is supplied by nonsafety-related Inverter ED-I-4.

3.2.2.4 Instrument Shelter

The instrument shelter is a prefabricated fiberglass enclosure manufactured by Plastic-Fab, Inc. The enclosure is mounted on a steel grating platform on the settling basin structure. The shelter and its anchorage are designed for 85 mph wind loads calculated in accordance with the Uniform Building Code - 1985, Section 2311. The ability of other structures supporting operation of the Backup Met System to withstand winds in excess of 50 mph was demonstrated during hurricane Gloria in September 1985 when a peak gust wind speed of 65 mph was measured by the Primary Met System upper level.

The shelter's heating system consists of a Singer wall-mounted 500-watt (1707 Btus/hr), 120 Volt electric heater. An integral thermostat/off-on switch controls the heater. The shelter is also equipped with 115 Volt dual exhaust fans. Fan capacity is 220 cfm free air and is controlled with a thermostat/off-on switch.

TABLE 3-1

List of Primary Met System Data Statistics
Compiled and Displayed by the MPCS

Parameter	Statistic[a]	Range	Accuracy
Wind Speed	instantaneous	0 to 100 mph	±0.29 mph @ 5 mph
	3-minute average	"	±0.29 mph @ 15 mph
	15-minute average	"	±0.36 mph @ 25 mph
Wind Direction	instantaneous	0 to 540 deg	±2.9 deg
	3-minute average	0 to 360 deg	
	15-minute average	"	
	15-minute standard deviation	0 to 99 deg	
Temperature	instantaneous	-30 to +110 deg F	±0.45 deg F
	15-minute average	"	
Temperature Difference	instantaneous	-10 to +18 deg F	±0.18 deg F
	15-minute average	"	
Solar Radiation	instantaneous	0 to 2 Langley/min	±0.05 Langley /min[c]
	15-minute average	"	"
Precipitation	15-minute total	0 to 0.99 in	±0.01 in @ 1 in/hr

(a) Each 3-minute data value is updated on-the-hour and every 3 minutes thereafter; each 15-minute data value is updated on-the-hour and every 15 minutes thereafter.

(b) Deleted

(c) For zenith angles between 0 and 70 deg.

TABLE 3-2

List of Backup Met System Data Statistics
Compiled and Displayed by the SSW Computer

Parameter	Statistic[a]	Range	Accuracy
Lower Wind Speed	instantaneous 15-minute average	0 to 100 mph "	±0.15 mph @ 5 mph ±0.15 mph @ 15 mph ±0.25 mph @ 25 mph
Lower Wind Direction	instantaneous 15-minute average 15-minute standard deviation	0 to 360 deg " 0 to 100 deg	±2.0 deg
Upper Wind Speed	15-minute average[b]	0 to 100 mph	NA
Upper Wind Direction	15-minute average[c]	0 to 360 deg	NA
Stability Class	15-minute value[d]	A to G	NA
Equivalent 150'-43' Temperature Difference	15-minute average[e]	-1.2 to +4.0 deg F	NA
Equivalent 209'-43' Temperature-Difference	15-minute average[e]	-1.8 to +4.0 deg F	NA

(a) Each 15-minute data value is updated on-the-hour and every 15 minutes thereafter.

(b) The upper wind speed is estimated as a function of lower wind speed and equivalent delta-temperature.

(c) The upper wind direction is estimated as a function of lower wind direction.

(d) Atmospheric stability class is estimated as a function of wind speed, wind direction standard deviation, and time-of-day (daytime versus nighttime).

(e) The equivalent 150'-43' and 209'-43' delta-temperatures are estimated as a function of stability class.

4.0 SYSTEM DESIGN BASIS

The intent of the on-site meteorological monitoring program is to provide the meteorological data needed to estimate potential radiation doses resulting from the routine or accidental release of radioactive material to the atmosphere. The meteorological monitoring program also provides information for supporting the operation of the Cooling Tower during normal plant operating conditions and for identifying high wind speeds for initiating Emergency Action Levels.

The system is classified as nonsafety related containing non-Class 1E equipment and is non-seismically qualified. Regulatory Guide 1.97 classifies the Primary Meteorological Monitoring System wind speed, wind direction, and temperature difference parameters as Design Category 3, Type E variables.

4.1 Primary Met System

The design requirements applicable to the Primary Meteorological Monitoring System (Primary Met System) were derived primarily from the following documents:

Regulatory Guide 1.23 (Safety Guide 23)

Regulatory Guide 1.97

Supplement 1 to NUREG-0737

ANSI/ANS-2.5-1984

Post-TMI documents NUREG-0654 (Appendix 2) and NUREG-0737 (Item III.A.2) specified additional meteorological monitoring system requirements and endorsed Proposed Revision 1 to Regulatory Guide 1.23 (Draft SS 926-4). Subsequently, however, Supplement 1 to NUREG-0737 provided clarification on certain basic post-TMI requirements, including the meteorological items discussed in NUREG-0654 and NUREG-0737. Supplement 1 to NUREG-0737 called for providing reliable indication of the meteorological variables specified in Regulatory Guide 1.97 (e.g., wind speed, wind direction, and temperature difference) in the Control Room, Technical Support Center, and the Emergency Operations Facility. No changes to existing meteorological monitoring systems were necessary if they had historically provided reliable indication of meteorological conditions in the vicinity (up to about 10 miles) of the plant site. ANSI/ANS-2.5-1984 subsequently reiterated the meteorological-related items in Supplement 1 to NUREG-0737 and Regulatory Guide 1.97, and the Second Proposed Revision 1 to Regulatory Guide 1.23 (Draft ES 926-4) subsequently endorsed ANSI/ANS-2.5-1984.

4.1.1 Tower

a. A tower or mast approximately 60 meters (197 feet) high is required in order to obtain the necessary meteorological measurements. ANSI/ANS-2.5-1984 specifies that the tower site should represent as closely as possible the same meteorological characteristics as the region into which any airborne material will be released. Both Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 specify that the tower should be sited at approximately the same elevation as finished plant grade and should be located in an area where natural or man-made obstructions and the plant's heat dissipation system will have little or no influence on meteorological measurements. Where practical, the tower should be located over level, open terrain covered with short grass or natural earth at a distance of at least ten times the height of any nearby obstruction.

4.1.2 Instrumentation

a. Regulatory Guide 1.97 specifies that the instrumentation should be of high-quality commercial grade and should be selected to withstand its specified service environment.

b. ANSI/ANS-2.5-1984 specifies that to minimize the impact of damage due to direct lightning strike or electrical power surges, the instrumentation should be protected by grounding and be provided with surge protection devices on the incoming power lines and signal lines.

c. Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 specify that in order to obtain the basic meteorological information required for estimates of atmospheric transport and diffusion, wind speed and wind direction measurements at a minimum of two levels and a least one measurement of air temperature difference should be provided on one tower.

d. Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 specify that the lower set of wind speed, wind direction, and temperature difference instrumentation should be mounted at an elevation of approximately 10 meters (33 feet) above the ground (interpreted to be ground elevation near the release point). The 10-meter level is generally accepted as a standard meteorological reference measurement level. Because Seabrook's primary meteorological tower is located at elevation 10 ft MSL (10 feet below plant grade of 20 ft MSL), the lower level wind and temperature data are collected at a tower elevation of 13.1 meters (43 feet) in order to be representative of meteorological conditions at approximately 10 meters (33 feet) above plant grade. The wind data from this lower level are used to analyze atmospheric transport and diffusion characteristics of ground-level radiological releases.

e. Regulatory Guide 1.23 specifies that the upper set of wind speed, wind direction, and temperature difference instrumentation should be mounted at the height of release of radioactive material (e.g., plant vent height) but should be positioned not less than 30 meters (98 feet) above the lower sensor set. ANSI/ANS/2.5-1984 specifies that the upper set of wind and temperature difference sensors should be monitored at approximately 60 meters (197 feet) to coincide with the normal light-water-reactor release level (Seabrook Station's Primary Vent Stack release point is approximately 58 meters above plant grade). Because Seabrook's primary meteorological tower is located at elevation 10 ft MSL (10 feet below plant grade of 20 ft MSL), the upper level wind and temperature data are collected at a tower elevation of 63.7 meters (209 feet) in order to be representative of meteorological conditions at approximately 60 meters (197 feet) above plant grade. The wind data from this upper level are used to analyze atmospheric transport and diffusion characteristics of primary-vent-stack radiological releases.

f. Temperature difference data provide an estimate of atmospheric stability (e.g., the amount of air turbulence available to disperse a plume). One set of temperature difference data is collected between the tower elevations of 13.1 meters (43 feet) and 63.7 meters (209 feet) to correspond to Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 specifications; a second set of temperature difference data is collected between the tower elevations of 13.1 meters (43 feet) and 45.7 meters (150 feet) in order to correspond with the temperature difference data set collected during the plant's construction licensing phase.

g. Technical Requirement 22, TR22-3.3.3.4 requires: (i) wind speed and wind direction be measured at nominal tower elevations of 43 feet and 209 feet; and (ii) temperature difference be measured between tower elevations 43 ft and 150 ft and between tower elevations 43 ft and 209 ft.

h. Regulatory Guide 1.23 specifies that temperature and dew point (or humidity) should be measured at sites where there is a potential for fogging or icing due to an increase in atmospheric moisture content caused by plant operation. ANSI/ANS-2.5-1984 specifies that ambient temperature and ambient moisture (e.g., relative humidity, dew point, or wet bulb) should be monitored when cooling towers or spray ponds are used. Both Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 specify that temperature and humidity should be measured at approximately 10 meters. Because the primary meteorological tower is located at elevation 10 ft MSL (10 feet below plant grade), Seabrook's temperature data is collected at an tower elevation of 13.1 meters (43 feet) to be representative of meteorological conditions at 10 meters (33 feet) above plant grade. The routine collection of humidity (dew point) data has been discontinued since the infrequent operation of the cooling tower minimizes the potential for fog or ice formation. The data required to support operation of the cooling tower during normal plant operation is now collected manually through the use of a psychrometer.

i. ANSI/ANS-2.5-1984 specifies that precipitation should be measured at or within one-half mile of the primary meteorological tower. Precipitation data are used to quantify the effects of washout on airborne radionuclide concentrations.

j. Although not specified by any guidance documents, solar radiation data are collected to quantify the effects of certain meteorological phenomena associated with coastal sites on atmospheric transport and diffusion.

k. Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 specify that the basic reduced data should be hourly averaged. A continuous 15-minute average may be utilized to represent the hourly average. ANSI/ANS-2.5-1984 states that if a 15-minute average is utilized, the same 15-minute period each hour should be used.

l. The Annual Radioactive Effluent Release Report in accordance with Technical Specification Item 6.8.1.4 includes an annual summary of meteorological data. Consequently, long-term continuous archiving of the hourly wind speed, wind direction, and temperature difference database is required.

m. Three-minute average wind speed and direction data are available via the Main Plant Computer System (MPCS) per request of the Emergency Operations Facility Response Manager to allow early detection of rapidly changing meteorological conditions during radiological emergencies.

n. Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 both specify that dual recording systems should be utilized for data acquisition. Regulatory Guide 1.23 specifies that either redundant digital recorders or a digital recorder supplemented by analog (e.g., strip chart) recorders may be used; ANSI/ANS-2.5-1984 specifies that both a digital and an analog system should be used.

o. Regulatory Guides 1.23 and 1.97, Supplement 1 to NUREG-0737, and ANSI/ANS-2.5-1984 specify that data from the Primary Met System should be available for monitoring by Control Room (CR) personnel during plant operation. Regulatory Guide 1.97 specifies that the data may be displayed on an individual device or they may be processed for display on-demand. To the extent practicable, the same instruments should be used for accident monitoring as are used for the normal operations of the plant to enable the operators to use, during accident situations, instruments with which they are familiar.

p. Supplement 1 to NUREG-0737 and ANSI/ANS-2.5-1984 specify that following an accident, wind speed, wind direction, and atmospheric stability (e.g., temperature difference) data should be available for monitoring at the Technical Support Center (TSC) and Emergency Operations Facility (EOF). Supplement 1 to NUREG-0737 specifies that the TSC and EOF should be capable of reliable collection, storage, analysis, display, and communication of meteorological information. ANSI/ANS-2.5-1984 specifies that the data available to the CR, TSC, and EOF should include a time history record (e.g., either analog charts or digital printout) of wind speed and direction as well as a measure of atmospheric stability (e.g., temperature difference).

q. Regulatory Guide 1.23 specifies that the instrumentation should be inspected and serviced at a frequency which will assure at least a 90% data recovery and minimize extended outages. ANSI/ANS-2.5-1984 specifies that the instrumentation should be inspected and serviced at a frequency to assure at least an annual 90 percent joint data recovery of wind speed, wind direction, and atmospheric stability (e.g., temperature difference) for each level which represents an effluent release point. Annual data recovery for other individual parameters should be at least 90 percent for each parameter. Both Regulatory Guide 1.23 and ANSI/ANS-2.5-1984 specify that the system should be calibrated at least semi-annually and as frequently as necessary to ensure meeting specified parameter accuracies. Regulatory Guide 1.97 specifies that periodic checking, testing, calibration, and calibration verification should be in accordance with the applicable portions of Regulatory Guide 1.118. Seabrook Station Technical Requirements require daily channel checks and semi-annual calibration of the wind speed, wind direction and temperature difference channels.

4.1.3 Power Supply

a. Regulatory Guide 1.97 specifies that the meteorological monitoring system is Design Category 3 and only requires off-site power. However, a December 1985 NRC Emergency Plan Implementation Appraisal (Open Item 50-443/85-32-20) requested that backup power be provided to the instrument shelter (e.g., signal translators, recorders, aspirated temperature shields, wind sensor heaters, precipitation gauge heater, lighting and HVAC systems). Momentary power interruptions are acceptable, but the backup power supply should be available for a minimum duration of twelve hours after the loss of off-site power.

4.1.4 Instrument Shelter

a. An instrument shelter having an adequately controlled environment for the system's electronics should be provided.

4.2 Backup Met System

There are no regulatory requirements or industry standards requiring a backup to a reliable Primary Met System. However, considering the importance of meteorological information in the implementation of the Seabrook Station Radiological Emergency Plan and the fact that the loss of all meteorological information constitutes an initiating condition for a notification of an Unusual Event per Appendix 1 of NUREG-0654, an independent Backup Meteorological Monitoring System (Backup Met System) has been installed. The Backup Met System is intended to provide data in the Control Room when data from the Primary Met System is not available, assuring that basic meteorological information will be available to generate plume transport and dispersion estimates during and immediately following an accidental airborne radioactivity release.

The design requirements applicable to the Backup Met System were derived primarily from Proposed Revision 1 to Regulatory Guide 1.23 (Draft SS 926-4).

4.2.1 Tower

a. A tower or mast approximately 10 meters (33 feet) high is required in order to obtain the necessary meteorological measurements. The tower site should represent as closely as possible the same meteorological characteristics as the Primary Met System tower site. The backup tower should be sited at approximately the same elevation and should be located in an area where natural or man-made obstructions and the plant's heat dissipation system will have little or no influence on the meteorological measurements. Where practical, the tower should be located over level, open terrain covered with short grass or natural earth at a distance of at least ten times the height of any nearby obstruction.

4.2.2 Instrumentation

a. The instrumentation should be of high-quality commercial grade and should be selected to withstand its specified service environment.

b. To minimize the impact of damage due to direct lightning strike or electrical power surges, the instrumentation should be protected by grounding and be provided with surge protection devices on the incoming power lines and signal lines.

c. In order to assure that basic meteorological data will be available to generate atmospheric transport and diffusion estimates during and immediately following an accidental airborne radioactivity release, wind speed, wind direction, and an indication of atmospheric stability (e.g., wind direction standard deviation) representative of 10 meters (33 feet) above plant grade should be monitored.

d. The basic reduced data should be 15-minute average for input into the emergency response dose assessment codes. The Backup Met System should provide data to the Control Room in a real-time mode in the event necessary parameters from the Primary Met System are not available.

e. The instrumentation should be inspected and serviced at a frequency to assure at least an annual 90 percent joint data recovery of wind speed, wind direction, and atmospheric stability (e.g., wind direction standard deviation). The system should be calibrated as frequently as necessary to ensure meeting specified parameter accuracies. Periodic checking, testing, calibration, and calibration verification should be in accordance with the applicable portions of Regulatory Guide 1.118.

4.2.3 Power Supply

a. The instrumentation and heaters located on the backup tower and in the Backup Met System instrument shelter require only off-site power; however, this power should be independent from the normal power supply for the Primary Met System instrumentation.

4.2.4 Instrument Shelter

a. An instrument shelter having an adequately controlled environment for the Backup Met System's field electronics should be provided.

5.0 COMPONENT DESIGN BASIS

5.1 Primary Met System

5.1.1 Tower

a. The top of the primary meteorological tower structure should extend approximately 60 meters (197 ft) above plant grade to assure the specified meteorological measurements can be taken.

b. To avoid the influence of the tower structure on measurements, the use of a open-lattice tower is preferred. Closed towers, stacks, cooling towers, and similar solid structures should not be used to support sensors.

c. Tower structure design loads which require consideration are wind and ice loads, including the effect of increased sail area due to ice. Applicable minimum design loads from ANSI A58.1-1982 include a basic wind speed of 85 mph coincident with an ice thickness of 0.5 in. In order to be able to monitor the required wind speed range, the tower design wind speed should be at least 50 mph.

d. 14 CFR 77 states that to assure aeronautical conspicuousness, any temporary or permanent object that exceeds an overall height of 200 feet above ground level should normally be marked and/or lighted in accordance with the standards described in FAA 70/7460-1G. This document requires that a 210-foot tall tower be painted with seven equal-width bands of paint alternating between aviation orange and white. These bands should be perpendicular to the tower's vertical axis, with the bands at the top and bottom colored orange. At least one flashing red beacon should be mounted at the top and two or more steady burning red lights should be installed half-way up the tower on diagonally or diametrically opposite positions. The lights may remain on continuously or may be operated by a satisfactory control device (e.g., photo cell, timer, etc.) adjusted so the lights will be turned on when the northern sky illuminance reaching a vertical surface falls below a level of approximately 35 footcandles.

The FAA recommends use of only those paint materials and lighting systems which meet the minimum technical standards established by the FAA. Further details on paint and lighting standards are described in FAA 70/7460-1G.

5.1.2 Instrumentation

a. In order to preclude the tower structure from substantially influencing measurements, ANSI/ANS-2.5-1984 specifies that the sensors should be located on instrument booms oriented into the prevailing wind direction and at a minimum distance of two tower widths from the tower. Wind instruments installed on top of a tower structure should be mounted at least one tower diameter/diagonal above the top of the tower structure to preclude the tower structure from substantially influencing measurements.

b. Regulatory Guide 1.97 specifies the following instrument ranges for the following parameters:

Parameter	Range
Wind Speed	0 to 50 mph
Wind Direction	0 to 360 deg
Temperature Difference	-9 deg F to +18 deg F

A 100 mph span was selected for the original system as this was standard industry practice. National Weather Service observations and projections are used for wind speeds near or in excess of the plant design basis wind speed of 110 mph for use in classifying Emergency Action Levels (EALs) in ER 1.1, "Classification of Emergencies". Met System monitoring of wind speeds above 50 mph can be used in classifying EALs but is not a design basis.

c. Parameter accuracies as specified by Regulatory Guides 1.23 and 1.97 and ANSI/ANS-2.5-1984 are presented in Table 5-1. Some of the accuracies specified in the various documents differ from each other. Licensing commitments have been made to meet the Regulatory Guide 1.23 and 1.97 monitoring criteria. ANSI/ANS-2.5-1984 is the more recent and detailed document and has been endorsed by the Second Proposed Revision 1 to Regulatory Guide 1.23 (Draft ES 926-4); consequently, ANSI/ANS-2.5-1984 monitoring criteria are also used as guidance. In case of conflict, the Regulatory Guide 1.97 criteria should be considered controlling.

d. Regulatory Guides 1.23 and 1.97 and ANSI/ANS-2.5-1984 specify the following wind speed transducer and cup characteristics:

Characteristic	Reg Guide 1.23	Reg Guide 1.97	ANSI/ANS 2.5-1984
starting threshold	< 1.0 mph	< 1.0 mph	< 1.0 mph
distance constant	NA	≤ 6.6 ft	NA

e. Regulatory Guide 1.97 and ANSI/ANS-2.5-1984 specify the following wind direction transducer and vane characteristics:

Characteristic	Reg Guide 1.97	ANSI/ANS-2.5-1984
starting threshold	< 1.0 mph	< 1.0 mph
damping ratio	≥ 0.4	0.4 - 0.6
delay distance	≤ 6.6 ft	≤ 6.6 ft

f. Temperature sensors should be placed in aspirated temperature shields to protect them from the influences of direct and reflected solar radiation and precipitation. The shields should be efficient enough to ensure the specified temperature and temperature difference system accuracies can be achieved. For temperature difference measurements, sensors should be housed in identical shields. ANSI/ANS-2.5-1984 states that the shields should be pointed either downward or laterally towards the north.

g. ANSI/ANS-2.5-1984 specifies that precipitation should be measured with a recording rain gauge with a resolution of 0.01 in. Precipitation collectors should be located so that obstructions do not interfere with the collection of precipitation and should be placed on level ground so that the mouth is horizontal and open to the sky. A heated collector should be provided to ensure proper measurement of frozen precipitation.

h. Solar radiation measurements should be taken in open areas free of obstructions to avoid obstructions from casting shadows on the sensor at any time.

i. Regulatory Guide 1.23 specifies that the wind, temperature, and humidity data should be averaged over a period of at least 15 minutes at least once an hour. ANSI/ANS-2.5-1984 specifies that the basic reduced data should be hourly averaged. A continuous 15-minute average may be utilized to represent the hourly average if the same 15-minute period each hour is used.

j. ANSI/ANS-2.5-1984 specifies that the wind speed and direction analog recorders should be of the continuous strip chart recording type. Multipoint strip chart recorders are sufficient for recording all other parameters.

k. ANSI/ANS-2.5-1984 specifies that all digital recording (except for precipitation and wind direction standard deviation) should consist of a sampling of data at intervals no longer than 60 seconds and the mean values for the accumulated data shall be determined using no less than 30 instantaneous values or equivalent spaced equally over not less than a 15-

minute period. Precipitation should be recorded on a cumulative basis at least once per hour. If wind direction standard deviation is calculated, it should be determined by statistical analysis of samples from no less than 180 instantaneous values of lateral wind direction during the sampling period, with a maximum sampling period of one hour.

l. The wind speed, temperature, temperature difference, and solar radiation averages calculated by the digital system should be scalar averages (e.g., the sum of the valid samples during the sampling period divided by the number of samples summed). The wind direction average should be a unit vector mean wind direction and the wind direction standard deviation should be calculated utilizing Yarmartino's algorithm as described in YNSD memorandum REG 119/89. Total precipitation is determined by subtracting the previous precipitation gauge counter reading from the current precipitation gauge counter reading.

m. In order to provide appropriate input to the emergency response dose assessment models, 15-minute wind speed, wind direction, temperature difference, and solar radiation averages and 15-minute total precipitation accumulation values should be compiled on-the-hour and at 15, 30, and 45 minutes past the hour. These data should be available for display with at least the following measurement resolution:

Parameter	Measurement Resolution
Wind Speed	0.1 mph
Wind Direction	1 deg
Temperature Difference	0.1 deg F
Precipitation	0.01 in
Solar Radiation	0.01 Langle/min

5.1.3 Power Supply

a. The instrumentation for the Primary Met System as recommended in Regulatory Guide 1.97 is Design Category 3 and requires only off-site power. However, the need for a backup (reliable) power source for the Primary Met System during loss-of-offsite-power events was documented as an open item during an NRC Emergency Plan Implementation Appraisal (Open Item 50-443/85-32-20). The Primary Met System power supply was designed to resolve this NRC open item.

b. The cables and equipment should be installed in accordance with the separation criteria as established in the FSAR Chapter 8.

5.1.4 Instrument Shelter

a. The instrument shelter should have an adequately controlled environment for the system's field electronics. Because of the stringent accuracy requirements specified for the temperature difference measurements and the impact of temperature changes on the temperature difference translator accuracy, the instrument shelter temperature should remain within ±7.2 deg F from the time of each calibration.

b. The current governing building code should be used in the design of any future modifications for this structure. In order to be able to monitor the required wind speed range, the instrument shelter design wind speed should be at least 50 mph.

5.2 Backup Met System

5.2.1 Tower

a. The top of the backup meteorological tower structure should extend approximately 10 meters (33 ft) above plant grade to assure the specified meteorological measurements can be taken.

b. To avoid the influence of the tower structure on measurements, the use of a open-lattice tower is preferred. Closed towers, stacks, cooling towers, and similar solid structures should not be used to support sensors.

c. A free-standing aluminum tower with tilt-down base was chosen to hold the Backup Met System instrumentation because of its low price and the ability to access the instrumentation without climbing the tower or using a bucket truck.

d. Tower structure design loads which require consideration are wind and ice loads, including the effect of increased sail area due to ice. Applicable minimum design loads from ANSI A58.1-1982 include a basic wind speed of 85 mph coincident with an ice thickness of 0.5 in. In order to be able to monitor the wind speed range specified in Regulatory Guide 1.97, the tower design wind speed should be at least 50 mph.

e. The backup tower's location on top of the settling basin was chosen because: (i) it is near the primary tower; (ii) it represents good exposure without nearby obstructions causing turbulence; and (iii) ac power, conduit, and an instrument shelter were available nearby. The loads imposed on the settling basin structure are negligible, per YNSD Calculation SBC-326.

f. Since the top of the backup tower is just outside the nominal 45 deg cone-of-protection from the primary tower, a separate lightning protection system is provided to the backup tower.

5.2.2 Instrumentation

a. In order to preclude the tower structure from substantially influencing measurements, the sensors should be located on instrument booms oriented into the prevailing wind direction and at a minimum distance of two tower widths from the tower. Wind instruments installed on top of a tower structure should be mounted at least one tower diameter/diagonal above the top of the tower structure to preclude the tower structure from substantially influencing measurements.

b. The wind speed transducer and cup characteristics, the wind direction transducer and vane characteristics, and wind speed and direction parameter accuracies specified in Section 5.1.2 for the Primary Met System are applicable to the Backup Met System. The wind speed and wind direction instrument ranges specified in Regulatory Guide 1.97 (0 to 50 mph and 0 to 360 deg) are also applicable to the Backup Met System.

c. Digital data transmission from the instrument shelter to the Control Room via modems and telephone cables was selected because of high cost of pulling new cable if analog signals were utilized instead.

d. The digital system should calculate scalar mean lower wind speeds, unit vector mean lower wind directions, and lower wind direction standard deviations utilizing the algorithms described in YNSD memorandum REG 119/89. Stability classes and the resulting 150'-43' and 209'-43' temperature differences should be determined as a function of average lower wind speed, wind direction standard deviation, and time-of-day (daytime versus nighttime). Upper wind speed averages should be estimated as a function of lower wind speed averages and stability class, and the upper wind direction averages should be represented by the lower wind direction averages. The algorithms needed to implement the above calculations are described in YNSD memorandum REG 151/86.

e. In order to provide appropriate meteorological data for the emergency response dose assessment models, 15-minute wind speed and direction averages and 15-minute wind direction standard deviation values should be compiled on-the-hour and at 15, 30, and 45 minutes past the hour. These data should be available for display on-demand in the Control Room with at least the following display resolution:

Parameter	Display Resolution
Wind Speed	0.1 mph
Wind Direction	1 deg
Wind Direction Standard Deviation	0.1 deg

The 15-minute average wind speed and wind direction data, along with an equivalent temperature difference data value (derived from the 15-minute wind speed average and wind direction standard deviation data and the time-of-day), can be used as input into the emergency response dose assessment models if data from the Primary Met System are not available.

f. Control Room digital data displays were chosen in lieu of analog indicators because the digital displays can provide a better precision readout and simplify the data gathering process. A video display was chosen in lieu of digital indicators because of the potential to: (i) interface with the Primary Met System to display the Primary Met System data in the Control Room if the Main Plant Computer System (MPCS) is inoperative; and (ii) run the emergency response dose assessment codes on the same equipment.

5.2.3 Power Supply

a. To assure Met System data availability, the power supply to the Backup Met System should be provided from a source which is independent of the on-site power source.

b. The cables and equipment should be installed in accordance with the separation criteria as established in UFSAR Section 8.

5.2.4 Instrument Shelter

a. The instrument shelter should have an adequately controlled environment for the system's field electronics. The DAS located in the backup shelter has a specified operating range of -13 to +122 deg F.

b. The shelter should be designed to withstand the wind loading requirements of ANSI A58.1-1982. In order to be able to monitor the wind speed range specified in Regulatory Guide 1.97, the shelter design wind speed should be at least 50 mph.

TABLE 5-1
Parameter Accuracies Specified by Guidance Documents

Parameter	Reg Guide 1.23	Reg Guide 1.97	ANSI/ANS-2.5-1984 Digital System	ANSI/ANS-2.5-1984 Analog System
Wind Speed	±0.5 mph	±0.5 mph for speeds less than 5 mph, ±10% of measured value for speeds in excess of 5 mph	±0.5 mph for speeds less than 5 mph, ±10% of measured value for speeds in excess of 5 mph	±0.75 mph for speeds less than 5 mph, ±15% of measured value for speeds in excess of 5 mph
Wind Direction	±5 deg	±5 deg	±5 deg	±7.5 deg
Wind Direction Standard Deviation	NA	NA	±5% of true statistical value	±5% of true statistical value
Temperature	±0.9 deg F	NA	±0.9 deg F	±0.9 deg F
Temperature Difference	±0.18 deg F	±0.3 deg F per 164-ft interval	±0.27 deg F per 164-ft interval	±0.27 deg F per 164-ft interval
Precipitation	NA	NA	±10% of total accumulated catch for amounts in excess of 0.2 in	±10% of total accumulated catch for amounts in excess of 0.2 in
Solar Radiation	NA	NA	NA	NA
Time	NA	NA	±5 min	±10 min

1. The Regulatory Guide 1.23 specified parameter accuracies are for time averaged values, except for wind direction accuracies which are for instantaneous recorded values.

2. The ANSI/ANS-2.5-1984 specified parameter accuracies are for time averaged values and refer to the composite accuracy reflecting the errors introduced by sensor, cable, signal conditioning, temperature environment for signal conditioning and recording, recorders, and data reduction process.

6.0 TECHNICAL SPECIFICATION / TECHNICAL REQUIREMENT AND LICENSING COMMITMENTS

6.1 Technical Specification / Technical Requirements

a. Technical Requirement 22, TR22- 3.3.3.4 requires that the primary tower meteorological monitoring instrumentation channels listed below shall be FUNCTIONAL at all times:

Instrument	Location	Minimum FUNCTIONAL
1. Wind Speed		
a. Lower Level	Nominal Elev. 43 ft	1
b. Upper Level	Nominal Elev. 209 ft	1
2. Wind Direction		
a. Lower Level	Nominal Elev. 43 ft	1
b. Upper Level	Nominal Elev. 209 ft	1
3. Air Temperature - ΔT		
a. Lower Level	Between Elev. 43 ft and 150 ft	1
b. Upper Level	Between Elev. 43 ft and 209 ft	1

With less than the minimum FUNCTIONAL channels available, the required Technical Requirement 22 ACTION is determined by an evaluation conducted in accordance with the Corrective Action Program. An evaluation is not required if the noncompliance is a consequence of surveillance testing or planned maintenance.

b. Technical Requirement 22, TR22- 4.3.3.4 requires that each of the primary tower meteorological monitoring instrument channels shown in Item (a) above be demonstrated FUNCTIONAL by performance of a Daily CHANNEL CHECK and a semiannual CHANNEL CALIBRATION.

c. The Annual Radioactive Effluent Release Report required by Technical Specification 6.8.1.4 includes an annual summary of meteorological data collected over the previous year. This annual summary is in the form of joint frequency distributions of wind speed, wind direction, and atmospheric stability. In lieu of submission with the Annual Radioactive Effluent Release

Report, the licensee has the option of retaining this summary of required meteorological data on site in a file that shall be provided to the NRC upon request.

6.2 UFSAR Commitments

a. Section 1.8 addresses the degree of conformance of the Meteorological Monitoring System (Met System) to guidance provided in Regulatory Guides 1.21 (Rev. 1), 1.23 (Rev. 0), 1.97 (Rev. 3), and 1.101 (Rev. 2).

b. Section 2.3.3.3 describes the Operational Meteorological Monitoring Program and states that a meteorological monitoring program commensurate with the final plant design and consistent with NRC requirements for on-site meteorological programs will be maintained throughout the life of the plant.

c. Section 7.5.4 discusses the Accident Monitoring Instrumentation (including the wind speed, wind direction, and temperature difference meteorological parameters) implemented to comply with Regulatory Guide 1.97.

6.3 Other Licensing Commitments

a. Section 6.2.3.1 of the Seabrook Station Radiological Emergency Plan briefly describes the Met System as used to support the station's Radiological Emergency Plan.

b. NRC Emergency Plan Implementation Appraisal No. 50-443/85-32 (December 9-13, 1985) identified the following open item (50-443/85-32-20): "Provide for backup meteorological measurements representative of conditions in the vicinity of the site and provide for backup power to the instrument building."

   This item was addressed by revising the Seabrook Station Radiological Emergency Plan (SSREP) to indicate that an arrangement between YNSD and Weather Services International (WSI) provides for backup meteorological data, including a terminal in the Emergency Operations Facility (EOF). The plan also provides for backup weather data from National Weather Service (NWS) offices and hourly data from Pease Air Force Base through WSI, Portland, ME, and Concord, NH NWS stations. The plan was also revised to provide for corporate meteorological support available on a 24-hr emergency call basis.

   This item was also addressed by committing to evaluate and take actions to enhance the Met System reliability by December 31, 1986. An Engineering Review of the Met System was performed (SBE-86-055) and the resulting actions included: (i) providing the Primary Met System backup power from the station's Train A diesel generator (DCR 86-425); (ii) replacing the primary tower's guy wire anchors (DCR 86-120); and (iii) refurbishing the Primary Met System's instrumentation (ECA 03/117088D).

   Consequently, this item was closed via Inspection Report No. 50-443/86-30 Addendum based on the provision for multiple off-site backup sources of meteorological data (one of which, Pease

AFB, was considered representative of conditions in the vicinity of the site) and Seabrook's commitment to resolve the on-site Met System reliability by December 31, 1986.

c. NRC Emergency Plan Implementation Appraisal No. 50-443/85-32 (December 9-13, 1985) also identified the following open item (50-443/85-32-24): "Provide the basic data required for atmospheric dispersion calculations (15 minute averages), which includes a time history (analog or digital printout) of wind direction and speed at each level and temperature difference with height in the control room and EOF."

   This item was address by having the Main Plant Computer System (MPCS) sample and 15-minute average the Primary Met System wind speed, wind direction, and temperature difference parameters for on-demand display in the Control Room (CR) and on MPCS Emergency Response Facility Workstation terminals located in the Technical Support Center (TSC), and Emergency Operations Facility (EOF). In addition, a "Meteorological 24-hour History Report" listing archived 15-minute averages (one per hour for 24 hours) was implemented on the MPCS for printout in the CR, TSC, and EOF.

   This item was closed via Inspection Report No. 50-443/86-46.

d. The FAA-approved `Notice of Proposed Construction or Alteration' for the primary meteorological tower requires the tower to be obstruction marked and lighted with aviation red obstruction lights in accordance with the current version of FAA/7460-1. FAA/7460-1G requires any failure or malfunction of the top flashing red beacon which will last more than 30 minutes be immediately reported by telephone or telegraph to the nearest Flight Service Station.

7.0 CALCULATION SUMMARY

a. Ehresmann Engineering Inc. Report J.O. 1180, "Anchor Design for Tower Specialist Inc.", dated April 26, 1986 (attached to Foreign Print 4924D).

b. Yankee Nuclear Services Division Calculation No. SBC-148, "System Accuracy of Meteorological Instruments for Operational Monitoring Program," Revision 1, dated July 6, 1990.

c. Yankee Nuclear Services Division Calculation No. SBC-176, "Selection of Cable Size for Meteorological Tower Power Supply," Revision 0, dated September 23, 1986.

d. Yankee Nuclear Services Division Calculation No. SBC-326, "Backup Met Tower Design, DCR 89-035," Revision 0, dated June 29, 1989.

e. United Engineers & Constructors Inc. Calculation No. 9763-3-ED-00-20-F, "Non-Class 1E UPS Loading Calculation," Revision 3.

8.0 REFERENCES

8.1 UFSAR

a. Section 1.8, "Conformance to NRC Regulatory Guides."

b. Section 2.3.3.3, "On-Site Meteorological Measurement Program - Operational Program."

c. Section 7.5.4, "Accident Monitoring Instrumentation."

d. Section 8, "Electric Power."

e. Technical Requirement 22, "Meteorological Instrumentation"

8.2 Radiological Emergency Plan

a. Section 6.2.3.1, "Geophysical Phenomena Monitors - Meteorological."

b. Emergency Response Procedure ER 1.1, "Classification of Emergencies."

c. Emergency Response Procedure ER 5.1, "HP-41 Dose Projection Determination."

d. Emergency Response Procedure ER 5.3, "Operation of the METPAC System."

8.3 NRC Regulations

a. 10 CFR 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors."

b. 10 CFR 50.47b, "Emergency Plans."

c. 10 CFR 50, Appendix E, "Emergency Planning and Preparedness for Production and Utilization Facilities."

d. 10 CFR 50, Appendix I, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low as is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."

8.4 FAA Regulations

a. 14 CFR 77.13, "Construction or Alteration Requiring Notice."

b. 14 CFR 77.19, "Acknowledgement of Notice."

8.5 NRC Regulatory Guides

a. 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," Revision 1, June 1974.

b. 1.23, "Onsite Meteorological Programs" (Safety Guide 23), February 17, 1972.

c. 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants," Revision 3, November 1978.

   1. Section 2.3.3, "Onsite Meteorological Measurements Program."

d. 1.97, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident," Revision 3, May 1983.

e. 1.101, "Emergency Planning and Preparedness for Nuclear Power Reactors," Revision 2, October 1981.

f. 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," Revision 1, October 1977.

g. 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," Revision 1, July 1977.

h. 1.118, "Periodic Testing of Electric Power and Protection Systems," Revision 2, June 1978.

i. 1.145, "Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants," Revision 1, November 1982.

j. Draft SS 926-4, "Meteorological Programs in Support of Nuclear Power Plants," Proposed Revision 1 to Regulatory Guide 1.23, September 1980.

k. Draft ES 926-4, "Meteorological Measurement Program for Nuclear Power Plants," Second Proposed Revision 1 to Regulatory Guide 1.23, April 1986.

8.6 FAA Advisory Circulars

a. 70/7460-1G, "Obstruction Marking and Lighting," October 1985.

8.7 Codes and Standards

a. American Institute of Steel Construction, Steel Construction Manual, 8th Edition.

b. American National Standards Institute Standard A58.1-1982, "Minimum Design Loads for Buildings and Other Structures."

c. American National Standards Institute/Electronics Industries Association Standard ANSI/EIA-222-D-1986, "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures."

d. American National Standards Institute/American Nuclear Society Standard ANSI/ANS-2.5-1984, "Standard for Determining Meteorological Information at Nuclear Power Sites."

e. Building Officials and Code Administrators, "Basic Building Code," 1975.

f. Electronics Industries Association Standard EIA-RS-222-C (1976), "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures."

g. The Institute of Electrical and Electronic Engineers Standard IEEE 338-1977, "IEEE Standard Criteria of the Periodic Testing of Nuclear Power Generating Station Safety Systems."

8.8 Calculations

a. Ehresmann Engineering Inc. Report J.O. 1180, "Anchor Design for Tower Specialist Inc.", dated April 26, 1986 (attached to Foreign Print 4924D).

b. Yankee Nuclear Services Division Calculation No. SBC-148, "System Accuracy of Meteorological Instruments for Operational Monitoring Program," Revision 1, dated July 6, 1990.

c. Yankee Nuclear Services Division Calculation No. SBC-176, "Selection of Cable Size for Meteorological Tower Power Supply," Revision 0, dated September 23, 1986.

d. Yankee Nuclear Services Division Calculation No. SBC-326, "Backup Met Tower Design, DCR 89-035," Revision 0, dated June 29, 1989.

e. United Engineers & Constructors Inc. Calculation No. 9763-3-ED-00-20-F, "Non-Class 1E UPS Loading Calculation," Revision 3.

8.9 System Drawings

8.9.1 NHY Drawings

a. 1-NHY-301602 Temporary Power & Light 480 V One Line Diagram

b. 1-NHY-301619, Sh. L36/7 Backup Met System-Cable Schematic

c. 1-NHY-310046 460 V Motor Control Center 1-E523 One Line Diagram

d. 1-NHY-310050 480 V Unit Substation Bus 1-21 One Line Diagram

e. 1-NHY-310104, Sh. C1Ha 460 V MCC 1-E523 & Alternate Feed to Essential LTG PNL MM-212C - 3 Line dia. & Cable Schematic

f. 1-NHY-310105, Sh. EJ9a UPS ED-I-4 Non-Vital Distribution Panel ED-PP-5 Schedule

g. 1-NHY-310231 Motor Load List

h. 1-NHY-311496, Sh. L36 Lighting Panel Schedule

i. 1-NHY-350015 Bus Failure Analysis, 120 Vac Non Vital (UPS)

j. 1-NHY-506546 MET-Meteorological Monitoring Loop Diagram

k. 9763-M-301604 Temporary Power & Light 480 V Distribution Schedule

l. EOL-1-SGB-312051 Guardhouse One Line Diagram

8.9.2 Foreign Prints

a. 4924D, Meteorological Tower Anchor Replacement

b. 72687, Auxiliary Panel

c. 72688, Meteorological Cabinet Layout

d. 72689, Wiring Connections, Mainframe No. 2, Seabrook

e. 72690, Wiring Connections, Mainframe No. 1, Seabrook

f. 72691, Meteorological Block Dia., Seabrook

g. 72693, Floor Plan & Elevations, Control House, Meteorological Tower

h. 72694, Site Plan & Elevations, Tower & Control House, Meteorological Tower

i. 72695, Foundation Sect & Details, Meteorological Tower

j. 72696, Fence & Grounding, Plan & Details, Meteorological Tower

k. 72697, Architectural Elevations & Sections for Control House, Meteorological Tower

l. 72698, Section & Details, Control House, Meteorological Tower

m. 72699, A.C. Distribution Panel, Control House, Meteorological Tower

n. 72700, S.A. Meteorological Tower, Seabrook Station

o. 72701, TRC Instrumentation Conn., Meteorological Tower, Seabrook Station

p. 72702, Wiring Diagram, Entry Alarm, Meteorological Tower, Seabrook Station

q. 73728, 210' No. 80 Tower Assembly

r. 74192, Enviroplan/Seabrook 209' J-Box Wiring

s. 74193, Enviroplan/Seabrook 150' J-Box Wiring

t. 74194, Enviroplan/Seabrook 43' J-Box Wiring

u. 74195, Enviroplan/Seabrook Base "J" Box/Slp Wiring

v. 74196, Enviroplan/Seabrook Mainframe Wiring

w. 74197, Modlr Metrl Sys Bk Enviroplan Climatron

x. 74198, Modlr Metrl Sys Bk 2 Enviroplan Climatro

y. 74199, Enviroplan/Seabrook Output Terminal Panel

z. 74200, Auxiliary Panel Rear View

aa. 74201, Enviroplan/Seabrook Tower Site Detail

bb. 74566, PC Workstation Instruction Manual

cc. 74671, Climatronics Instruction Manual

dd. 74672, Campbell Micrologger Instruction Manual

ee. 74673, DDA-06 Instruction Manual

ff. 77499, Chessel 4250M Instruction Manual

gg. 77500, Chessel 4250C Instruction Manual

8.10 Engineering Design Changes

a. DCR 86-425, Seabrook Meteorological Tower Backup Power

b. DCR 87-094, Alternate Power Supply to Sec. Equipment

c. DCR 89-035, Backup Meteorological Monitoring System

d. ECA 03/117088, Conduit and Box Installation Plan for Met Tower Refurbishment

e. ECA 98/118117, Can the Esterline Angus Multipoint Recorder Be Replaced by a Chessel Model 4001

f. DCR 92-004, Moisture Separator Reheater Control System Replacement

g. 03MSE144-00, MET Tower AC and Heating System

h. 95MMOD622, Delete Dewpoint and Precipitation Instruments

i. 99MMOD584, MET Tower Recorder MET-UR-1 Replacement

j. 07MSE148, 1-MET-LE-1 Model Change for Replacement MET Rain Gauge

8.11 Procedures

a. Procedure No. IN0654.510, Backup Met System Calibration

b. Procedure No. IN0654.525, Met System Calibration - Non Tech Spec

c. Procedure No. IX0654.500, Met System Calibration - Tech Spec

d. Procedure No. IX0654.550, Met System Checks/Data Collection

8.12 Miscellaneous

a. NHY Computer Development Department Report, "Meteorological Monitoring System Functional Description," dated June 4, 1986.

b. NHY Computer Development Department Report, "Meteorological Data Link Functional Description," dated February 1988.

c. NHY memorandum, NA Pillsbury to Distribution, "Meteorological Tower and Instrumentation Refurbishment Coordination Meeting," SS# 23699, IRT-86-047, dated March 24, 1986.

d. NRC letter, TT Martin to RJ Harrison, "Inspection Report No. 50-443/85-32," dated February 18, 1986.

e. NRC letter, TT Martin to RJ Harrison, "Inspection Report No. 50-443/86-18," dated May 15, 1986.

f. NRC letter, TT Martin to RJ Harrison, "Inspection Report No. 50-443/86-30 Addendum," dated August 1, 1986.

g. NRC letter, EC Wenzinger to RJ Harrison, "Inspection No. 50-443/86-46," dated October 22, 1986.

h. YNSD memorandum, J DeVincentis to GS Thomas, "Engineering Review of the Meteorological Monitoring System," SBE-86-055, dated January 23, 1986.

i. Deleted

j. YNSD memorandum, RB Harvey/RJ DeLoach to JM Vargas, "Evaluation of the Seabrook Station Meteorological Monitoring System (YSR 89-003)," SBP 89-109, REG 26/89, dated February 16, 1989.

k. YNSD memorandum, RB Harvey to WN Fadden, "Backup Met Tower Data Processing (DCR 89-0035)," REG 119/89, dated June 14, 1989.

l. Climatronics letter (with catalog information), SR Rosten to WN Fadden, dated April 10, 1989.

9.0 SUMMARY OF CHANGES

0	Original Issue
1	Incorporate DCR 92-004, Partial Incorporation of UFSAR 94-009 (Delete Dewpoint Sensor Requirements)
2	Reformatted to EDI 30020 Rev. 4 Chg 2. Incorporated 03MSE144-00, 07MSE148, 95MMOD622-00 and 99MMOD584-00
3	Incorporated AR 00216120. Revised DBD to indicate system operability and surviellance requirements are now specified in Technical Requirement 22.

Florida Power & Light Company, P.O. Box 14000, Juno Beach, FL 33408-0420
(561) 694-4000

FPL.

March 21, 2006

U.S. Environmental Protection Agency
Attn: Jerome Blackman
MC6205J
1200 Pennsylvania Avenue
Washington, DC 20460

345 kV Seabrook Transmission Substation
SF_6 Emissions Reduction Partnership for Electric Power Systems
Annual Report for 2005

Florida Power & Light-New England Division (FPL-NED) hereby submits the SF_6 Emissions Reduction Partnership for Electric Power Systems Annual Report for the year 2005. FPL-NED is the majority owner of the gas insulated 345kV Seabrook Transmission Substation ("Seabrook Transmission Substation") located in Seabrook, NH. This report is submitted pursuant to Section IV, Paragraph B., of the Memorandum of Understanding between the United States Environmental Agency (EPA) and FPL-NED, effective February 3, 2005 (SF_6 MOU).

Sulfur hexafluoride (SF_6) emissions during the year 2005 were calculated in accordance with the SF_6 Emissions Inventory Reporting Protocol and Form included in the SF_6 MOU. No changes were made to SF_6 system capacity. Emissions of 264 lbs. were calculated for the year 2005. This represents 0.62% of the total SF_6 system capacity and achieves the FPL-NED 2005 goal of emitting less than 5% of the total SF_6 system capacity. The 2005 SF_6 emissions also represent an emissions reduction of 97.3% from the 1990 baseline emission level of 9,890 lbs. The year 2005 Worksheet is attached hereto, as Attachment I.

By letter dated August 31, 2005 FPL-NED informed the EPA of certain initiatives FPL-NED was undertaking to identify specific opportunities for SF_6 emissions reduction improvements. FPL-NED indicated that until those initiatives had been completed, it was maintaining its then current goal for annual SF_6 emissions of not more than 5% of total SF_6 system capacity. A copy of this letter is attached hereto, as Attachment II.

As an update on where FPL-NED stands with respect to these initiatives, FPL-NED desires to inform the EPA that it has engaged the services of ABB, Inc. to perform a comprehensive study of FPL-NED's procedures for handling and storage of SF_6, and for the maintenance of all SF_6 equipment and apparatus, as well as an evaluation of the condition of said equipment and apparatus. Currently, ABB and FPL-NED are in the process of scheduling the on-site portions of the work including the physical inspection of the equipment, and the use of a laser leak detector, with the other on-going

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work at the Seabrook Nuclear Station. FPL-NED expects ABB to complete the study later this spring. Until then, FPL-NED is going to maintain its current SF_6 annual emissions goal of not more than 5% of system capacity. Once the ABB study has been completed, FPL-NED will use the results of this study to determine whether the current goal is appropriate to maintain, or whether the study supports a change to said goal. FPL-NED will inform the EPA of these results as soon as they are competed.

If you have any questions regarding this report, please contact Mr. Bob Triana, Operations Manager – Transmission and Substation (561) 694-4706.

Sincerely,

C. Martin Mennes
Vice President, Transmission & Substation
Florida Power & Light Company – New England Division

cc: M. Murphy
S. Garwood
W. Locke
A. Legendre
R. Critelli
R. Triana

FPL

P.O. Box 14000, Juno Beach, FL 33408-0420

Attachment II

August 31, 2005

Mr. Jerome Blackman
Climate Protection Division
US EPA Office of Atmospheric Programs
Ariel Rois Building
Pennsylvania Ave, N. W. (6202J)
Washington, DC 20460

Re: Seabrook Station SF6 Emissions Reduction Procedures and Goals

Pursuant to the terms of the Memorandum of Understanding ("MOU") between the United States Environmental Protection Agency ("EPA") and the Florida Power & Light Company – New England Division ("FPL-NED"), this letter is intended to provide information to the EPA regarding FPL-NED's procedures for handling, maintaining, recycling and/or disposing of SF6 gas and its transmission facilities containing such SF6 gas located at the Seabrook Transmission Substation at Seabrook Nuclear Generating Station in Seabrook, New Hampshire. In addition, FPL-NED would like to take this opportunity to update the EPA with regard to FPL-NED's SF6 Emissions Goals for 2005 and the process by which it is intending to establish future goals.

SF6 Procedures

In accordance with Section IV.F of the MOU, FPL-NED is hereby furnishing the EPA with the following SF6-related procedures that FPL-NED has adopted with regard to the handling, maintaining, recycling and/or disposing of SF6 gas and its transmission facilities containing such SF6 gas located at the FPL-NED Seabrook Transmission Substation:

LD0560.15	Gas Transfer Cart 300 Hour PM
LD0560.16	Gas Transfer Cart 100 Hour PM
LD0560.17	Gas Transfer Cart Semi-Annual SF6 Compressor & Vacuum Pump Oil Change
LN0560.10	SF6 Dewpoint Check
LN0560.11	SF6 Gas Sampling
LN0561.06	30 Month Gas Circuit Breaker Preventive Maintenance
LN0561.07	60 Month Gas Circuit Breaker Preventive Maintenance
LN0561.09	Addition of SF6 Gas to Gas Circuit Breaker and Gas Insulated Bus Ducts Zone 1-7
LN0561.18	345kV Gas-Insulated Bus Duct Repair
LN0561.19	345kV SF6 Bus Duct Repair Retest

Please be advised that the adopted procedures listed above are the same procedures previously utilized by the Seabrook Nuclear Generating Station operating and maintenance personnel for the purpose of compliance with Section IV.F of the MOU. To the extent there are references to "Seabrook Station" in these procedures, those references are hereby deemed to be superceded

SF6 Emissions Reductions Goal

As reported to the EPA by FPL-NED in its Annual Report dated March 31, 2005, the SF6 Emissions Reductions Goal for 2004 of leakage less than 2,117 lbs. or less than 5% of SF6 system capacity, was achieved. Actual 2004 emissions were confined to 1,713 lbs, or approximately 4% of system capacity.

Pursuant to Section VI.G. of the MOU, FPL-NED has adopted the same SF6 Emissions Reduction Goal for 2005 as was established in 2004, i.e. 5% of system capacity. FPL-NED has elected to maintain this level of emissions reduction as its goal for 2005 while it attempts to identify specific opportunities for SF6 emissions reduction improvements. To that end, FPL-NED is in the process of identifying consulting firms with expertise in the areas of SF6 equipment and emission reductions which can assist it with a comprehensive evaluation of its SF6 equipment and handling / maintenance procedures for the purpose of developing a comprehensive emissions reduction improvement plan. This will enable FPL-NED to establish future SF6 emission goals and to further FPL-NED's committment towards SF6 emission reduction improvements consistent with the spirit and intent of the MOU.

The existing procedures identified above, in conjunction with the stated annual emissions reduction goals, constitute FPL-NED's SF6 Policy. Pursuant to Section IV.E., FPL-NED has distributed said policy to all company-personnel and contractors whose responsibilities include handling, maintaining, recycling and/or disposing of SF6 gas and its transmission facilities containing such SF6 gas located at the Seabrook Transmission Substation. To the extent FPL-NED's goals or procedures are revised based on the aforementioned comprehensive evaluation FPL-NED intends to conduct in 2005/2006, FPL-NED will furnish the EPA with such revised goals and procedures.

Sincerely,

Ronald D Critelli Jr.

Ron Critelli
Director, Transmission & Substation
Florida Power & Light Company – New England Division

cc: M. Murphy
S. Garwood
W. Locke
A Legenre

Year: 2005

Attachment I

WORKSHEET

Table 1

Inventory		Amount (lbs.)	Comments
A	Beginning of year	3,979	20 cylinders @ 115 lbs. plus 1679 lbs in the gas cart
B	End of year	6,015	40 cylinders @ 115 lbs. plus 1415 lbs in the gas cart

Table 2

Additions to Inventory		
	Amount (lbs.)	**Comments**
1. Purchases of SF_6 (including SF_6 provided by equipment manufacturers with or inside new equipment.)	2,300	
2. SF_6 returned to the site after off- site recycling	996	Gas returned from recycle
C: Total Additions (add items 1-2)	3,296	
Subtractions from Inventory		
	Amount (lbs.)	**Comments**
3. Sales of SF_6 (to other entities, including the gas left in retired breakers)	0	
4. Returns of SF_6 to supplier	0	
5. SF_6 taken from storage and/or equipment and disposed of	0	
6. SF_6 taken from storage and/or equipment and sent off site for recycling	996	Contaminated gas sent for recycle
D: Total subtractions (add items 3-6)	996	
Change to Nameplate Capacity		
	Amount (lbs.)	**Comments**
7. Total nameplate capacity of new equipment	0	
8. Total nameplate capacity of retiring equipment	0	
E: Change to nameplate capacity (subtract item 8 from item 7)	0	

Total Annual Emissions = A – B + C – D – E = 264 lbs.

NED - 31.1

Florida Power & Light Company, P.O. Box 029100, Miami, FL 33102-9100

FPL

April 30, 2007

U.S. Environmental Protection Agency
Attn: Jerome Blackman
MC6205J
1200 Pennsylvania Avenue
Washington, DC 20460

345 kV Seabrook Transmission Substation
SF6 Emissions Reduction Partnership for Electric Power Systems
Annual Report for 2006

This correspondence is to explain the delay in the submission of the Florida Power & Light-New England Division (FPL-NED) SF6 Emissions Reduction Partnership for Electric Power Systems Annual Report for the year 2006. FPL-NED is the majority owner of the gas insulated 345kV Seabrook Transmission Substation ("Seabrook Transmission Substation") located in Seabrook, NH. This explanation is submitted in lieu of the report pursuant to Section IV, Paragraph B., of the Memorandum of Understanding between the United States Environmental Agency (EPA) and FPL-NED, effective February 3, 2005 (SF6 MOU).

During the preparation of this year's Annual Report, FPL-NED discovered that the process used to determine the SF6 emissions at Seabrook for this reporting period was inconsistent with the SF6 Emissions Inventory Reporting Protocol prescribed by the SF6 MOU.

FPL-NED discovered that the methodology, which was used by the prior facility owner and which has continued in use until now, was a method based upon the Ideal Gas Law. Use of this method resulted in a highly accurate accounting of SF6 emissions from the substation bus work and equipment. This method differs from the MOU methodology because use of the Ideal Gas Law did not account for gases stored or returned throughout the system.

Upon realizing the aforementioned methodological difference, FPL-NED attempted to reconstruct its SF6 emissions for 2006 using the methodology prescribed by the SF6 MOU, but due to historical inventory data gaps, FPL-NED was not able to confidently reconstruct a balance of the entire system.

Based on FPL-NED's application of the Ideal Gas Law methodology described above, FPL-NED has determined that its SF6 emissions during the year 2006 was 1,521 lbs. This represents 3.6% of the total SF6 system capacity and achieves the FPL-NED 2006 goal of emitting less than 5% of the total SF6 system capacity. The 2006 SF6 emissions also represent an emissions reduction of 84.6% from the 1990 baseline emission level of 9,890 lbs. Because FPL-NED now knows that the methodology prescribed by the SF6 MOU was not used for determining its 2006 SF6 emissions, FPL-NED will not be providing an Attachment B to this year's Annual Report.

FPL-NED has taken steps to ensure that its process of accounting for SF6 inventory, usage and emissions will comply with the SF6 Emissions Inventory Reporting Protocol prescribed by the SF6 MOU for all future reporting periods starting with the 2007 data.

If you have any questions regarding this report, please contact Mr. Bob Triana, Manager – Substation Operations (561) 694-4706.

Sincerely,

C. Martin Mennes
Vice President, Transmission Operations & Planning
Florida Power & Light Company – New England Division

cc: M. Archer
D. Cleary
B. Locke
S. Garwood
B. Triana
M. Murphy
A. Legendre

P. O. Box 029311, Miami, FL 33102-9311

FPL

March 25, 2008

U.S. Environmental Protection Agency
Attn: Ms. Sally Rand
MC6205J
1200 Pennsylvania Avenue
Washington, DC 20460

345 kV Seabrook Transmission Substation
SF6 Emissions Reduction Partnership for Electric Power Systems
Annual Report for 2007

Florida Power & Light-New England Division (FPL-NED) hereby submits the SF6 Emissions Reduction Partnership for Electric Power Systems Annual Report for the year 2007. FPL-NED is the majority owner of the gas insulated 345kV Seabrook Transmission Substation ("Seabrook Transmission Substation") located in Seabrook, NH. This report is submitted pursuant to Section IV, Paragraph B., of the Memorandum of Understanding between the United States Environmental Agency (EPA) and FPL-NED, effective February 3, 2005 (SF6 MOU).

During the preparation of last year's Annual Report, FPL-NED discovered that the process used to determine the SF6 emissions at Seabrook for that reporting period was inconsistent with the SF6 Emissions Inventory Reporting Protocol prescribed by the SF6 MOU. As reported in last year's report, FPL-NED discovered that the methodology, which was used by the prior facility owner and which had continued in use though 2006, was a method based upon the Ideal Gas Law. Use of this method resulted in a highly accurate accounting of SF6 emissions from the substation bus work and equipment but nonetheless differed from the SF6 MOU prescribed methodology because use of the Ideal Gas Law did not account for gases stored or returned throughout the system. FPL-NED committed to revising its procedures for determining SF6 Emissions for reporting periods covering all future periods. As such, this report covering 2007 reporting period is based on the SF6 MOU prescribed procedures.

Sulfur hexafluoride (SF6) emissions during the year 2007 were calculated in accordance with the SF6 Emissions Inventory Reporting Protocol and Form included in Attachment B to the SF6 MOU. SF6 emissions of 3,919 lbs. were calculated for the year 2007 or 9.25% of the total SF6 system capacity[1]. This usage exceeds the FPL-NED 2007 goal of emitting less than 5% of the total SF6 system capacity, but still represents an emissions reduction of 60.4% from the 1990 baseline emission level of 9,890 lbs. The year 2007 Annual Reporting Form is attached hereto.

[1] Total System Capacity is 42,351 lbs.

The SF6 emissions above the 2007 goal were caused in large part, by two equipment failures. One involved the unforeseeable failure of a rupture disk on Gas Bus Zone 4 which caused the complete and sudden evacuation of SF6 Gas from this bus zone. This single failure is estimated to have resulted in 1,022 lbs. of SF6 emissions. The second equipment failure occurred when one of FPL-NED's Gas Carts experienced a hose rupture which is estimated to have contributed 565 lbs. of SF6 emissions.

FPL-NED has undertaken an extensive analysis of the condition of all of its other rupture disks and is making certain system design changes, including the elimination of some rupture disks and replacing or relocating others. In addition, FPL-NED has purchased a new state-of-the-art Gas Cart and repaired the Gas Cart that experienced the hose rupture, which will be now be used only as a backup. Finally, FPL-NED is in the process of performing a complete and thorough system condition assessment of its Seabrook Transmission Substation. It is believed that these efforts will prevent such excessive SF6 emissions going forward and will help ensure FPL-NED's SF6 emissions will remain below its stated annual emission goal of less than 5% of the total SF6 system capacity.

If you have any questions regarding this report, please contact Mr. Mike O' Neil, Director – Substation and Protection & Control Operations whose phone number is (561) 691-2202.

Sincerely,

For CMM

C. Martin Mennes
Vice President, Transmission & Substation
Florida Power & Light Company – New England Division

cc: M. Archer
D. Cleary
B. Locke
S. Garwood
M. O' Neil
M. Powers
M. Murphy
A. Legendre
T. Cooper

SF_6 Emissions Reduction Partnership for Electric Power Systems

Annual Reporting Form

Name:	C. Martin Mennes	Company Name:	FPL-NED
Title:	V.P. Transmission Operations & Planning	Report Year:	2007
Phone:	(305)-552-4138	Date Completed:	31-Mar-08

Change in Inventory (SF_6 contained in cylinders, not electrical equipment)

Inventory (in cylinders, **not** equipment)	AMOUNT (lbs.)	Comments
1. Beginning of Year	2,999.00	20 cylinders @115lbs. Incl. 699lbs. In cart
2. End of Year	5,980.00	40 cyl. in WH & Shop / 1,380lbs. in cart.
A. Change in Inventory (1 - 2)	(2,981.00)	

Purchases/Acquisitions of SF_6

	AMOUNT (lbs.)	Comments
3. SF_6 purchased from producers or distributors in cylinders	6,900.00	60 cylinders @ 115lbs.
4. SF_6 provided by equipment manufacturers with/inside equipment	-	
5. SF_6 returned to the site after off-site recycling	-	
B. Total Purchases/Acquisitions (3+4+5)	6,900.00	

Sales/Disbursements of SF_6

	AMOUNT (lbs.)	Comments
6. Sales of SF_6 to other entities, including gas left in equipment that is sold	-	
7. Returns of SF_6 to supplier	-	
8. SF_6 sent to destruction facilities	-	
9. SF_6 sent off-site for recycling	-	
C. Total Sales/Disbursements (6+7+8+9)	-	

Change in Nameplate Capacity

	AMOUNT (lbs.)	Comments
10. Total nameplate capacity (proper full charge) of new equipment	-	
11. Total nameplate capacity (proper full charge) of retired or sold equipment	-	
D. Change in Capacity (10 - 11)	-	

Total Annual Emissions

	lbs. SF_6	Tonnes CO_2 equiv. (lbs.SF_6x23,900/2205)
E. Total Emissions (A+B-C-D)	3,919.00	42,478.05

Emission Rate (optional)

	AMOUNT (lbs.)	Comments
Total Nameplate Capacity at End of Year	42,351.00	
	PERCENT (%)	
F. Emission Rate (Emissions/Capacity)	9.3%	

March 31, 2009

U.S. Environmental Protection Agency
Attn: Ms. Sally Rand
MC6205J
1200 Pennsylvania Avenue
Washington, DC 20460

345 kV Seabrook Transmission Substation
SF6 Emissions Reduction Partnership for Electric Power Systems
Annual Report for 2008

Florida Power & Light-New England Division (FPL-NED) hereby submits the SF6 Emissions Reduction Partnership for Electric Power Systems Annual Report for the year 2008. FPL-NED is the majority owner of the gas insulated 345kV Seabrook Transmission Substation ("Seabrook Transmission Substation") located in Seabrook, NH. This report is submitted pursuant to Section IV, Paragraph B., of the Memorandum of Understanding between the United States Environmental Protection Agency (EPA) and FPL-NED, effective February 3, 2005 (SF6 MOU).

Sulfur hexafluoride (SF6) emissions during the year 2008 were calculated in accordance with the SF6 Emissions Inventory Reporting Protocol and Form included in Attachment B to the SF6 MOU. SF6 emissions of 1,442 lbs. were calculated for the year 2008 representing 3.4% of the total SF6 system capacity[1]. This usage results in FPL-NED achieving its 2008 goal of emitting less than 5% of the total SF6 system capacity, and represents an emissions reduction of 85.4% from the 1990 baseline emission level of 9,890 lbs. FPL-NED intends to maintain the same emissions goal during calendar year 2009 as was in effect for calendar year 2008. The Annual Reporting Form for 2008 is attached hereto.

If you have any questions regarding this report, please contact Mr. Mike O' Neil, Director – Substation and Protection & Control Operations whose phone number is (561) 691-2202.

Sincerely,

Jim Keener
Vice President, Transmission & Substation
Florida Power & Light Company – New England Division

cc: M. Archer
D. Cleary
B. Locke
S. Garwood
M. O' Neil
M. Powers
G. Birgisson
A. Legendre
T. Cooper

[1] Total System Capacity is 42,351 lbs.

SF_6 Emissions Reduction Partnership for Electric Power Systems

Annual Reporting Form

Name:	Tim Cooper	Company Name:	FPL-New England Division
Title:	FPL-NED Project Manager	Report Year:	2008
Phone:	(603) 773-7548	Date Completed:	16-Mar-09

Change in Inventory (SF_6 contained in cylinders, not electrical equipment)

Inventory (in cylinders, **not** equipment)	AMOUNT (lbs.)	Comments
1. Beginning of Year	5,980.00	40 cylinders WH + 1380 lbs in gas cart
2. End of Year	4,307.00	1087lbs in gas carts; 3220lbs in gas bottles
A. Change in Inventory (1 - 2)	1,673.00	

Purchases/Acquisitions of SF_6

	AMOUNT (lbs.)	Comments
3. SF_6 purchased from producers or distributors in cylinders	1,380.00	12 cylinder @ 115lbs for Jan. outage
4. SF_6 provided by equipment manufacturers with/inside equipment	-	
5. SF_6 returned to the site after off-site recycling	1,154.00	To DILO for cleaning; returned all but <20lbs
B. Total Purchases/Acquisitions (3+4+5)	2,534.00	

Sales/Disbursements of SF_6

	AMOUNT (lbs.)	Comments
6. Sales of SF_6 to other entities, including gas left in equipment that is sold	-	
7. Returns of SF_6 to supplier	-	
8. SF_6 sent to destruction facilities	1,591.00	sent with LIMCO Cart off site
9. SF_6 sent off-site for recycling	1,174.00	Returned under "B-5" 20lbs lost in recycling
C. Total Sales/Disbursements (6+7+8+9)	2,765.00	

Change in Nameplate Capacity

	AMOUNT (lbs.)	Comments
10. Total nameplate capacity (proper full charge) of new equipment	-	
11. Total nameplate capacity (proper full charge) of retired or sold equipment	-	
D. Change in Capacity (10 - 11)	-	

Total Annual Emissions

	lbs. SF_6	Tonnes CO_2 equiv. (lbs.SF_6x23,900/2205)
E. Total Emissions (A+B-C-D)	1,442.00	15,629.84

Emission Rate (optional)

	AMOUNT (lbs.)	Comments
Total Nameplate Capacity at End of Year	42,351.00	
	PERCENT (%)	
F. Emission Rate (Emissions/Capacity)	3.4%	

700 Universe Blvd., Juno Beach, FL 33408

FPL

March 31, 2010

U.S. Environmental Protection Agency
Attn: Ms. Sally Rand
MC6205J
1200 Pennsylvania Avenue
Washington, DC 20460

345 kV Seabrook Transmission Substation
SF6 Emissions Reduction Partnership for Electric Power Systems
Annual Report for 2009

Florida Power & Light-New England Division (FPL-NED) hereby submits the SF6 Emissions Reduction Partnership for Electric Power Systems Annual Report for the year 2009. FPL-NED is the majority owner of the gas insulated 345kV Seabrook Transmission Substation ("Seabrook Transmission Substation") located in Seabrook, NH. This report is submitted pursuant to Section IV, Paragraph B., of the Memorandum of Understanding between the United States Environmental Protection Agency (EPA) and FPL-NED, effective February 3, 2005 (SF6 MOU).

Sulfur hexafluoride (SF6) emissions during the year 2009 were calculated in accordance with the SF6 Emissions Inventory Reporting Protocol and Form included in Attachment B to the SF6 MOU. SF6 emissions of 1,540 lbs. were calculated for the year 2009 representing 3.5% of the total SF6 system capacity[1]. This usage results in FPL-NED achieving its 2009 goal of emitting less than 5% of the total SF6 system capacity, and represents an emissions reduction of 84.4% from the 1990 baseline emission level of 9,890 lbs. FPL-NED intends to maintain the same emissions goal during calendar year 2010 as was in effect for calendar year 2009. The Annual Reporting Form for 2009 is attached hereto.

If you have any questions regarding this report, please contact me at phone number (561) 691-2202.

Sincerely,

FOR MIKE O'NEIL

Mr. Mike O' Neil, Director
Substation and Protection & Control Operations
Florida Power & Light Company – New England Division

[1] Total System Capacity is 43,664 lbs., representing an increase of 1,313 lbs. from the prior year's total system capacity. This change in total system capacity results from the retirement / replacement / addition of GIS breakers and Bus Work performed as part of an upgrade to the Seabrook Transmission Substation implemented during 2009.

SF_6 Emissions Reduction Partnership for Electric Power Systems

Annual Reporting Form

Name:	Tim Cooper	Company Name:	FPL-New England Division
Title:	FPL-NED Project Manager	Report Year:	2009
Phone:	(603) 773-7548	Date Completed:	10-Mar-10

Change in Inventory (SF_6 contained in cylinders, not electrical equipment)

Inventory (in cylinders, **not** equipment)	AMOUNT (lbs.)	Comments
1. Beginning of Year	4,307.00	1087 lb. in Carts / 3220 in bottles lb.
2. End of Year	4,501.00	1281 lb. in Carts / 3220 in bottles lb.
A. Change in Inventory (1 - 2)	(194.00)	

Purchases/Acquisitions of SF_6

	AMOUNT (lbs.)	Comments
3. SF_6 purchased from producers or distributors in cylinders	10,543.00	
4. SF_6 provided by equipment manufacturers with/inside equipment	-	
5. SF_6 returned to the site after off-site recycling		
B. Total Purchases/Acquisitions (3+4+5)	10,543.00	

Sales/Disbursements of SF_6

	AMOUNT (lbs.)	Comments
6. Sales of SF_6 to other entities, including gas left in equipment that is sold	-	
7. Returns of SF_6 to supplier	80.00	
8. SF_6 sent to destruction facilities	7,416.00	
9. SF_6 sent off-site for recycling	-	
C. Total Sales/Disbursements (6+7+8+9)	7,496.00	

Change in Nameplate Capacity

	AMOUNT (lbs.)	Comments
10. Total nameplate capacity (proper full charge) of new equipment	6,051.00	Breaker Replacement/Reconfiguration Upgrade
11. Total nameplate capacity (proper full charge) of retired or sold equipment	4,738.00	Breaker Replacement/Reconfiguration Upgrade
D. Change in Capacity (10 - 11)	1,313.00	

Total Annual Emissions

	lbs. SF_6	Tonnes CO_2 equiv. (lbs.SF_6x23,900/2205)
E. Total Emissions (A+B-C-D)	1,540.00	16,692.06

Emission Rate (optional)

	AMOUNT (lbs.)	Comments
Total Nameplate Capacity at End of Year	43,664.00	
	PERCENT (%)	
F. Emission Rate (Emissions/Capacity)	3.5%	

State of New Hampshire

Department of Environmental Services
Waste Management Division

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

Stage I / II Gasoline Vapor Recovery System

Certificate of Compliance

Certificate Number 021207930308A
Date: March 20, 2008

The New Hampshire Department of Environmental Services, Waste Management Division ("DES"), hereby issues this Stage I/II Gasoline Vapor Recovery System Certificate of Compliance to:

Owner Name: FPL ENERGY SEABROOK STATION
Owner Address: PO BOX 300
SEABROOK, NH

Facility Name: FPL ENERGY SEABROOK STATION
Facility Address: 626 LAFAYETTE RD
SEABROOK, NH

Facility ID#: 930908A Site #: 199309008

This certificate documents the above facility's completion of the certification requirements for gasoline vapor recovery systems in accordance with the N.H. Code of Admin. Rules, Env-A 1205. The facility has submitted the following to DES:

a. A completed station notification form;
b. A non-refundable renewal fee; and
c. Documentation demonstrating compliance with the Stage II system testing requirements in accordance with Env-A 1205.23.

This certificate is valid provided that the owner and operator of the above facility operates and maintains its Stage I and Stage II gasoline vapor recovery system in accordance with Env-A 1205. Compliance with Env-A 1205 includes performing daily visual inspections of the vapor recovery components. If a defective system component is found it shall be tagged "Out of Order" and use of the associated system shall not be allowed until the component is repaired, replaced or adjusted, as necessary. Notice shall be given to DES by telephone, letter, or fax within 8 hours of the repair, replacement or adjustment of the defective equipment.

This certificate expires on the date specified at the bottom of this certificate or upon performance of any significant modification to the facility, whichever is sooner. Upon expiration, it is the responsibility of the above facility to re-certify its system within 90 days prior to the expiration date below or in the case of significant modification within 15 days of completing the modification. In order to re-certify the system, the owner must submit a new notification form and renewal fee and successfully complete a Stage II vapor recovery test.

A copy of this certificate shall be kept on site and be made available to an inspector upon request.

CERTIFICATE EXPIRATION DATE:

December 11, 2010

Thomas J Beaulieu

Supervisor, Oil Remediation and Compliance Bureau

P.O. Box 95, 6 Hazen Drive, Concord, N.H. 03301

STATE OF NEW HAMPSHIRE
Department of Environmental Services
Air Resources Division

TITLE V OPERATING PERMIT

Permit No:**TV-OP-017**
Date Issued: **June 5, 2006; Administrative Amendment issued on March 13, 2009**

This certifies that:
FPL Energy LLC
700 Universe Blvd.
Juno Beach, FL 33408-0420
has been granted a Title V Operating Permit for the following facility and location:

FPL Energy Seabrook, LLC
P.O. Box 300
626 Lafayette Road
Seabrook, NH 03874
AFS No. 3301500047

This Title V Operating Permit is hereby issued under the terms and conditions specified in the Title V Operating Permit Application filed with the New Hampshire Department of Environmental Services on **October 8, 2003** under the signature of the following responsible official certifying to the best of their knowledge that the statements and information therein are true, accurate and complete.

Responsible Official:
Gene St. Pierre
Site Vice President, FPL Energy Seabrook, LLC
(603) 773-7471

Responsible Official/Technical Contact:
Michael O'Keefe
Licensing Manager
(603) 773-7745

This Permit is issued by the New Hampshire Department of Environmental Services, Air Resources Division pursuant to its authority under New Hampshire RSA 125-C and in accordance with the provisions of the Code of Federal Regulations, Title 40, Part 70.

This Title V Operating Permit shall expire on **June 30, 2011**.

SEE ATTACHED SHEETS FOR ADDITIONAL PERMIT CONDITIONS

For the New Hampshire Department of Environmental Services, Air Resources Division

Director, Air Resources Division

TABLE OF CONTENTS

ABBREVIATIONS

AAL	Ambient Air Limit
AP-42	Compilation of Air Pollutant Emission Factors
ASTM	American Society for Testing and Materials
BTU	British Thermal Units
CAA	Clean Air Act
CAS	Chemical Abstract Service
CF	Cubic Foot (ft^3)
CFR	Code of Federal Regulations
CO	Carbon monoxide
CO_2	Carbon Dioxide
DER	Discrete Emission Reduction
Env-A	New Hampshire Code of Administrative Rules – Air Resources Division
ERC	Emission Reduction Credit
FR	Federal Register
Ft^3	Cubic foot
Gal	Gallon
HP	Horse Power
Hr	Hour
kGal	1,000 gallons
KW	Kilo Watt
Lb/hr	Pounds per hour
LPG	Liquid Petroleum Gas (Propane)
MACT	Maximum Achievable Control Technology
MMBTU	Million British Thermal Units
MWe	Mega Watt Electric
NAAQS	National Ambient Air Quality Standard
NG	Natural Gas
NHDES (or DES)	New Hampshire Department of Environmental Services
NO_x	Oxides of Nitrogen
PM	Particulate Matter
PM_{10}	Particulate Matter less than 10 microns diameter
ppm	part per million
ppmv	part per million by volume
PSI	Pounds per Square Inch
PTE	Potential to Emit
RACT	Reasonably Available Control Technology
RSA	Revised Statues Annotated
RTAP	Regulated Toxic Air Pollutant
SO_2	Sulfur Dioxide
TAP	Toxic Air Pollutant
TSP	Total Suspended Particulate Matter
TPY	Tons per Year
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

Facility Specific Title V Operating Permit Conditions

I. Facility Description of Operations:

FPL Energy Seabrook LLC (Seabrook Station) is approximately 1,220 Mwe (net output) nuclear generating station. The facility is located along the New Hampshire seacoast in the town of Seabrook, in Rockingham County. Thus, the facility is located within the Merrimack Valley-Southern New Hampshire Air Quality Control Region, which has been designated as a serious non-attainment area for ambient ozone concentrations. As such, this region is subject to reduced emission limits for volatile organic compounds (VOC) and nitrogen oxides (NOx), which are the major precursors to ground-level ozone.

Production of electrical power is the primary function of the facility. The process uses a Westinghouse pressurized water reactor to produce heat through a controlled nuclear fission reaction. This heat is removed from the reactor through a pressurized coolant system and converted to steam, which is used to drive a General Electric turbine-generator which produces electrical power. While this primary function in itself produces no significant quantity of regulated air pollutants, the facility requires a number of supporting process systems that are the primary sources of regulated air pollutants.

The facility operates two auxiliary boilers for the production of process steam for various support purposes, such as: station heating, process steam for evaporator operations, and maintaining turbine steam seals. Sustained operation of these boilers is usually limited to facility outages, when main steam system supplies are not available. Each of the two boilers uses primarily diesel fuel, with small amounts of kerosene added in the winter to improve viscosity.

The facility maintains four large diesel powered emergency generating units. Two of these units are used for the production of back-up power in the event of a loss of normal off-site power supplies. These units are maintained in a standby condition. Under normal operating conditions, the operation of these units is limited to surveillance and post-maintenance testing. The other two units serve as an alternate source of emergency power when either large emergency diesel generator is out of service for maintenance or testing.

The facility also operates a number of small emergency generating units. The Operations Support Building (OSB) Generator provides back-up power to the OSB communications system when the normal off-site supply is not available. The General Office Building (GOB) Diesel Generator provides back-up power to the GOB, including the site computer system.

The Sullair diesel-engine driven air compressor is employed to provide air in the event of malfunction of the electric motor-driven air compressors but it is also use for any compressed air requirements.

In addition, propane fuel and waste oil is used in various small (permit-exempt) space heating units at the facility.

The facility is a major source of NOx, and SO_2 emissions and therefore requires a Title V Permit.

II. Permitted Activities:

In accordance with all of the applicable requirements identified in the Permit, the Permittee is authorized to operate the devices and/or processes identified in Sections III, IV, V, and VI within the terms and conditions specified in this permit.

III. Significant Activities Identification:

A. Significant Activities:

The activities identified in Table 1 are subject to and regulated by this Title V Operating Permit.

Table 1- Significant Activity Identification

Emission Unit Number (EU#)	Description of Emission Unit	Install Date	Manufacturers Rated Maximum Design Capacity
EU1	Auxiliary Boiler #1, Babcock and Wilcox Serial No. NB 24175	1977	Maximum Firing Rate: 105 MMBTU/hr equivalent to 750 gal/hr of diesel fuel/kerosene[1]
EU2	Auxiliary Boiler #2, Babcock and Wilcox Serial No. NB 24176	1977	Maximum Firing Rate: 105 MMBTU/hr equivalent to 750 gal/hr of diesel fuel/kerosene[1]
EU3	Emergency Generator 1A, Colt Industries/ Fairbanks-Morse Serial No. PO-206086C	1980	Maximum Firing Rate: 75.5 MMBTU/hr equivalent to 551gal/hr of diesel Rated output-8,414 HP; EU3 shall be limited to less than 500 hours during any consecutive 12-month period[2].
EU4	Emergency Generator 1B, Colt Industries/ Fairbanks-Morse Serial No. PO-206086D	1980	Maximum Firing Rate: 75.5 MMBTU/hr equivalent to 551gal/hr of diesel Rated output-8,414 HP; EU4 shall be limited to less than 500 hours during any consecutive 12-month period[2].
EU5	Emergency Generator 2A, Cummins Serial No. BO4K395120	2004	Maximum Firing Rate: 23.6 MMBTU/hr equivalent to 172 gal/hr of diesel Rated output-3,741 HP; EU5 shall be limited to less than 300 hours during any consecutive 12-month period[2].
EU6	Emergency Generator 2B, Cummins Serial No. BO4K395130	2004	Maximum Firing Rate: 23.6 MMBTU/hr equivalent to 172 gal/hr of diesel Rated output-3,741 HP; EU6 shall be limited to less than 300 hours during any consecutive 12-month period[2].
EU7	Emergency Generator Caterpillar Operations Support	1986	Maximum Firing Rate: 3.1 MMBTU/hr equivalent to 22.3 gal/hr of diesel

[1] Kerosene is used as a winter blend additive in a ratio of 2.3 parts oil to 1 part kerosene during month of November through February.

[2] Although operation of devices EU3 and EU4 will be limited to 500 hours/year and EU5 and EU6 will be limited to 300 hours/year under normal circumstances, the facility's license from the Nuclear Regulatory Commission (NRC) requires that these units must be able to meet certain energy needs in case of a nuclear incident. In the case of such an extreme event, the 500 hours/year and 300 hours/year limits may be exceeded in the interest of public safety. In this event, the devices will then be subject to the NOx limitations of Env-A 1211.07(c)(2)b Emission Standards for Stationary Internal Combustion Engines. Also, if EU5 and EU6 exceed 300 hours/year limit the facility may be subject to New Source Review (NSR).

Table 1- Significant Activity Identification			
Emission Unit Number (EU#)	**Description of Emission Unit**	**Install Date**	**Manufacturers Rated Maximum Design Capacity**
	Building (OSB) Serial No. 90U3499		Rated output-345 HP; EU7 shall be limited to less than 500 hours during any consecutive 12-month period.
EU8	Emergency Generator Komatsu/Onan General Office Building (GOB) Serial No. 10993	1986	Maximum Firing Rate: 1.95 MMBTU/hr equivalent to 14.2 gal/hr of diesel Rated output-285 HP; EU8 shall be limited to less than 500 hours during any consecutive 12-month period.
EU9	Sullair Air Compressor Serial No. 004-144524	2005	Maximum Firing Rate: 1.70 MMBTU/hr equivalent to 12.4 gal/hr of diesel Rated output-275 HP; EU9 shall be limited to less than 500 hours during any consecutive 12-month period.

B. Stack Criteria:

The stack indicated in Table 2 – Stack Criteria, for the significant devices described in Table 1 and listed below, shall discharge vertically without obstruction (including rain caps) and meet the following criteria in accordance with the state-only requirements[3] of Env-A 606.

Table 2 – Stack Criteria			
Stack #	**Emission Unit #**	**Minimum Stack Height Above Base Elevation (Feet)**	**Maximum Stack Diameter or Dimensions (Feet)**
Stack 1	EU1 & EU2	142	8.0

The Permittee may change the stack criteria described in Table 2 without obtaining approval from the DES provided that an air quality impact analysis is performed either by the facility or the DES (if requested by the facility in writing) in accordance with Env-A 606 and the "Guidance and Procedure for Performing Air Quality Impact Modeling in New Hampshire", and that the analysis demonstrates that emissions from the modified stack will continue to comply with all applicable emission limitations and ambient air limits. All air modeling data and analyses shall be kept on file at the facility for review by the DES upon request.

[3] The term "state-only requirement" is used to refer to those requirements that are not federally enforceable but are state requirements as defined in Env-A 101.259.

IV. Insignificant Activities Identification:

All activities at this facility that meet the criteria identified in Env-A 609.04(d) shall be considered insignificant activities. Emissions from the insignificant activities shall be included in the total facility emissions for the emission-based fee calculation described in Section XXIII of this Permit.

V. Exempt Activities Identification:

All activities identified in Env-A 609.03(c) shall be considered exempt activities and shall not be included in the total facility emissions for the emission based fee calculation described in Section XXIII of this permit.

VI. Pollution Control Equipment/Technique Identification:

Pollution control equipment is not used for any of the devices identified in this Permit.

VII. Alternative Operating Scenarios:

No alternative operating scenarios were identified in this Permit.

VIII. Applicable Requirements:

A. State-only Enforceable Operational and Emission Limitations:

The Permittee shall be subject to the state-only operational and emission limitations identified in Table 3 below.

Table 3 – State-only Enforceable Operational and Emission Limitations

Item #	Applicable Requirements	Applicable Emission Unit	Regulatory Cite
1.	Methods of Demonstrating Compliance In accordance with Env-A 1405.01, the owner of any device or process, that emits a regulated toxic air pollutant, shall determine compliance with the ambient air limits (AALs) by using one of the methods provided in Env-A 1405.02, Env-A 1405.03, Env-A 1405.04, Env-A 1405.05 or Env-A 1405.06.	Facility Wide	Env-A 1405.01
2.	Compliance Demonstration In accordance with Env-A 1402.01(c)(3), documentation for the demonstration of compliance shall be retained at the facility, and shall be made available to the DES for inspection.	Facility Wide	Env-A 1402.01(c)(3)
3.	24-hour and Annual Ambient Air Limit The emissions of any regulated toxic air pollutant shall not cause an exceedance of its associated 24-hour or annual ambient air limit as set forth in Env-A 1450.01, *Table Containing the List Naming All Regulated Toxic Air Pollutants.*	Facility Wide	Env-A 1400

Table 3 – State-only Enforceable Operational and Emission Limitations			
Item #	Applicable Requirements	Applicable Emission Unit	Regulatory Cite
4.	Revisions of the List of RTAPs In accordance with RSA 125-I:5 IV, if DES revises the list of regulated toxic air pollutants (RTAPs) or their respective ambient air limits or classifications under RSA 125-I:4, II and III, and as a results of such revision the Permittee is required to obtain or modify the Permit under the provisions of RSA 125-I or RSA 125-C, the Permittee shall have 90 days following publication of notice of such final revision in the New Hampshire Rulemaking Register to file a complete application for such permit or permit modification. DES shall include as conditions in any permit issued as a result of a revision to the list of RTAPs a compliance plan and a schedule for achieving compliance based on public health, economic and technical consideration, not to exceed 3 years.	Facility Wide	RSA 125-I:5 IV
5.	Activities Exempt from Opacity Standards a) For fuel burning devices, EU1 and EU2, the average opacity shall be allowed to be in excess of those standards specified in Env-A 2002.02 for one period of 6 continuous minutes in any 60 minute period during startup, shutdown, malfunction, soot blowing, grate cleaning, and cleaning of fires; b) In addition, EU1and EU2 shall be exempt from the opacity standard of Env-A 2002.02 specified above in Table 4, Item 9, where the Permittee demonstrates to DES that such exceedances: 1) Were the result of the adherence to good boiler operating practices which, in the long term, result in the most efficient or safe operation of the boiler; 2) Occurred during periods of cold startup of a boiler over a continuous period of time resulting in efficient heat-up and stabilization of its operation and the expeditious achievement of normal operation of the unit; 3) Occurred during periods of continuous soot blowing of the entire boiler tube section over regular time intervals as determined by the operator and in conformance with good boiler operating practice; and 4) Were the result of the occurrence of an unplanned incident in which the opacity exceedances was beyond the control of the operator and in response to such incident, the operator took appropriate steps in conformance with good boiler operating practice to eliminate the	EU1 & EU2	Env-A 2002.04(c)(d)(e)(f) eff 4-23-05

Table 3 – State-only Enforceable Operational and Emission Limitations			
Item #	**Applicable Requirements**	**Applicable Emission Unit**	**Regulatory Cite**
	excess opacity as quickly as possible:		
6.	Contaminants Limits for Specification Used Oil a) The used oil shall not otherwise exhibit any hazardous waste characteristics specified in Env-Wm 403. b) The used oil shall not be mixed with hazardous waste; and c) The allowable limits of the contaminants on a dry weight basis shall be as follows: Sulfur (% by weight) 2.0% maximum Arsenic 5 ppm maximum Cadmium 2 ppm maximum Chromium 10 ppm maximum Flash point 100 °F minimum Lead 60 ppm maximum[4] Halogens as HCl 1000ppm maximum PCBs less than 2 ppm	Facility wide	Env-Wm 807.02 eff 10-13-01

B. Federally Enforceable Operational and Emission Limitations

The Permittee shall be subject to the federally enforceable operational and emission limitations identified in Table 4[5] below:

Table 4 – Federally Enforceable Operational and Emission Limitations			
Item #	**Applicable Requirement**	**Applicable Emission Unit**	**Regulatory Cite**
1.	Auxiliary Boilers Auxiliary boilers shall be subject to the requirements of Env-A 1211.12 if the combined theoretical potential emissions from all devices and processes located at the stationary source exceed 50 tons per calendar year of NOx at any time after December 31, 1989.	EU1 & EU2	Env-A 1211.01(k) eff 10-31-02 Env-A 1211.02(k) Federally Enforceable
2.	NOx RACT for Auxiliary Boilers a) On and after May 31, 1995 auxiliary boilers shall be limited at all times to NOx RACT emission limits no greater than 0.20 lb per million Btu based on a 24-hour calendar day average, regardless of the type of fuel burned. b) The emissions from all auxiliary boilers shall be included in the calculation of both the actual and theoretical potential emissions from the stationary	EU1 & EU2	Env-A 1211.12(c)(d)(e) eff 12-22-04 Env-A 1211.12(b)(d)(e) Federally Enforceable

[4]Based on modeling the facility is applicable to more stringent lead limit of 60 ppm, than allowed by specification used oil standards in Env-Wm 807.02.
[5] NH rules cited in this section as Federally Enforceable are contained in the EPA-approved State Implementation Plan (SIP), or they are awaiting EPA approval and are at least as stringent as the SIP rule. Each citation of a non-SIP rule is followed by the effective date of that rule and a regulatory cite of the SIP approved rule if different from the current rule.

Table 4 – Federally Enforceable Operational and Emission Limitations			
Item #	Applicable Requirement	Applicable Emission Unit	Regulatory Cite
	source. c) Compliance with the NOx RACT emission standards specified in this section shall be determined by the testing methods in Env-A 1211.20.		
3.	<u>Emergency Generators</u>[6] The emergency generators, Cummins 2A and 2B, shall be limited to less than 300 hours of operation during any consecutive 12-month period.	EU5 & EU6	Env-A 618.02 (b)(11)g.1. eff 4-26-03 & 40 CFR 51
4.	<u>Emergency Generators</u> All emergency generators at the facility, except for Cummins 2A and 2B, shall be limited to less than 500 hours of operation during any consecutive 12-month period.	EU3, EU4, EU7, EU8, & EU9	Env-A 1211.11(b) eff 10-31-02 Federally Enforceable
5.	<u>Emergency Generators Applicability</u> The facility shall be subject to the requirements of Env-A-1211.11 since: a) The combined theoretical potential emissions from all devices located at the facility exceed 50 tons per calendar year of NOx; and b) All emergency generators that are limited to less than 500 hours of operation have combined theoretical potential emissions of NOx greater than 25 tons for any consecutive 12-month period.	EU3, EU4, EU5, EU6, EU7, EU8, & EU9	Env-A 1211.01(j) eff 10-31-02 Env-A 1211.02(j), (k) Federally Enforceable
6.	<u>Emission Standards and Control Options for Emergency Generators</u> All stationary internal combustion engines in existence on or after May 31, 1995 operating as emergency generators shall meet the requirements of Env-A 1211.11(d) as specified in Table 5, Item 3[7].	EU3, EU4, EU5, EU6, EU7, EU8, & EU9	Env-A 1211.11(d) eff 10-31-02 Federally Enforceable
7.	<u>Internal Combustion Engines Applicability</u>[8] Stationary internal combustion engine(s), except for stationary internal combustion engines operating as emergency generators shall be subject to the requirements of Env-A 1211.07 if the combined maximum heat input rate of such engines exceeds 4,500,000 Btu per hour at any time after December 31, 1989.	EU3, EU4, EU5, EU6	Env-A 1211.01(f) eff 10-31-02 Env-A 1211.02(e) Federally Enforceable
8.	<u>Emission Standards for Stationary Internal Combustion Engines</u>[8] On or after May 31, 1995 oil-fired stationary internal combustion engines that exceed the 500 hours per year limit shall be limited at all times to hourly average NOx RACT emission limit no greater than 8.0 grams per bhp-hr, or 2.44 lb per million Btu. Compliance with the NOx RACT emission standards shall be determined by the	EU3, EU4, EU5, EU6	Env-A 1211.07(c)(d) eff 10-31-02 Federally Enforceable

[6] In the event that the 300 hours/year limit for EU5 and EU6 is exceeded, as referenced in footnote 2, the facility may be subject to NSR.
[7] The CO emission concentrations from EU3, EU4, EU5, EU6, EU7 and EU9 are above 100 ppmdv therefore precluding the requirement to adjust the ignition timing. Also, see memo dated 3/1/2004 titled *Applicability of NOx RACT Requirements for the Proposed Installation of Two Emergency Generators 2A and 2B.*
[8] In the event that the 500 hours/year limit for EU3 and EU4 and 300 hours/year limit for EU5 and EU6 is exceeded, for reasons specified in footnote 2, the devices will be subject to Env-A 1211.07(c)(d).

Table 4 – Federally Enforceable Operational and Emission Limitations			
Item #	**Applicable Requirement**	**Applicable Emission Unit**	**Regulatory Cite**
	testing methods in Env-A 800.		
9.	Opacity from Fuel Burning Device Installed after May 13, 1970 No owner or operator shall cause or allow average opacity from fuel burning devices installed after May 13, 1970 in excess of 20 percent opacity for any continuous 6-minute period.	Facility Wide	Env-A 2002.02 & TP-B-0507 Federally Enforceable
10.	PM Emissions Standards from Fuel Burning Devices Installed after May 13, 1970 but before January 1, 1985 No owner or operator shall cause or allow emissions of particulate matter from fuel burning devices installed after May 13, 1970 but before January 1, 1985 in excess of the rates set forth below, where: I= maximum gross heat input rate in 10^6 BTU/hr; and E=the maximum allowable particulate matter emission rate in lb/10^6 BTU. a) For devices with I less than 10 E shall be equal to 0.60; b) For devices with I equal to or greater than 10 but less than 250, E shall be calculated by raising I to the –0.234 power, and multiply the results by 1.028, expressed mathematically in the formula below: $E = 1.028 I^{-0.234}$	Facility Wide	Env-A 2002.07 eff 4-23-05 Env-A 1202.06 Federally Enforceable
11.	PM Emission Standard for Fuel burning Devices Installed on or After January 1, 1985 No owner or operator shall allow emissions of particulate matter from fuel burning devices in excess of the rates set below where: I= maximum gross heat input rate in 10^6 BTU/hr; and E=the maximum allowable particulate matter emission rate in lb/10^6 BTU. For devices with I less than 100, E shall be equal to 0.30;	Facility Wide	Env-A 2002.08(c)(1) eff 4-23-05 Env-A 1202.07 Federally Enforceable
12.	Accidental Release Program Requirements Currently, substances regulated under 40 CFR 68 are stored at the facility in amounts less than the applicable threshold quantities established in 40 CFR 68.130. The facility is subject to the Purpose and General Duty clause of the 1990 Clean Air Act, Section 112(r)(1). General Duty includes the following responsibilities: a) Identify potential hazards which result from such releases using appropriate hazard assessment techniques; b) Design and maintain a safe facility; c) Take steps necessary to prevent releases; and d) Minimize the consequences of accidental releases that do occur.	Facility Wide	CAAA 112(r)(1)

Table 4 – Federally Enforceable Operational and Emission Limitations

Item #	Applicable Requirement	Applicable Emission Unit	Regulatory Cite
13.	<u>Maximum Sulfur Content in Liquid Fuels</u> a) The sulfur content of No. 2 oil shall not exceed 0.40 percent sulfur by weight; b) The sulfur content of kerosene-1 shall not exceed 0.04 percent sulfur by weight;	Facility Wide	Env-A 1604.01(a)(e) eff 4-23-05 & 40 CFR 51
14.	<u>Stratospheric Ozone Protection</u> In accordance with 40 CFR 82.154 *Recycling and Emission Reduction,* effective June 13, 2005, no person servicing, maintaining, repairing or disposing of appliances may knowingly vent or otherwise release into the environment any refrigerant or refrigerant substitute from such appliances.	All refrigeration equipment using Class I or Class II refrigerant or their substitute	Subpart F, 40 CFR 82
15.	<u>Asbestos Management and Control - Notification</u> Facility shall comply with the requirements of Env-A 1800 upon the removal of asbestos-containing materials from buildings. These requirements include, but are not limited to, notification of the DES, payment of fees, maintenance of records, inspection provisions, work practice requirements, alternative work practices, and adherence to National Emission Standards for Hazardous Air Pollutants	Facility Wide	Env-A 1800 eff 4-1-97 & 40 CFR 61.145, Subpart M
16.	<u>National Ambient Air Quality Standards (NAAQS).</u> The facility shall comply with the national ambient air quality standards and the applicable requirements as specified in Env-A 609.10.	Facility Wide	Env-A 609.10 eff 4-26-03 Federally Enforceable

C. Emission Reductions Trading Requirements

This Title V Permit allows for trading of NOx allowances in accordance with Env-A 3200 *NOx Budget Trading Program*. All allowances and emission reduction trading must be authorized under the applicable requirements of 42 U.S.C §7401 et seq. (the "Act"), and either Env-A 3000 the *Emissions Reductions Credits (ERCs) Trading Program* or Env-A 3100 the *Discrete Emissions Reductions (or DERs) Trading Program* and Env-A 3200.

Additionally, the Permittee has requested provisions be made for banking of emission reductions for greenhouse gas in accordance with Env-A 3800 *Voluntary Greenhouse Gas Emissions Reduction Registry*. Protocols for determining verifiable emission reductions and previously accrued reductions have been submitted to NHDES for registration. Trading of these reductions will not be authorized until rules governing a trading program are adopted under Env-A 3800. For the year 1991 through 2002, Seabrook Station has registered a total of 366,880 metric tons of CO_2 equivalents.

D. Monitoring and Testing Requirements:

The Permittee is subject to the monitoring and testing requirements as contained in Table 5[9] below:

Table 5 – Monitoring/Testing Requirements

Item #	Parameter	Method of Compliance	Frequency of Method	Device	Regulatory Cite
1.	Compliance Stack Testing for NOx	All owners or operators of stationary sources subject to Env-A 1211 shall conduct periodic compliance stack testing in accordance with Env-A 802.	Every 3 years	EU1 & EU2	Env-A 803.02(c) eff 10-31-02 Env-A 801.01 Federally Enforceable
2.	Compliance Stack Testing for NOx	Compliance stack testing for NOx shall be planned and carried out at the frequency specified. The pre-test protocol shall contain the following information: a) Calibration methods and sample data sheets; b) Description of the test methods to be used; c) Pre-test preparation procedures; d) Sample collection and analysis methods; e) Process data to be collected; and f) Complete test program description. At least 15 days prior to the test date, the facility and any contractor that the facility retains for performance of the test, shall participate in pre-test conference with a Division representative. The pre-test protocol must be submitted to DES by the facility at least 30 days prior to the commencement of testing. Emission testing shall be carried out under the observation of a Division representative. Upon commencement of any performance test, the performance test shall not be aborted unless approved by DES. The Permittee shall submit a stack test report to DES within 60 days of completion of the actual testing.	Every 3 years	EU1 & EU2	Env-A 802.02 & Env-A 802.04 eff 10-31-02 Env-A 801.01 Federally Enforceable Env-A 802.05 eff 10-31-02 Env-A 802.03 eff 10-31-02 Env-A 802.11, eff 10-31-02 Env-A 802. Federally Enforceable
3.	Emission Standards and Control Options for Emergency	All stationary internal combustion engines in existence on or after May 31, 1995 operating as emergency generators shall perform the following: a) Set and maintain the ignition timing of the engine 4 degrees retarded relative to standard timing,	Every 3 years.	EU3, EU4, EU5, EU6 EU7,	Env-A 1211.11(d) eff 10-31-02 Federally Enforceable

[9] NH rules cited in this section as Federally Enforceable are contained in the EPA-approved State Implementation Plan (SIP), or they are awaiting EPA approval and are at least as stringent as the SIP rule. Each citation of a non-SIP rule is followed by the effective date of that rule and a regulatory cite of the SIP approved rule if different from the current rule.

Table 5 – Monitoring/Testing Requirements

Item #	Parameter	Method of Compliance	Frequency of Method	Device	Regulatory Cite
	Generators	provided that the ignition timing shall not be retarded beyond the point that[10]: 1) The CO emission concentration increases beyond 100 pmvd, corrected to 15% oxygen; 2) The turbocharger speed is increased beyond the maximum operating speed recommended by the manufacturer; 3) The exhaust port temperature increases beyond the manufacturer's recommended maximum operating temperature; or 4) The opacity of the emissions from the engine exhaust is equal to or greater than 20% opacity; b) Install, operate, and maintain an elapsed time meter for each engine to indicate, in cumulative hours, the elapsed engine operating time for the previous 12 months; c) Determine the hours of operation for each engine for the previous 12-month period on a monthly basis; d) Maintain records to certify that the ignition timing of the engine has been inspected and adjusted at least once every 3 years; e) Notify the division in writing in the event that the hours of operation exceed 500 hours for any consecutive 12-month period.		EU8, & EU9	
4.	Gaseous Concentration Measurements for Emergency Generators	Following the performance of tuneup activities as specified in Env-A 1211.11, the owner or operator of an emergency generator shall perform gaseous concentration measurements for carbon monoxide (CO) and oxygen (O_2) as specified below: a) Any monitors listed in Env-A 803.04(a) shall be acceptable for making the gaseous concentration measurements; b) A concentration monitor shall be operated following the operating procedure specified by the manufacturer; c) Measurements shall be taken at one minute intervals at each representative operation condition over a minimum of a 15-minute period following achievement of stable operation; d) All measurements shall be documented and	Every 3 years	EU3, EU4, EU5, EU6, EU7, EU8, & EU9	Env-A 803.03(d) & Env-A 803.04 eff 12-24-04 & TP-B-0507 Federally Enforceable

[10] The CO emission concentrations from EU3, EU4, EU5, EU6, EU7, and EU9 are above 100 ppmdv therefore precluding the requirement to adjust the ignition timing. Also, see memo dated 3/1/2004 titled *Applicability of NOx RACT Requirements for the Proposed Installation of Two Emergency Generators 2A and 2B.*

Table 5 – Monitoring/Testing Requirements

Item #	Parameter	Method of Compliance	Frequency of Method	Device	Regulatory Cite
		averaged over the period of testing; e) Prior to and following measurement, the owner or operator shall perform, following the manufacturer's recommended procedures, two calibrations as follows: 1) A calibration with a gas containing between 0% and 20% of the expected concentration of gas being measured, based on manufacturer's data or EPA-published emission factors for the device; and 2) A calibration with a gas containing between 80% and 150% of the expected concentration of gas being measured, based on manufacturer's data or EPA-published emission factors for the device; f) All calibration data shall be recorded and kept on-site; and g) Concentration measurements shall be reported on a dry basis and if a direct measurement is on a wet basis, the basis for the percentage moisture used and the correction calculation to dry basis shall be documented.			
5.	Testing for Opacity from Emergency Generators	The owner of operator of an emergency generator subject to Env-A 1211.11(d) shall measure opacity by one of the two procedure identified below: a) The owner or operator shall make visual determinations of opacity: 1) As specified in 40 CFR 60, Appendix A, Method 9, Visual Determination of the Opacity of Emissions from Stationary Sources; and 2) For a period of at least 18 minutes during normal operation of the device. b) The owner or operator shall conduct opacity monitor testing as specified in Env-A 807.03(c).	Every 3 years	EU3, EU4, EU5, EU6, EU7, EU8, & EU9	Env-A 807.03 eff 10-31-02 TP-B-0507 Federally Enforceable
6.	Sulfur Content of Liquid Fuels	The operator shall conduct testing in accordance with appropriate ASTM test methods or retain delivery tickets that certify the weight percent of sulfur for each delivery of fuel oil to determine compliance with the sulfur content limitation provisions specified in this permit for liquid fuels.	For each delivery of fuel oil to the facility	Facility Wide	Env-A 806.02 eff 10-31-02 Env-A 404.01(c) Federally Enforceable

Table 5 – Monitoring/Testing Requirements					
Item #	**Parameter**	**Method of Compliance**	**Frequency of Method**	**Device**	**Regulatory Cite**
7.	Sulfur Content in Blended Fuels	The Facility may use blended fuel that combines fuel with the sulfur content above the specification limit with fuel with the sulfur content below the specification limit provided the user maintain records of the following: a) Analyses of the original fuels; and b) A demonstration that the sulfur content of the resultant blended fuel is below the limit of the fuel permitted for the device.	Whenever fuels are blended	EU1 & EU2	Env-A 806.02(b) eff 10-31-02 404.01(c) Federally Enforceable
8.	Specification Used Oil Monitoring	The owner or operator shall conduct testing of on site generated specification used oil in accordance with appropriate ASTM test methods to determine compliance with limitation provisions specified in Table 3, Item 6 prior to burning.	Before using specification used oil	Facility wide	Env-Wm 807.10(b)(7) eff 10-13-02 Federally Enforceable

E. Recordkeeping Requirements:

The Permittee shall be subject to the recordkeeping requirements identified in Table 6[11] below:

Table 6 – Applicable Recordkeeping Requirements				
Item #	**Applicable Recordkeeping Requirement**	**Records Retention Requirement**	**Applicable Emission Unit**	**Regulatory Cite**
1.	Retention of Records The Permittee shall retain records of all required monitoring data, recordkeeping and reporting requirements, and support information for a period of at least 5 years from the date of origination.	Retain for a minimum of 5 years	Facility Wide	40 CFR 70.6(a)(3)(ii)(B)& Env-A 902.01(a) eff 4-23-99
2.	Env-A 1400 Records Facilities subject to the requirements of Env-A 1400, shall maintain records in accordance with the applicable methods used to demonstrate compliance pursuant to Env-A 1405.	Maintain on a continuous basis	Facility-wide	Env-A 902.01(c) eff 4-23-99 State-only Enforceable
3.	Compliance Certification The owner or operator shall meet the requirements for compliance certification with terms and conditions contained in this permit, including emission limitations, standards, or work practices. Compliance certifications shall meet the	Annually	Facility Wide	40 CFR 70.6(c)(5)

[11] NH rules cited in this section as Federally Enforceable are contained in the EPA-approved State Implementation Plan (SIP), or they are awaiting EPA approval and are at least as stringent as the SIP rule. Each citation of a non-SIP rule is followed by the effective date of that rule and a regulatory cite of the SIP approved rule if different from the current rule.

Table 6 – Applicable Recordkeeping Requirements				
Item #	**Applicable Recordkeeping Requirement**	**Records Retention Requirement**	**Applicable Emission Unit**	**Regulatory Cite**
	requirements outlined in Section XXI of this permit.			
4.	Monitoring Data The Permittee shall maintain records of monitoring requirements as specified in Table 5 of this Permit including: a) Summary of maintenance and repair records associated with emission units; b) Summary of inspection, maintenance and test results for each device; and c) Summary of testing and/or delivery ticket certifications for sulfur content and specification used oil contaminants limitation provisions.	Maintain on a continuous basis	Facility Wide	40 CFR 70.6(a)(3)(iii)(A)
5.	Records of Fuel Utilization: For each fuel burning device at the facility, the owner or operator shall keep records of fuel utilization in accordance with the following: a) Consumption; b) Fuel type; c) Sulfur content as percent sulfur by weight of fuel; and d) The concentration of the contaminants in the specification used oil listed in Table 3, Item 6.	Monthly	Facility Wide	Env-A 903.03 eff 10-21-03 TP-B-0507 Federally Enforceable
6.	NO_x Recordkeeping Requirements: For fuel burning devices, including boilers, and internal combustion engines, the following information shall be recorded and maintained: a) Identification of each fuel burning device; b) Operating schedule during the high ozone season for each combustion device identified in (a), above including: 1) Hours of operation per calendar month; 2) Days of operation per calendar month; 3) Number of weeks of operation; 4) Type, and amount of fuel burned, for each fuel burning device; 5) Heat input rate in million BTUs per hour or, in tons per hour; and 6) The following NOx emission data, (a) Actual NO_x emissions for each fuel-burning	On a continuous basis	Facility Wide	Env-A 905.02 eff 4-23-99 TP-B-0507 Federally Enforceable

Table 6 – Applicable Recordkeeping Requirements				
Item #	Applicable Recordkeeping Requirement	Records Retention Requirement	Applicable Emission Unit	Regulatory Cite
	device identified in a) above for i. Each calendar year, in tons; and ii. A high ozone season day during that calendar year, in pounds per day; and (b) The emission factors and the origin of the emission factors used to calculate the NOx emissions.			

F. Reporting Requirements:

The Permittee shall be subject to the reporting requirements identified in Table 7[12] below:

Table 7 – Applicable Reporting Requirements				
Item #	Reporting Requirements	Frequency of Reporting	Applicable Emission Unit	Regulatory Cite
1.	Certification of Accuracy Any report submitted to the DES and/or EPA shall include the certification of accuracy statement outlined in Section XXI.B of this Permit and shall be signed by the responsible official.	As specified in this Permit	Facility Wide	40 CFR 70.6(c)(1)
2.	Annual Compliance Certification Annual compliance certification shall be submitted in accordance with Section XXI of this Permit.	Annually (no later than April 15th of the following year)	Facility Wide	40 CFR 70.6(c)(1)
3.	Permit Deviations Prompt reporting of deviations from Permit requirements including those attributed to upset conditions as defined in the permit, the probable cause of such deviations, and any corrective actions or preventative measures taken shall be conducted in accordance with Section XXVIII of this permit.	Prompt reporting (within 24-hours of discovery of an occurrence)	Facility Wide	40 CFR 70.6(a)(3)(iii)(B)
4.	Semi-Annual Permit Deviation and Monitoring Report The Permittee shall submit a summary report of monitoring and permit deviations including the following: a) Summary of maintenance and inspection results for fuel	Semi-annually by July 31st and January 31st of each calendar year.	Facility Wide	40 CFR 70.6(a)(3)(iii)(A)

[12] NH rules cited in this section as Federally Enforceable are contained in the EPA-approved State Implementation Plan (SIP), or they are awaiting EPA approval and are at least as stringent as the SIP rule. Each citation of a non-SIP rule is followed by the effective date of that rule and a regulatory cite of the SIP approved rule if different from the current rule.

Table 7 – Applicable Reporting Requirements				
Item #	Reporting Requirements	Frequency of Reporting	Applicable Emission Unit	Regulatory Cite
	burning devices; b) Summary of testing and/or delivery ticket certifications for fuel sulfur content and specification used oil contaminants limitation provisions; and c) Summary of permit deviations.			
5.	Annual Emissions Report The owner or operator shall submit an annual report of the actual emissions including: a) For combustion devices all information listed in Table 6, Item 5; and b) The actual annual emissions speciated by individual New Hampshire RTAP including a breakdown of VOC emissions by compound.	Annually (no later than April 15th of the following year)	Facility Wide	Env-A 907.01[13] eff 4-23-99 State-only Enforceable
6.	Emission-Based Fees Report Annual reporting of emission based fees shall be conducted in accordance with Section XXIII of this Permit. The owner or operator of a stationary source, an area source, or device having actual emissions of 1,000 tons or less shall pay to the department the annual emission-based fee no later than by April 15 each subsequent year for emissions from the previous calendar year.	As specified	Facility Wide	Env-A 705.04 [14] eff 4-26-03 Federally Enforceable
7.	NO_x Report For fuel burning devices, including boilers, and engines, the owner or operator shall submit annually (no later than April 15th of the following year), reports of the data specified in Table 6, Item 6.	Annually (no later than April 15th of the following year)	Facility Wide	Env-A 909 eff 4-23-99 TP-B-0507 Federally Enforceable
8.	Compliance Stack Testing Reports The owner or operator shall submit a report to the division documenting the results of the compliance stack emissions test no more than 60 days after completion of testing.	60 days after completion of testing	EU1, EU2	Env-A 802.11 eff 10-31-02 Env-A 802.06 Federally Enforceable

IX. Requirements Currently Not Applicable:

Requirements not currently applicable to the facility were not identified by the Permittee.

[13] The "New" Env-A 900 effective October 21, 2003, has not been adopted as part of the State Implementation Plan (SIP) and is considered State-only enforceable until such time as the SIP is amended and approved by EPA.

[14] Adopted June 26, 2004.

General Title V Operating Permit Conditions

X. Issuance of a Title V Operating Permit:

A. This Permit is issued in accordance with the provisions of Env-A 609. In accordance with 40 CFR 70.6(a)(2), this Permit shall expire on the date specified on the cover page of this Permit, which shall not be later than the date five (5) years after issuance of this Permit.

B. Permit expiration terminates the Permittee's right to operate the Permittee's emission units, control equipment or associated equipment covered by this permit, unless a timely and complete renewal application is submitted at least 6 months before the expiration date.

XI. Title V Operating Permit Renewal Procedures

Pursuant to Env-A 609.07(b), an application for renewal of this Permit shall be considered timely if it is submitted to the Director at least six months prior to the designated expiration date of this Permit.

XII. Application Shield

Pursuant to Env-A 609.08, if an applicant submits a timely and complete application for the issuance or renewal of a Permit, the failure to have a Permit shall not be considered a violation of this part until the Director takes final action on the application.

XIII. Permit Shield

A. Pursuant to Env-A 609.09(a), a permit shield shall provide that:

1. For any applicable requirement or any state requirement found in the New Hampshire Rules Governing the Control of Air Pollution specifically included in this Permit, compliance with the conditions of this Permit shall be deemed compliance with said applicable requirement or said state requirement as of the date of permit issuance; and
2. The Permittee need not comply with any applicable requirement or state requirement found in the New Hampshire Rules Governing the Control of Air Pollution and specifically identified in Section IX of this Title V Operating Permit as not applicable to the stationary source or area source.

B. The permit shield identified in Section XIII.A. of this Permit shall apply only to those conditions incorporated into this Permit in accordance with the provisions of Env-A 609.09(b). It shall not apply to certain conditions as specified in Env-A 609.09(c) that may be incorporated into this Permit following permit issuance by DES.

C. If a Title V Operating Permit and amendments thereto issued by the DES does not expressly include or exclude an applicable requirement or a state requirement found in the New Hampshire Rules Governing the Control of Air Pollution, that applicable requirement or state requirement shall not be covered by the permit shield and the Permittee shall comply with the provisions of said requirement to the extent that it applies to the Permittee.

D. If the DES determines that this Title V Operating Permit was issued based upon inaccurate or incomplete information provided by the applicant or Permittee, any permit shield provisions in said Title V Operating Permit shall be void as to the portions of said Title V Operating Permit which are affected, directly or indirectly, by the inaccurate or incomplete information.

E. Pursuant to Env-A 609.09(f), nothing contained in Section XIII of this Permit shall alter or affect the ability of the DES to reopen this Permit for cause in accordance with Env-A 609.19 or to exercise its summary abatement authority.

F. Pursuant to Env-A 609.09(g), nothing contained in this section or in any title V operating permit issued by the DES shall alter or affect the following:

1. The ability of the DES to order abatement requiring immediate compliance with applicable requirements upon finding that there is an imminent and substantial endangerment to public health, welfare, or the environment;
2. The state of New Hampshire's ability to bring an enforcement action pursuant to RSA 125-C:15,II;
3. The provisions of section 303 of the CAA regarding emergency orders including the authority of the EPA Administrator under that section;
4. The liability of an owner or operator of a source for any violation of applicable requirements prior to or at the time of permit issuance;
5. The applicable requirements of the acid rain program, consistent with section 408(a) of the CAA;
6. The ability of the DES or the EPA Administrator to obtain information about a stationary source, area source, or device from the owner or operator pursuant to section 114 of the CAA; or
7. The ability of the DES or the EPA Administrator to enter, inspect, and/or monitor a stationary source, area source, or device.

XIV. Reopening for Cause

The Director shall reopen and revise a Title V Operating Permit for cause if any of the circumstances contained in Env-A 609.19(a) exist. In all proceedings to reopen and reissue a Title V Operating Permit, the Director shall follow the provisions specified in Env-A 609.19(b) through (g).

XV. Administrative Permit Amendments

A. Pursuant to Env-A 612.01, the Permittee may implement the changes addressed in the request for an administrative permit amendment as defined in Env-A 100 immediately upon submittal of the request.

B. Pursuant to Env-A 612.01, the Director shall take final action on a request for an administrative permit amendment in accordance with the provisions of Env-A 612.01(b) and (c).

XVI. Operational Flexibility

A. Pursuant to Env-A 612.02, the Permittee subject to and operating under this Title V Operating Permit may make changes involving trading of emissions, off-permit changes, and section 502(b)(10) changes at the permitted stationary source or area source without filing a Title V Operating Permit application for and obtaining an amended Title V Operating Permit, provided that all of the following conditions are met, as well as conditions specified in Section

XVI. B through E of this permit, as applicable. At this point, DES has not included any permit terms authorizing emissions trading in this permit.

1. The change is not a modification under any provision of Title I of the CAA;
2. The change does not cause emissions to exceed the emissions allowable under the Title V operating permit, whether expressed therein as a rate of emissions or in terms of total emissions;
3. The owner or operator has obtained any temporary permit required by Env-A 600;
4. The owner or operator has provided written notification to the director and administrator of the proposed change and such written notification includes:
    a. The date on which each proposed change will occur;
    b. A description of each such change;
    c. Any change in emissions that will result;
    d. A request that the operational flexibility procedures be used; and
    e. The signature of the responsible official, consistent with Env-A 605.04(b);
5. The change does not exceed any emissions limitations established under any of the following:
    a. The New Hampshire Code of Administrative Rules, Env-A 100-3800;
    b. The CAA; or
    c. This Title V Operating Permit; and
    d. The Permittee, DES, and EPA have attached each written notice required above to their copy of this Title V Operating Permit.

B. For changes involving the trading of emissions, the Permittee must also meet the following conditions:

1. The Title V Operating Permit issued to the stationary source or area source already contains terms and conditions including all terms and conditions which determine compliance required under 40 CFR 70.6(a) and (c) and which allow for the trading of emissions increases and decreases at the permitted stationary source or area source solely for the purpose of complying with a federally-enforceable emissions cap that is established in the permit independent of otherwise applicable requirements;
2. The owner or operator has included in the application for the Title V Operating Permit proposed replicable procedures and proposed permit terms which ensure that the emissions trades are quantifiable and federally enforceable for changes to the Title V Operating Permit which qualify under a federally- enforceable emissions cap that is established in the Title V Operating Permit independent of the otherwise applicable requirements;
3. The Director has not included in the emissions trading provision any devices for which emissions are not quantifiable or for which there are no replicable procedures to enforce emissions trades; and

4. The written notification required above is made at least 7 days prior to the proposed change and includes a statement as to how any change in emissions will comply with the terms and conditions of the Title V Operating Permit.

C. For off-permit changes, the Permittee must also meet the following conditions:

1. Each off-permit change meets all applicable requirements and does not violate any existing permit term or condition;
2. The written notification required above is made contemporaneously with each off-permit change, except for changes that qualify as insignificant under the provisions of Env-A 609.04;
3. The change is not subject to any requirements under Title IV of the CAA and the change is not a Title I modification;
4. The Permittee keeps a record describing the changes made at the source which result in emissions of a regulated air pollutant subject to an applicable requirement, but not otherwise regulated under this Permit, and the emissions resulting from those changes; and
5. The written notification required above includes a list of the pollutants emitted and any applicable requirement that would apply as a result of the change.

D. For section 502(b)(10) changes, the Permittee must also meet the following conditions:

1. The written notification required above is made at least 7 days prior to the proposed change; and
2. The written notification required above includes any permit term or condition that is no longer applicable as a result of the change.

E. Pursuant to Env-A 612.02(f), the off-permit change and section 502(b)(10) change shall not qualify for the permit shield under Env-A 609.09.

XVII. Minor Permit Amendments

A. Prior to implementing a minor permit modification, the Permittee shall submit a written request to the Director in accordance with the requirements of Env-A 612.05(b).

B. The Director shall take final action on the minor permit amendment request in accordance with the provisions of Env-A 612.05(c) through (g).

C. Pursuant to Env-A 612.05(h), the permit shield specified in Env-A 609.09 shall not apply to minor permit amendments under Section XVII. of this Permit.

D. Pursuant to Env-A 612.05(a), the Permittee shall be subject to the provisions of RSA 125-C:15 if the change is made prior to the filing with the Director of a request for a minor permit amendment.

XVIII. Significant Permit Amendments

A. Pursuant to Env-A 612.06, a change at the facility shall qualify as a significant permit amendment if it meets the criteria specified in Env-A 612.06(a)(1) through (5).

B. Prior to implementing the significant permit amendment, the Permittee shall submit a written request to the Director, which includes all the information as referenced in Env-A 612.06(b) and (c) and shall be issued an amended Title V Operating Permit from the DES. The Permittee shall be subject to the provisions of RSA 125-C:15 if a request for a significant permit amendment is not filed with the Director and/or the change is made prior to the issuance of an amended Title V Operating Permit.

C. The Director shall take final action on the significant permit amendment in accordance with the Procedures specified in Env-A 612.06(d), (e) and (f).

XIX. Title V Operating Permit Suspension, Revocation or Nullification

A. Pursuant to RSA 125-C:13, the Director may suspend or revoke any final permit issued hereunder if, following a hearing, the Director determines that:

1. The Permittee has committed a violation of any applicable statute or state requirement found in the New Hampshire Rules Governing the Control of Air Pollution, order or permit condition in force and applicable to it; or
2. The emissions from any device to which this Permit applies, alone or in conjunction with other sources of the same pollutants, presents an immediate danger to the public health.

B. The Director shall nullify any Permit if, following a hearing in accordance with RSA 541-A:30, II, a finding is made that the Permit was issued in whole or in part based upon any information proven to be intentionally false or misleading.

XX. Inspection and Entry

EPA and DES personnel shall be granted access to the facility covered by this Permit, in accordance with RSA 125-C:6,VII for the purposes of: inspecting the proposed or permitted site; investigating a complaint; and assuring compliance with any applicable requirement or state requirement found in the New Hampshire Rules Governing the Control of Air Pollution and/or conditions of any Permit issued pursuant to Chapter Env-A 600.

XXI. Certifications

A. Compliance Certification Report

In accordance with 40 CFR 70.6(c) the Responsible Official shall certify for the previous calendar year that the facility is in compliance with the requirements of this permit. The report shall be submitted annually, no later than April 15th of the following year. The report shall be submitted to the DES and to the U.S. Environmental Protection Agency – Region I. The report shall be submitted in compliance with the submission requirements below.

In accordance with 40 CFR 70.6(c)(5), the report shall describe:

1. The terms and conditions of the Permit that are the basis of the certification;
2. The current compliance status of the source with respect to the terms and conditions of this Permit, and whether compliance was continuous or intermittent during the reporting period;

3. The methods used for determining compliance, including a description of the monitoring, record keeping, and reporting requirements and test methods; and
4. Any additional information required by the DES to determine the compliance status of the source.

B. Certification of Accuracy Statement

All documents submitted to the DES shall contain a certification by the responsible official of truth, accuracy, and completeness. Such certification shall be in accordance with the requirements of 40 CFR 70.5(d) and contain the following language:

> "I am authorized to make this submission on behalf of the facility for which the submission is made. Based on information and belief formed after reasonable inquiry, I certify that the statements and information in the enclosed documents are to the best of my knowledge and belief true, accurate, and complete. I am aware that there are significant penalties for submitting false statements and information or omitting required statements and information, including the possibility of fine or imprisonment."

All reports submitted to DES (except those submitted as emission based fees as outlined in Section XXIII of this Permit) shall be submitted to the following address:

New Hampshire Department of Environmental Services
Air Resources Division
29 Hazen Drive
P.O. Box 95
Concord, NH 03302-0095
ATTN: Section Supervisor, Compliance Bureau

All reports submitted to EPA shall be submitted to the following address:

Office of Environmental Stewardship
Director Air Compliance Program
United States Environmental Protection Agency
1 Congress Street
Suite 1100 (SEA)
Boston, MA 02114-2023
ATTN: Air Compliance Clerk

XXII. Enforcement

Any noncompliance with a permit condition constitutes a violation of RSA 125-C:15, and, as to the conditions in this permit which are federally enforceable, a violation of the Clean Air Act, 42 U.S.C. Section 7401 et seq., and is grounds for enforcement action, for permit termination or revocation, or for denial of an operating permit renewal application by the DES and/or EPA. Noncompliance may also be grounds for assessment of administrative, civil or criminal penalties in accordance with RSA 125-C:15 and/or the Clean Air Act. This Permit does not relieve the Permittee from the obligation to comply with any other provisions of RSA 125-C, the New Hampshire Rules Governing the Control of Air Pollution, or the Clean Air Act, or to obtain any other necessary authorizations from other governmental agencies, or to comply with all other applicable Federal, State, or Local rules and regulations, not addressed in this Permit.

In accordance with 40 CFR 70.6 (a)(6)(ii), a Permittee shall not claim as a defense in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this Permit.

XXIII. Emission-Based Fee Requirements

A. The Permittee shall pay an emission-based fee annually for this facility as calculated each calendar year pursuant to Env-A 705.04.

B. The Permittee shall determine the total actual annual emissions from the facility to be included in the emission-based multiplier specified in Env-A 705.03(a) for each calendar year in accordance with the methods specified in Env-A 616.

C. The Permittee shall calculate the annual emission-based fee for each calendar year in accordance with the procedures specified in Env-A 705.03 and the following equation:

$$FEE = E * DPT * CPIm * ISF$$

Where:

FEE =	The annual emission-based fee for each calendar year as specified in Env-A 705.
E =	The calculation of total annual emissions as specified in Env-A 705.02 and the provisions specified in Env-A 705.03(a).
DPT =	The dollar per ton fee the DES has specified in Env-A 705.03(b).
CPIm=	The Consumer Price Index Multiplier as calculated in Env-A 705.03(c).
ISF =	The Inventory Stabilization Factor as specified in Env-A 705.03(d).

D. The Permittee shall contact the DES each calendar year for the value of the Inventory Stabilization Factor.

E. The Permittee shall contact the DES each calendar year for the value of the Consumer Price Index Multiplier.

F. The Permittee shall submit, to the DES, payment of the emission-based fee and a summary of the calculations referenced in Sections XXIII.B. and C of this Permit for each calendar year no later than April 15 each subsequent year for the emissions from the previous calendar year. The emission-based fee and summary of the calculations shall be submitted to the following address:

New Hampshire Department of Environmental Services
Air Resources Division
29 Hazen Drive
P.O. Box 95
Concord, NH 03302-0095
ATTN.: Emissions Inventory

G. The DES shall notify the Permittee of any under payments or over payments of the annual emission-based fee in accordance with Env-A 705.05.

XXIV. Duty To Provide Information

In accordance with 40 CFR 70.6 (a)(6)(v), upon the DES's written request, the Permittee shall furnish, within a reasonable time, any information necessary for determining whether cause exists for modifying, revoking and reissuing, or terminating the Permit, or to determine compliance with the Permit. Upon request, the Permittee shall furnish to the DES copies of records that the Permittee is required to retain by this Permit. The Permittee may make a claim of confidentiality as to any information submitted pursuant to this condition in accordance with Env-A 103 at the time such information is submitted to DES. DES shall evaluate such requests in accordance with the provisions of Env-A 103.

XXV. Property Rights

Pursuant to 40 CFR 70.6 (a)(6)(iv), this Permit does not convey any property rights of any sort, or any exclusive privilege.

XXVI. Severability Clause

Pursuant to 40 CFR 70.6 (a)(5), the provisions of this Permit are severable, and if any provision of this Permit, or the application of any provision of this Permit to any circumstances is held invalid, the application of such provision to other circumstances, and the remainder of this Permit, shall not be affected thereby.

XXVII. Emergency Conditions

Pursuant to 40 CFR 70.6 (g), the Permittee shall be shielded from enforcement action brought for noncompliance with technology based[15] emission limitations specified in this Permit as a result of an emergency[16]. In order to use emergency as an affirmative defense to an action brought for noncompliance, the Permittee shall demonstrate the affirmative defense through properly signed, contemporaneous operating logs, or other relevant evidence that:

A. An emergency occurred and that the Permittee can identify the cause(s) of the emergency;

B. The permitted facility was at the time being properly operated;

C. During the period of the emergency, the Permittee took all reasonable steps as expeditiously as possible, to minimize levels of emissions that exceeded the emissions standards, or other requirements in this Permit; and

D. The Permittee submitted notice of the emergency to the DES within two (2) business days of the time when emission limitations were exceeded due to the emergency. This notice must

[15]Technology based emission limits are those established on the basis of emission reductions achievable with various control measures or process changes (e.g., a new source performance standard) rather than those established to attain health based air quality standards.

[16]An "emergency" means any situation arising from sudden and reasonably unforeseeable events beyond the control of the source, including acts of God, which situation would require immediate corrective action to restore normal operation, and that causes the source to exceed a technology based limitation under the permit, due to unavoidable increases in emissions attributable to the emergency. An emergency shall not include noncompliance to the extent caused by improperly designed equipment, lack of preventative maintenance, careless or improper operations, operator error or decision to keep operating despite knowledge of any of these things.

contain a description of the emergency, any steps taken to mitigate emission, and corrective actions taken.

XXVIII. Permit Deviation

In accordance with 40 CFR 70.6(a)(3)(iii)(B), the Permittee shall report to the DES all instances of deviations from Permit requirements, by telephone, fax, or e-mail (pdeviations@des.state.nh.us) within 24 hours of discovery of such deviation. This report shall include the deviation itself, including those attributable to upset conditions as defined in this Permit, the probable cause of such deviations, and any corrective actions or preventative measures taken.

Within 10 days of discovery of the permit deviation, the Permittee shall submit a written report including the above information as well as the following: preventive measures taken to prevent future occurrences; date and time the permitted device returned to normal operation; specific device, process or air pollution control equipment that contributed to the permit deviation; type and quantity of excess emissions emitted to the atmosphere due to permit deviation; and an explanation of the calculation or estimation used to quantify excess emissions.

Said Permit deviation shall also be submitted in writing to the DES in the semi-annual summary report of monitoring and testing requirements due July 31st and January 31st of each calendar year. Deviations are instances where any Permit condition is violated and has not already been reported as an emergency pursuant to Section XXVII. of this Permit.

Reporting a Permit deviation is not an affirmative defense for action brought for noncompliance.

The State of New Hampshire

DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

July 2, 2008

Mr. Michael O'Keefe
FPL Energy Seabrook Emergency Operations Facility
P.O Box 300
Seabrook, NH 03874

Re: Issuance of General State Permit: GSP-EG-225
Source Category: Internal Combustion Engines Used As Emergency Generators
AFS #3301590914 Application #08-0128
FPL Energy Seabrook Emergency Operations Facility
165 Gosling Rd Newington, NH 03801

Dear Mr. O'Keefe:

The New Hampshire Department of Environmental Services, Air Resources Division (DES) hereby issues the enclosed General State Permit in accordance with the New Hampshire Code of Administrative Rules Env-A 610, *General State Permits and General Permits under Title V*. This General State Permit is issued specifically for the following device as described in the permit application submitted by FPL Energy Seabrook Emergency Operations Facility and received by DES on June 13, 2008:

Device	Make/Model/ Serial No.	Year Installed	Fuel(s)	Max. Heat Input Rate MMBtu/hr	Max. Fuel Use Rate gal/hr	Output Rating
Emergency Generator	John Deere 6081AF001 Serial No. RG 6081A175743	2006	Diesel	2.287	16.7	230 kW

The General State Permit for Internal Combustion Engines Used As Emergency Generators is viewable online at the following Web address: http://des.nh.gov/ard/GSP/GSP-EG.pdf.

Please note that the enclosed permit expires on **April 30, 2013**. If you wish to continue operation of the device beyond April 30, 2013, you must apply for permit renewal in accordance with Env-A 610.12, *Expiration Date and General State Permit Reestablishment Procedures*.

If you have any questions, please contact Colleen Higgins of the Air Resources Division, Permitting and Environmental Health Bureau, at (603) 271-0683 or via email at colleen.higgins@des.nh.gov.

Sincerely,

Robert R. Scott
Director
Air Resources Division

Cert. mail # 70073020000053210798
rrs/ceh
encl: General State Permit: Internal Combustion Engines Used As Emergency Generators

State of New Hampshire
Department of Environmental Services
Air Resources Division

General State Permit

GSP-EG-225

Source Category: Internal Combustion Engines Used as Emergency Generators

This general state permit is established in accordance with New Hampshire Code of Administrative Rules, Env-A 620, *Procedures for Establishing and Reestablishing General State Permits*, Env-A 610, *General State Permits and General Permits Under Title V*, and RSA 125-C of the New Hampshire Laws. The established milestones are as follows:

Date of Proposed General State Permit	February 25, 2008
Date Proposed General State Permit was Sent to EPA	February 28, 2008
Public Notice Date	February 27, 2008
Close of Public Comment Period	March 28, 2008
Public Hearing Date	None requested
Expiration Date of General State Permit	**April 30, 2013**

This General State Permit (GSP) is issued for the specific emergency generator(s) described in the registration package submitted to the New Hampshire Department of Environmental Services, Air Resources Division (Division) in accordance with Env-A 610.07, *Procedures for Registering to Operate Under a General State Permit*. Any replacement emergency generator (EG) or additional EG would require a new or updated registration package to be submitted to the Division for review.

Director
Air Resources Division

April 11, 2008
Date of Final Action

Abbreviations and Acronyms

ASTM	American Society of Testing and Materials
Btu	British thermal units
CFR	Code of Federal Regulations
CO	Carbon Monoxide
Division	New Hampshire Department of Environmental Services, Air Resources Division
Env-A	New Hampshire Code of Administrative Rules – Air Resources Division
EG	Emergency Generator
GSP	General State Permit
hr	hour
ICE	Internal Combustion Engine
lb	pound
MM	million
NOx	Oxides of Nitrogen
PM_{10}	Particulate Matter < 10 microns
ppm	parts per million
RSA	Revised Statutes Annotated
SO_2	Sulfur Dioxide
TSP	Total Suspended Particulate
tpy	tons per consecutive 12-month period
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

I. Source Category Description and Definitions

A. The source category Internal Combustion Engines Used as Emergency Generators is applicable to one or more internal combustion engines (ICEs), excluding any unit with a design rating less than or equal to 150,000 British thermal units per hour (Btu/hr), operated at a source as an EG as defined in Condition I.B, which either:

1. Combusts liquid fuel oil for which the combined total design gross heat input for all such engines is greater than or equal to 1.5 million British thermal units per hour (MMBtu/hr);
2. Combusts natural gas or liquefied propane gas for which the combined total design gross heat input of all such engines is greater than or equal to 10.0 MMBtu/hr; or
3. Has the potential to emit any single regulated air pollutant in an amount greater than 25 tons per consecutive 12-month period (tpy).

B. Env-A 101.66.1, *Definitions.* "Emergency generator" means a stationary ICE or stationary combustion turbine which operates as a mechanical or electrical power source only when the primary power source for a facility is not available during an emergency such as a power outage, or during the normal maintenance and testing procedure as recommended by the manufacturer. The term does not include a load-shaving unit or peaking power production unit, but does include the operation of the emergency generator during periods in which ISO New England, or any successor Regional Transmission Organization, directs the implementation of operating procedures for voltage reductions of 5% of normal operating voltage requiring more than 10 minutes to implement, voluntary load curtailments by customers, or automatic or manual load shedding within New Hampshire or within the entire New England region, in response to, or to prevent the occurrence of, unusually low frequency, equipment overload, capacity or energy deficiency, unacceptable voltage levels, or other such emergency conditions.

II. Operating and Emission Limitations

The Owner or Operator shall be subject to the operating and emission limitations identified in Table 1:

Table 1 - Operating and Emission Limitations		
Item #	**Requirement**	**Regulatory Basis**
1	*Facility-Wide Emission Limitations*[1] a. Facility-wide emissions of SO_2, PM_{10}, and CO shall be limited to less than 100 tpy; b. Facility-wide emissions of NO_x and VOCs shall be limited to less than 50 tpy.	Env-A 604.02(a)(1), and Env-A 1211.01(n)
2	*Emergency Generators* Each EG shall be limited to 500 hours of total operation during any consecutive 12-month period.	Env-A 1211.01(j)(1)
3	*Emergency Generators Manufactured After April 1, 2006* Each oil-fired EG manufactured after April 1, 2006 shall be limited to 100 hours of operation for maintenance checks and readiness testing during any consecutive 12-month period.	40 CFR 60.4211(e) (Subpart IIII)
4	*Fuel Usage Limitations* Total fuel consumption during any consecutive 12-month period for each EG covered by this GSP shall not exceed a quantity of fuel that would result in an exceedance of any condition specified in this GSP.	Env-A 604.02(a)(2)
5	*Visible Emission Standard for Fuel Burning Devices Installed on or Prior to May 13, 1970* The average opacity from fuel burning devices installed on or prior to May 13, 1970 shall not exceed 40 percent for any continuous 6-minute period.[2]	Env-A 2002.01
6	*Visible Emission Standard for Fuel Burning Devices Installed After May 13, 1970* The average opacity from fuel burning devices installed after May 13, 1970 shall not exceed 20 percent for any continuous 6-minute period.	Env-A 2002.02
7	*Activities Exempt from Visible Emission Standards* The average opacity shall be allowed to be in excess of the standards specified in Table 1, Items 5 and 6, for one period of 6 continuous minutes in any 60-minute period during startup, shutdown, or malfunction.	Env-A 2002.04(c)

1 Facility-wide emission limits are set for the purpose of establishing this source as a minor source of air pollution. Such limits shall not be construed to allow this source to construct or install a new or modified source, area source or device except in the manner set forth in the New Hampshire Rules Governing the Control of Air Pollution and, specifically, Env-A 603. Compliance with Item 1 of Table 1 is to be verified using fuel usage records and the appropriate USEPA AP-42 emission factors, manufacturer's certified emission rates or stack test data.

2 Compliance with visible emission limitations shall be determined using 40 CFR 60, Appendix A, Method 9, upon request by the Division.

Table 1 - Operating and Emission Limitations		
Item #	**Requirement**	**Regulatory Basis**
8	*Particulate Emission Standards for Fuel Burning Devices Installed on or Prior to May 13, 1970* a. For devices that have a maximum gross heat input rate of less than 10 MMBtu/hr, the particulate emission rate shall not exceed 0.60 lb/MMBtu. b. For devices that have a maximum gross heat input rate of equal to or greater than 10 MMBtu/hr, the allowable particulate emission rate (E) shall be calculated by raising the heat input rate (I) to the -0.166 power, and multiplying the result by 0.880 as shown in the following formula: $E = 0.880I^{-0.166}$	Env-A 2002.06
9	*Particulate Emission Standards for Fuel Burning Devices Installed After May 13, 1970, but before January 1, 1985* a. For devices that have a maximum gross heat input rate of less than 10 MMBtu/hr, the particulate emission rate shall not exceed 0.60 lb/MMBtu. b. For devices that have a maximum gross heat input rate of equal to or greater than 10 MMBtu/hr, the allowable particulate emission rate (E) shall be calculated by raising the heat input rate (I) to the -0.234 power, and multiplying the result by 1.028 as shown in the following formula: $E = 1.028I^{-0.234}$	Env-A 2002.07
10	*Particulate Emission Standards for Fuel Burning Devices Installed on or After January 1, 1985* The particulate matter emissions from fuel burning devices installed on or after January 1, 1985 shall not exceed 0.30 lb/MMBtu.	Env-A 2002.08
11	*Maximum Sulfur Content Allowable in Liquid Fuels* a. The sulfur content of No. 2 oil shall not exceed 0.40 percent sulfur by weight; and b. The sulfur content of kerosene-1 oil shall not exceed 0.04 percent sulfur by weight.	Env-A 1604.01(a) Env-A 1604.01(e)
12	*Sulfur Content Limitations for Gaseous Fuels* Gaseous fuels shall contain no more than 15 grains of sulfur per 100 cubic feet of gas at standard temperature and pressure.	Env-A 1605.01
13	*Fuel Requirements for EGs manufactured after April 1, 2006 and Fire Pumps manufactured after July 1, 2006* a. Beginning October 1, 2007, the sulfur content of liquid fuel shall not exceed 500 ppm (0.05 % by weight); and b. Beginning October 1, 2010, the sulfur content of liquid fuel shall not exceed 15 ppm (0.0015% by weight).	40 CFR 60.4207 (Subpart IIII)

Monitoring and Testing Requirements

The Owner or Operator is subject to the monitoring and testing requirements as contained in Table 2:

Table 2 - Monitoring and Testing Requirements				
Item #	**Parameter**	**Method of Compliance**	**Frequency**	**Regulatory Basis**
1	To Be Determined	When conditions warrant, the Division may require the Owner or Operator to conduct stack testing in accordance with USEPA or other Division approved methods.	Upon request by the Division	RSA 125-C:6 XI
2	Sulfur Content of Liquid Fuels	Conduct testing in accordance with appropriate ASTM test methods or retain delivery tickets in accordance with Table 3, Item 3 in order to demonstrate compliance with the sulfur content limitation provisions specified in this permit for liquid fuels.	For each delivery of fuel oil/diesel to the Facility	Env-A 806.02 & Env-A 806.05
3	Sulfur content of gaseous fuels	Conduct testing to determine the sulfur content in grains of sulfur per 100 cubic feet, of gaseous fuels.	Upon written request by EPA or the Division	Env-A 806.03
4	Hours of Operation	Oil-fired EGs manufactured after April 1, 2006, shall be equipped with a non-resettable hour meter.	Continuous	40 CFR 60.4209(a) (Subpart IIII)

IV. Recordkeeping Requirements

The Owner or Operator shall be subject to the recordkeeping requirements identified in Table 3:

Table 3 - Recordkeeping Requirements			
Item #	**Requirement**	**Duration/ Frequency**	**Regulatory Basis**
1	<u>Record Retention and Availability</u> Keep the required records on file. These records shall be available for review by the Division upon request.	Retain for a minimum of 5 years	Env-A 902
2	<u>General Recordkeeping Requirements for Combustion Devices</u> Maintain the following records: a. Type (e.g. diesel fuel, natural gas) and amount of fuel burned; and b. Hours of operation for each emergency generator.	Monthly	Env-A 903.03
3	<u>Liquid Fuel Oil Recordkeeping Requirements</u> In lieu of sulfur testing pursuant to Table 2, Item 2, the Owner or Operator may maintain a written statement from the fuel supplier that the sulfur content of the fuel as delivered does not exceed state or federal standards for that fuel.	Whenever there is a change in fuel supplier, but at least annually	Env-A 806.05

Table 3 - Recordkeeping Requirements			
Item #	**Requirement**	**Duration/ Frequency**	**Regulatory Basis**
4	*Gaseous Fuel Recordkeeping Requirements* Maintain one of the following: a. Sulfur content as percent sulfur by weight or in grains per 100 cubic feet of fuel; b. Documentation that the fuel source is from a utility pipeline; or c. Documentation that the fuel meets state sulfur limits.	Whenever there is a change in fuel supplier, but at least annually	Env-A 903.03
5	*General NO_x Recordkeeping Requirements* If the actual annual NO_x emissions from the Facility are greater than or equal to 10 tpy, then record the following information: a. Identification of each fuel burning device; b. Operating schedule during the high ozone season (June 1 through August 31) for each fuel burning device identified in Table 3, Item 5.a, above, including: 1. Typical hours of operation per day; 2. Typical days of operation per calendar month; 3. Number of weeks of operation; 4. Type and amount of each fuel burned; 5. Heat input rate in MMBtu/hr; 6. Actual NOx emissions for the calendar year and a typical high ozone day during that calendar year; and 7. Emission factors and the origin of the emission factors used to calculate the NOx emissions.	Maintain Current Data	Env-A 905.02
6	*Recordkeeping Requirements for Oil-Fired EGs Manufactured after April 1, 2006* a. Maintain documentation from the manufacturer certifying that the engine complies with the applicable emission standards stated in 40 CFR 60 Subpart IIII. b. Record the time of operation of the engine and the reason the engine was in operation during that time.	Maintain Current Data	40 CFR 60.4211 (Subpart IIII)

V. Reporting Requirements

The Owner or Operator shall be subject to the reporting requirements identified in Table 4 below. All emissions data submitted to the Division shall be available to the public. Claims of confidentiality for any other information required to be submitted to the Division pursuant to this permit shall be made at the time of submission in accordance with Env-A 103, *Claims of Confidentiality*.

Table 4 - Reporting Requirements			
Item #	**Requirement**	**Frequency**	**Regulatory Basis**
1	<u>*Annual Emissions Report*</u> Submit an annual emissions report which shall include the following information: a. Actual calendar year emissions from each device of NO_x, CO, SO_2, TSP, VOCs, and HAPs; b. The methods used in calculating such emissions in accordance with Env-A 705.02, *Determination of Actual Emissions for Use in Calculating Emission-Based Fees*; and c. All information recorded in accordance with Table 3, Items 2, 3 and 4.	Annually (no later than April 15th of the following year)	Env-A 907.01
2	<u>*NO_x Emission Statements Reporting Requirements*</u> If the actual annual NO_x emissions for the Facility are greater than or equal to 10 tpy, then include the following information with the annual emission report: a. A breakdown of NO_x emissions reported pursuant to Table 4, Item 1 by month; and b. All data recorded in accordance with Table 3, Item 5.	Annually (no later than April 15th of the following year)	Env-A 909
3	<u>*Permit Deviation Reporting Requirements*</u> Report permit deviations that cause excess emissions in accordance with Condition VI.B.	Within 24 hours of discovery of excess emission	Env-A 911.04(b)
4	<u>*Emission Based Fees*</u> Pay emission-based fees in accordance with Condition VII.	Annually (no later than April 15th of the following year)	Env-A 700

VI. Permit Deviation Reporting Requirements

A. Env-A 101, *Definitions*:

1. A *permit deviation* is any occurrence that results in an excursion from any emission limitation, operating condition, or work practice standard as specified in either a Title V permit, state permit to operate, temporary permit or general state permit issued by the Division.
2. An *excess emission* is an air emission rate that exceeds any applicable emission limitation.

B. Env-A 911.04(b), *Reporting Requirements*: In the event of a permit deviation that causes excess emissions, notify the Division of the permit deviation and excess emissions by telephone (603-271-1370), fax (603-271-7053) or e-mail (pdeviations@des.state.nh.us), within 24 hours of discovery of the permit deviation, unless it is a Saturday, Sunday, or state or federal legal holiday, in which event, the Division shall be notified on the next day which is not a Saturday, Sunday, or state or federal legal holiday.

VII. Emission-Based Fee Requirements

A. Env-A 705.01, *Emission-based Fees*: The Owner or Operator shall pay to the Division each year an emission-based fee for emissions from the devices covered under this GSP.

B. Env-A 705.02, *Determination of Actual Emissions for use in Calculating of Emission-based Fees*: The Owner or Operator shall determine the total actual annual emissions from the devices covered under this GSP for each calendar year in accordance with the methods specified in Env-A 616, *Determination of Actual Emissions*. If the emissions are determined to be less than one ton, the emission-based fee shall be calculated using an emission-based multiplier of one ton.

C. Env-A 705.03, *Calculation of Emission-based Fees*: The Owner or Operator shall calculate the annual emission-based fee for each calendar year in accordance with the procedures specified in Env-A 705.03 and the following equation:

$$FEE = E * DPT$$

where:
FEE = The annual emission-based fee for each calendar year as specified in Env-A 705;
E = Total actual emissions as determined pursuant to Condition VII.B; and
DPT = The dollar per ton fee the Division has specified in Env-A 705.03(e).

D. Env-A 705.04, *Payment of Emission-based Fee*: The Owner or Operator shall submit, to the Division, payment of the emission-based fee by April 15th for emissions during the previous calendar year. For example, the fees for calendar year 2008 shall be submitted on or before April 15, 2009.

The State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES

NHDES

Thomas S. Burack, Commissioner

April 2, 2010

RECEIVED
APR 08 2010
M.D. O'Keefe

Mr. Michael O'Keefe
Licensing Manager
NextEra Energy Seabrook, LLC
525 Lafayette Road
PO Box 300
Seabrook, NH 03874

RE: Inspection Report

Dear Mr. O'Keefe:

The New Hampshire Department of Environmental Services, Air Resources Division ("DES") conducted a Full Compliance Evaluation at your facility on May 7, 2009. Enclosed is a copy of the Inspection Report for your records.

The following deficiency was observed during the inspection, and is detailed in the enclosed report:

Seabrook Station has not conducted an air toxics compliance determination with the toxics rule in accordance with Env-A 1405.01 (a).

In order to return to compliance, an air toxics compliance determination must be completed and sent to DES by April 19, 2010.

The results of this inspection have been forwarded to the Enforcement Section for further review. If you have any questions, please contact me by telephone at (603) 271-6797 or by email at Alan.Moulton@des.nh.gov or Margaret Bastien, Compliance Assessment Section Supervisor, at (603) 271-4625.

Sincerely,

Alan H Moulton

Alan H. Moulton
Compliance Assessment Engineer
Air Resources Division

Enclosure: Inspection Report

cc: Barry M. Brenner, Town Manager, Town of Seabrook

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

ON-SITE FULL COMPLIANCE EVALUATION

NextEra Energy Seabrook, LLC
626 Lafayette Road
Seabrook, New Hampshire 03874
Rockingham County
(603) 773-7000

AFS # 3301500047

Inspection Date: May 7, 2009
Final Report: April 2, 2010

Inspected and Report Prepared by:

New Hampshire Department of Environmental Services
Air Resources Division
29 Hazen Dr., P.O. Box 95
Concord, New Hampshire 03302-0095

Alan H. Moulton
Compliance Assessment Engineer

I. Inspection

On May 7, 2009, the New Hampshire Department of Environmental Services, Air Resources Division ("DES") conducted an On-site Full Compliance Evaluation of NextEra Seabrook, LLC ("Seabrook Station"), located in Seabrook, NH. Seabrook Station was targeted for inspection based on DES inspection criteria, which requires that a major source with a Title V Permit be inspected once every two years.

DES contacted Seabrook Station on April 30, 2009 to schedule a compliance inspection for May 7, 2009. DES scheduled the appointment for the inspection in advance to accommodate security procedures.

Date/Time of Inspection:	May 7, 2009, 10:00 AM - 2:50 PM
Type of Inspection:	On-site Full Compliance Evaluation
Inspected by:	Alan H. Moulton, DES Compliance Assessment Engineer
Weather:	Cloudy and ~50°F
Source Contact(s):	Allen L. Legendre, Jr., Environmental Compliance Supervisor Sabre A. Gagnon, Environmental Compliance
Last compliance inspection conducted at facility: Inspection Result:	August 28, 2007, Off-site Full Compliance Evaluation No issues of non-compliance were identified during the offsite evaluation.
Permit Number(s):	TV-OP-017 Issued: June 5, 2006; with Administrative Amendment issued on March 13, 2009 Expires: June 30, 2011

The purpose of the inspection was discussed as well as the rules pertaining to claims of confidentiality and facility safety concerns. Seabrook Station agreed to the inspection and authorized access to the facility. No material provided during the inspection was stated to be confidential.

Details are discussed in later sections.

II. Facility Description

Seabrook Station is a 1,245 megawatt ("MW") (net output), nuclear-powered, electric generating facility. Seabrook's primary function is the production of electrical power. The process uses a Westinghouse pressurized water reactor to produce heat through a controlled nuclear fission reaction. This heat is removed from the reactor through a pressurized coolant system, converted to steam, and used to drive a General Electric turbine-generator to produce electrical power. This primary function itself produces no significant quantity of regulated air pollutants; however, Seabrook Station requires a number of supporting process systems that are primary sources of regulated air pollutants.

Seabrook Station operates two auxiliary boilers for the production of process steam for various support functions, such as station heating, process steam for evaporator operations, and maintaining turbine steam seals. Sustained operation of these boilers is usually limited to facility outages, when main steam system supplies are not available. Each boiler uses primarily diesel fuel, with small amounts of kerosene added in the winter to improve viscosity.

Seabrook Station maintains four large diesel-powered emergency generators. Two of these generators are for the production of back-up electrical power in the event of a loss of normal off-site electrical power supplies. Seabrook maintains these generators in a standby condition. Under normal operating conditions, the operation of these generators is limited to surveillance and post-maintenance testing. The other two generators serve as an alternate source of emergency power when either of the first two emergency generators are out of service for maintenance or testing.

Seabrook also operates a number of small emergency generators. For example, the Operations Support Building ("OSB") generator provides back-up power to the OSB communications system when the normal off-site supply is not available. Also, the General Office Building ("GOB") generator provides back-up power to the GOB, including the computer system.

Seabrook has a Sullair diesel engine-driven air compressor that provides air in the event of a malfunction of the electric motor-driven air compressors, and is also used for any compressed air requirements.

Seabrook Station also has two fire pumps driven by diesel engines, which are not listed in the current Title V Permit. At the time the Permit was written, DES had a policy of exempting fire pump engines from permitting. That policy has now changed and the fire pump engines will need to be added to the new Title V Permit, at the time of renewal.

Seabrook uses propane or waste oil in various small, permit-exempt, space heating units.

Construction of Seabrook Station occurred between 1976 and 1986 and became fully operational in 1990. At the time of inspection, the facility's name changed to NextEra Energy Seabrook LLC, due to an internal restructuring. In November 2002, FPL Energy LLC purchased the facility, which was previously owned by a consortium of 11 different companies and managed by Northeast Utilities under the name North Atlantic Energy Services Corp. Seabrook produces electricity full-time.

NextEra Energy Seabrook LLC, a publicly-owned company, employs 1,000 people. The station occupies approximately 900 acres and currently operates three eight-hour shifts per day, seven days per week, and 365 days per year.

During a tour of the facility, DES observed the various devices listed in the Permit. The nuclear reactor was in operation; however, none of the permitted devices were in operation.

III. Emission Unit Identification and Operating Conditions

Table 1: Emission Unit Identification, Operating Restrictions and Fuel Usage Data

Emission Unit	Description	Permitted Operational Restrictions	Reported Operational & Fuel Usage Data
EU1	Auxiliary Boiler 1A Babcock & Wilcox Model #: FM10 Serial #: NB24175 Heat Rating: 105 MMBtu/hr Fuel: Diesel fuel/ Kerosene Maximum Design Fuel Flow Rate: 750 gal/hr Install Date: 1977	Sulfur content of diesel fuel and kerosene limited to 0.4% by weight. Opacity: 20%	2008: 155,414.0 gals diesel 2007: 13,208.0 gals diesel
EU2	Auxiliary Boiler 1B Babcock & Wilcox Model #: FM10 Serial #: NB24176 Heat Rating: 105 MMBtu/hr Fuel: Diesel fuel/ Kerosene Maximum Design Fuel Flow Rate: 750 gal/hr Install Date: 1977	Sulfur content of diesel fuel and kerosene limited to 0.4% by weight. Opacity: 20%	2008: 177,238.0 gals diesel 2007: 22,083.0 gals diesel
EU3	Emer. Generator 1A Colt Industries/ Fairbanks Morse Model #: NA Serial #: PO-206086C Rating: 8,414 hp 75.5 MMBtu/hr Maximum Design Fuel Flow Rate: 551 gal/hr Install Date: 1977	Hours of operation; 500 hr/yr Sulfur content of diesel fuel limited to 0.4% by weight. Opacity: 20%	2008: 22,261.0 gals diesel 2007: 15,850.0 gals diesel
EU4	Emer. Generator 1B Colt Industries/ Fairbanks Morse	Hours of operation; 500 hr/yr Sulfur content of diesel fuel limited	2008: 28,083.0 gals diesel 2007: 21,405.0 gals diesel

Table 1: Emission Unit Identification, Operating Restrictions and Fuel Usage Data

Emission Unit	Description	Permitted Operational Restrictions	Reported Operational & Fuel Usage Data
	Model #: NA Serial #: PO-206086D Rating: 8,414 hp 75.5 MMBtu/hr Maximum Design Fuel Flow Rate: 551 gal/hr Install Date: 1977	to 0.4% by weight. Opacity: 20%	
EU5	Emer. Generator 2A Cummins Model #: 2700DQLA Serial #: B04K395120 Rating: 3,741 hp 23.6 MMBtu/hr Maximum Design Fuel Flow Rate: 172 gal/hr Install Date: 2004	Hours of operation; 300 hr/yr Sulfur content of diesel fuel limited to 0.4% by weight. Opacity: 20%	2008: 1,988.0 gals diesel 2007: 5,418.0 gals diesel
EU6	Emer. Generator 2B Cummins Model #: 2700DQLA Serial #: B04K395130 Rating: 3,741 hp 23.6 MMBtu/hr Maximum Design Fuel Flow Rate: 172 gal/hr Install Date: 2004	Hours of operation: 300 hr/yr Sulfur content of diesel fuel limited to 0.4% by weight. Opacity: 20%	2008: 2,164.0 gals diesel 2007: 5,304.0 gals diesel
EU7	Emer. Generator Operations Support Building ("OSB") Caterpillar Model #: 3406 Serial #: 90U3499 Rating: 345 hp 3.1 MMBtu/hr	Hours of operation: 500 hr/yr Sulfur content of diesel fuel limited to 0.4% by weight. Opacity: 20%	Hour Meter Reading: 254.0 hrs. 2008: 247.5 gals diesel 2007: 151.7 gals diesel

Table 1: Emission Unit Identification, Operating Restrictions and Fuel Usage Data			
Emission Unit	**Description**	**Permitted Operational Restrictions**	**Reported Operational & Fuel Usage Data**
	Maximum Design Fuel Flow Rate: 22.3 gal/hr Install Date: 1986		
EU8	Emer. Generator General Office Building ("GSB") Komatsu/Onan Model #: 06152TA-B Serial #: 10993 Rating: 285 hp 1.95 MMBtu/hr Maximum Design Fuel Flow Rate: 14.2 gal/hr Install Date: 1986	Hours of operation: 500 hr/yr Sulfur content of diesel fuel limited to 0.4% by weight. Opacity: 20%	Hour Meter Reading: 2072.2 hrs. 2008: 237.5 gals diesel 2007: 247.2 gals diesel
EU9	Air Compressor Sullair Model #: 750HFALDTQ Serial #: 004-144524 Rating: 275 hp 1.70 MMBtu/hr Maximum Design Fuel Flow Rate: 12.4 gal/hr Install Date: 2005	Hours of operation: 500 hr/yr Sulfur content of diesel fuel limited to 0.4% by weight. Opacity: 20%	2008: 459.0 gals diesel 2007: 400.5 gals diesel

Seabrook Station has two fire pumps that are large enough to be listed as significant activities in the current Title V permit.

In the renewal application filed on October 8, 2003, the facility filed ARD-2 Forms on each fire pump. At the time of the application, DES considered the fire pump engines to be exempt activities in accordance with Env-A 609.03. Since that time, DES has reversed its policy and is now requiring fire pump engines that exceed the permitting threshold in Env-A 607.01(d) to be permitted. The data on the fire pump engines is in Table 2 below.

Table 2: Non-Permitted Fire Pump Engine Data		
	Diesel Fire Pump 1A	**Diesel Fire Pump 1B**
Location		
Manufacturer	Cummins Engine Co.	Cummins Engine Co.
Model #	N-855F	N-885F
Serial #	761-17749-2-1	761-17749-2-2
Power Rating	193 hp	193 hp
Fuel	Diesel fuel	Diesel fuel
Maximum Design Fuel Flow Rate	8 gallons/hr	8 gallons/hr
Status	Not in operation during the inspection.	Not in operation during the inspection.
Hour Meter Reading		
Installation Date	1982	1982
Other Information		

Emissions:

Facility wide emissions for calendar years 2007-2008 are included in Table 3. Facility emissions are calculated using the facility's fuel usage data, the EPA's AP-42 Emission Factors, and NOx stack test (10/11/07) data on the two auxiliary boilers. The fuel usage data and the facility emissions reported by Seabrook Station were confirmed during this inspection.

Table 3: Facility-Wide Emissions					
	Nitrogen Oxides (tpy)	**Sulfur Dioxide (tpy)**	**Carbon Monoxide (tpy)**	**Particulate Matter-PM_{10} (tpy)**	**VOCs (tpy)**
Permitted Emission Limits	**276.85**	**378.30**	**72.17**	**9.21**	**5.43**
2008	15.47	10.22	4.10	1.06	0.36
2007	11.32	1.75	2.97	0.88	0.29

IV. Control Equipment

No air pollution control equipment is used at this source.

V. Stack Criteria

The following devices at the Facility shall have exhaust stacks that discharge, without obstruction, and meet the criteria in Table 4:

Table 4 – Stack Criteria

Stack Number	Emission Unit or Pollution Control Equipment ID	Minimum Height (feet above ground surface)	Maximum Exit Diameter (feet)	Stack Orientation
1	EU1 & EU2	142.0	8.0	Vertical
2	EU3	63.0	5.0	Vertical
3	EU4	63.0	5.0	Vertical
4	EU5	87.3	1.6	Vertical
5	EU6	87.3	1.6	Vertical
6	EU7	8.2	0.6	Vertical
7	EU8	9.0	0.4	Vertical
8	EU9	8.2	0.6	Vertical

VI. Compliance with Permitting Requirements

CHAPTER Env-A 300 – Ambient Air Quality Standards

DES conducted modeling in April 1999, May 1997, and August 1994. The results of the modeling predicted that Seabrook Station's emissions would not cause or contribute to any violation of the NAAQS beyond the 3,000-foot exclusion zone around the facility. In addition, it was determined through modeling that the GOB emergency generator would not consume the available Prevention of Significant Deterioration ("PSD") Increments for sulfur dioxide and particulate matter.

CHAPTER Env-A 500 - Standards Applicable to Certain New or Modified Facilities and Sources of Hazardous Air Pollutants

Seabrook Station is not subject to any of the New Source Performance Standards ("NSPS") specified in Env-A 503.01 or 40 CFR 60. The generator engines at Seabrook Station were manufactured prior to the April 1, 2006 applicability date listed in 40 CFR 60, Subpart IIII. There are no other NSPS that are applicable to Seabrook Station's devices.

Seabrook Station is subject to Env-A 504.01 and the National Emission Standards for Hazardous Air Pollutants ("NESHAP"), 40 CFR 61, Subpart M, *National Emission Standard for Asbestos*, as incorporated by the requirements in Env-A 1800. See Section XIII of this report on Env-A 1800 – Asbestos Management and Control.

Seabrook Station is not subject to any of the National Emission Standards for Hazardous Air Pollutants for Source Categories (Maximum Achievable Control Technology, or MACT

Standards) specified in Env-A 505.01 or 40 CFR 63. Seabrook Station is not subject to 40 CFR 63, Subpart ZZZZ, because Seabrook Station is not a major source of HAPs.

CHAPTER Env-A 600 - Statewide Permit System

On June 5, 2006, DES issued Title V Operating Permit TV-OP-017 ("the Permit") to Seabrook Station. DES issued an Administrative Amendment to the Permit on March 13, 2009. The Permit expires on June 30, 2011.

Seabrook Station is a major source of NOx and SO_2 emissions and, therefore, requires a Title V Operating Permit.

Part Env-A 609 – Title V Operating Permits

Env-A 609.04 – Insignificant Activities

Seabrook Station has identified in its Title V Permit application the following insignificant activities listed in Table 5.

Table 5: Insignificant Activities

Device/Process	Description
Two – Clean Burn waste oil furnace space heaters Model #: CB-90BH	280,000 Btu/ hr each Equivalent to 2 gal/hr
One – Clean Burn waste oil furnace space heater Model #: CB-2800	280,000 Btu/hr Equivalent to 1.3 gal/hr
Space Heating Units/Propane	< 10 MMBtu/hr
7,000 gal. gasoline tank	Emissions - 724 lbs/year

Env-A 609.08 – Application Shield

During the inspection, the DES reminded Seabrook Station that in order to renew the current permit and be in compliance with application shield per Env-A 609.08, it must submit a complete permit application to DES at least six months prior to the expiration date of the Permit, *i.e.*, by December 31, 2010.

Part Env-A 618 – Additional Requirements in Non-Attainment Areas and the New Hampshire Portion of the Northeast Ozone Transport Region

Seabrook Station is an existing major source located in Rockingham County of New Hampshire and is in the Northeast Ozone Transport Region. Rockingham County is classified in this part as an ozone non-attainment area. Seabrook Station is not a new major stationary source nor has it made any major modifications during the inspection review period. Therefore, it is not subject to this part.

Part Env-A 619 – Prevention of Significant Deterioration ("PSD") of Air Quality Permit Requirements

Seabrook Station is located in Rockingham County of New Hampshire, which is attainment for all criteria pollutants other than ozone. The facility is an existing major PSD source because it has the potential to emit greater than 250 tons per year of NOx and SO_2. Seabrook Station is not a new major PSD stationary source nor has it made any major modifications during the inspection review period; therefore, this part is not applicable to the facility.

VII. Compliance with Permit Fee System

CHAPTER Env-A 700 - Permit Fee System

Env-A 705.04 – Payment of Emission-Based Fee

Emission-based fees are due by April 15 of the year following the emissions year.

Seabrook Station submitted timely payment of its emission-based fees for the review period, calendar years 2007 and 2008.

VIII. Source Testing and Monitoring

CHAPTER Env-A 800 - Testing and Monitoring Procedures

The Permit and Env-A 800 require Seabrook Station to conduct compliance stack tests every three years on Auxiliary Boilers 1A and 1B, which are subject to Env-A 1211. On August 14 & 15, 2007, NOx RACT testing was conducted on Auxiliary Boilers 1A and 1B. See Table 5 for the test results.

The Permit and Env-A 800 require Seabrook Station to perform the following, every three years, on the Emergency Generators 1A, 1B, 2A, 2B, the OSB emergency generator, the GOB emergency generator, and the Sullair Air Compressor engine:

- Set and maintain the ignition timing of the engine 4 degrees retarded relative to standard timing, provided that the ignition timing shall not be retarded beyond the point that the CO increases beyond 100 ppmdv, the turbocharger speed increases beyond the manufacturer's recommended maximum operating speed, the exhaust port temperature increases beyond the manufacturer's recommended maximum operating temperature, or the opacity of emissions is equal to or greater than 20%.
- Each engine shall have an elapsed time meter and the facility shall record the hours of operation on a monthly basis.
- The facility shall also perform gaseous concentration measurements for CO and O_2 and

measure opacity from each engine,

The required tests on the equipment were conducted between October 22, 2008 and March 11, 2009. See the NOx RACT section of this report.

Seabrook Station demonstrated that it meets the requirements of the Permit.

IX. Compliance with Recordkeeping and Reporting

CHAPTER Env-A 900 - Owner or Operator Recordkeeping and Reporting Obligations

Part Env-A 902 Availability of Records

Seabrook Station demonstrated that it maintains records for a minimum of 5 years.

Env-A 903.03 – General Recordkeeping Requirements for Combustion Devices

Seabrook Station is required to maintain the following records for each combustion device, on a monthly basis:

- Amount of fuel consumed;
- Type of fuel consumed;
- Sulfur content as percent sulfur by weight of fuel; and
- The concentration of the contaminants in the specification used oil.

Seabrook Station maintains records of the consumption, fuel type, and sulfur content of the fuel used in each device. These records include the amount of fuel combusted in each device on a monthly basis and the sulfur content of the fuel oil. DES determined that Seabrook Station meets the requirements of this part.

The specification used oil that the facility burns in its waste oil heaters is self-generated and it is tested once a year.

Part Env-A 905 – NO_x Emission Statements Recordkeeping Requirements

Seabrook Station emits greater than 10 tons per year of NOx, which subjects the facility to this part. Therefore, they are required to maintain the following records:

- Identification of each combustion device
- Operating schedule during the high ozone season for each combustion device, including:
  - The typical hours of operation per day;
  - The typical days of operation per calendar month;
  - Number of weeks of operation; and
  - Heat input rate in million Btu per hour.
- The following NOx emission data:
  - Actual calendar year NOx emissions, in tons, from each NOx-emitting device; and

- Typical high ozone season day NOx emissions, in pounds per day, from each NOx-emitting device.

Seabrook Station is maintaining the operational data required by this part.

Part Env-A 907 – General Reporting Requirements

Seabrook Station is required to submit an annual emissions report, in addition to several other reports that are submitted on an annual or semi-annual basis. The company has submitted the reports as required; see *Appendix 1 - Full Compliance Evaluation Records Review*.

DES reviews the reports as they are received. Based on the review of the reports, DES determined that Seabrook Station meets the requirements of this part.

Part Env-A 909 – NOx Emission Statements Reporting Requirements

Seabrook Station has actual emissions greater than 10 tons per year and, therefore, is required to submit annual NOx emission statements. Seabrook Station is submitting NOx Emissions Statements as part of its Annual Emissions Reports.

DES determined that Seabrook Station meets the requirements of this part

Part Env-A 911 – Recordkeeping and Reporting Requirements for Permit Deviations

Seabrook Station is aware of the recordkeeping and reporting requirements for Permit Deviations. However, during the inspection period, Seabrook Station has not had any permit deviations to report.

X. <u>Compliance with RACT</u>

CHAPTER Env-A 1200 – Prevention, Abatement, and Control of Stationary Source Air Pollution

Part Env-A 1204 - Stationary Sources of VOCs

Seabrook Station has no devices or processes that are subject to Reasonably Available Control Technology ("RACT") requirements for VOCs. Seabrook Station does not have the potential to emit VOCs equaling or exceeding 50 tons during any consecutive 12-month period. Therefore, it is not subject to this part.

Part Env-A 1211 - Nitrogen Oxides

The auxiliary boilers at Seabrook Station are subject to control requirements in Env-A 1211.12. Seabrook Station shall comply with a NOx emissions rate of 0.20 lb/MMBtu, based on a 24-hour calendar day average. On August 14 & 15, 2007, Seabrook Station conducted a stack test on the auxiliary boilers. See Table 6 for stack test results. DES determined that Seabrook Station meets the requirements of this part.

Table 6: Stack Test for NOx		
Device Tested	**Permit Limit in Lb/MMBtu**	**Result in Lb/MMBtu**
EU1, Auxiliary Boiler 1A	0.20	0.116
EU2, Auxiliary Boiler 1B	0.20	0.139

The emergency generators at Seabrook Station are subject to the NOx RACT provisions of Env-A 1211.11. The engines on these devices operate less than 500 hours during any consecutive 12-month period and the engines have combined theoretical potential NOx emissions greater than 25 tons per any consecutive 12-month period.

The requirements of Env-A 1211.11 state that Seabrook Station is required to set and maintain the ignition timing of each engine 4 degrees retarded relative to standard timing, provided that the ignition timing shall not be retarded beyond the point that the CO increases beyond 100 ppmdv, the turbocharger speed increases beyond the manufacturer's recommended maximum operating speed, the exhaust port temperature increases beyond the manufacturer's recommended maximum operating temperature, or the opacity of emissions is equal to or greater than 20%.

During the inspection, Seabrook Station stated that the CO emissions from each of the emergency generators are above 100 ppmdv; therefore, precluding the requirement to adjust the ignition timing. Between October 22, 2008 and March 11, 2009, Seabrook Station conducted CO and opacity testing on each of the emergency generators. See Table 7 for the test results. The test data for EU5, EU6, and EU9 shows the CO emissions to be less than 100 ppmdv. The engines on EU5, EU6, and EU9 have electronic timing. The engine manufacturers have told Seabrook Station that the timing on engines with electronic timing can not be manually adjusted to meet the requirements of the NOx RACT rule. The purpose of the electronic timing is that the controller adjusts the engine to operate more efficiently and the test results demonstrate that. When the NOx RACT rule was written, electronic timing was not in common use for these types of engines. DES is in the process of updating and changing the NOx RACT rules and recognizes this as one area that needs to be addressed. Based on this, DES has determined that Seabrook Station will not be required to adjust the timing on the emergency generators.

Table 7: Emergency Generators Compliance with Env-A 1211		
Device	**Compliance Method**	**Compliance Status**
EU3, Emergency Generator 1A	CO = 177.4 ppm; 10/22/08 Stack Test.	Exempt due to CO levels.
EU4, Emergency Generator 1B	CO = 160.1 ppm; 11/05/08 Stack Test.	Exempt due to CO levels.
EU5, Emergency Generator 2A	CO = 39.9 ppm; 2/18/09 Stack Test.	Timing is electronically controlled; therefore, it cannot be manually adjusted.

Table 7: Emergency Generators Compliance with Env-A 1211		
Device	**Compliance Method**	**Compliance Status**
EU6, Emergency Generator 2B	CO = 34.6 ppm; 2/18/09 Stack Test.	Timing is electronically controlled; therefore, it cannot be manually adjusted.
EU7, OSB Emergency Generator	CO = 346.2 ppm; 10/24/08 Stack Test.	Exempt due to CO levels.
EU8, GOB Emergency Generator	CO = 424.0 ppm; 10/24/08 Stack Test.	Exempt due to CO levels.
EU9, Sullair Air Compressor	CO = 96.1 ppm; 10/24/08 Stack Test.	Timing is electronically controlled; therefore, it cannot be manually adjusted.

XI. Compliance with Toxics Regulations

CHAPTER Env-A 1400 – Regulated Toxic Air Pollutants ("RTAPs")

Seabrook Station emits compounds on the list of air toxics in Table 1450-1 of Env-A 1400. The toxics at the facility are: sulfur hexafluoride, ethylene glycol, hydrazine, and ammonia. The facility uses these compounds in the various cooling systems. During the inspection, DES asked Seabrook Station if its air toxics compliance determination had been updated since the October 2003 permit renewal application. Upon further review, it was determined that Seabrook Station had not completed a formal air toxics compliance determination. DES requested that a formal air toxics compliance determination be completed.

Seabrook Station has not conducted an air toxics compliance determination with the toxics rule in accordance with Env-A 1405.01 (a).

Fuel burning devices burning virgin fuels are exempt from an Env-A 1400 compliance determination.

Seabrook Station uses three used-oil furnaces. Seabrook Station only burns self-generated waste oil and has that oil tested once per year. The Toxics Section also conducted a study on the impacts of toxic air pollutants from used-oil furnaces. As a result of the study, a criteria list was developed such that if the used-oil furnace met each item on the list, then the impacts from toxics are below the Ambient Air Limits, and the facility passes the air toxics compliance determination without further analysis. The list of criteria includes:

- Unit is rated at 500,000 Btu/hr or less heat input;
- Unit is rated at 3.6 gallons/hr or less fuel use;
- Unit burns 8,640 gallons/yr or less of waste oil;
- Exhaust stack is 8 inches or less inside diameter;
- Exhaust stack outlet is 20 feet or more above the ground;

- The exhaust stack is vertical; and
- The unit is operated and maintained in accordance with manufacturer's specifications.

Seabrook Station's used-oil furnaces meet the requirements; therefore, the facility passes the air toxics compliance determination without further analysis.

XII. Compliance with Process/Particulate/Opacity Regulations

CHAPTER Env-A 1600 - Fuel Specifications

Env-A 1603.01 – Applicable Liquid Fuels

Seabrook Station uses diesel fuel in the emergency generators.

Seabrook Station uses diesel fuel/kerosene in the auxiliary boilers. Kerosene is used as a winter blend additive in a ratio of 2.3 parts oil to 1 part kerosene during the months of November through February.

Seabrook Station is using self-generated used oil in three used-oil furnaces.

Env-A 1604.01 – Maximum Sulfur Content Allowable in Liquid Fuels

Env-A 1604.01 and the Permit limit the sulfur content of #2 fuel oil to 0.4% sulfur by weight. Env-A 1604.01 and the Permit limit the sulfur content of kerosene to 0.04% sulfur by weight. Seabrook Station uses ultra low sulfur diesel fuel for the devices that use #2 fuel oil, #2 fuel oil/kerosene, or diesel fuel. Ultra low sulfur diesel fuel by definition has a maximum sulfur content of 0.0015% by weight. During the inspection, Seabrook Station presented written verification that the sulfur content of the fuel oils being used met the requirements.

CHAPTER Env-A 2000 - Fuel Burning Devices

Env-A 2002.02 – Visible Emission Standard for Fuel Burning Devices Installed After May 13, 1970

Env-A 2002.02 and the Permit limit the emissions from the boilers at this facility to 20% opacity. During the inspection, the boilers and generators were not in operation; therefore, opacity readings were not taken.

Env-A 2002.07 – Particulate Emission Standards for Fuel Burning Devices Installed After May 13, 1970 but Before January 1, 1985

Applicable particulate emission standards are based on specific requirements in the Permit and the formula presented in Env-A 2002.07. Compliance with emission standards for the fuel burning devices can only be determined through stack testing which has not been required for these devices, to date.

Env-A 2002.08 – Particulate Emission Standards for Fuel Burning Devices Installed On or After January 1, 1985

Applicable particulate emission standards are based on specific requirements in the Permit and the formula in Env-A 2002.08. Compliance with emission standards for the fuel burning devices can only be determined through stack testing which has not been required for these devices, to date.

XIII. Compliance with other Miscellaneous Provisions

CHAPTER Env-A 1800 – Asbestos Management and Control

Applicable if reconstruction/modification/demolition occurs. Between 2007 and 2009, Seabrook Station conducted some projects involving the removal of asbestos. For each project, Seabrook Station submitted the appropriate notifications. Seabrook Station meets the requirements of Env-A 1800.

CHAPTER ENV-A 3200 – NOx Budget Trading Program

Seabrook Station receives allowances for being a non-emitter under the NOx Budget Trading Program. The facility has a bank of allowances, which have not been traded or sold. The DES Emissions Trading Program Manager also reviews this information as it is received and accounts for it properly. No compliance issues have been observed with this Program.

CHAPTER Env-A 3800 – Voluntary Greenhouse Gas Emissions Reduction Registry

Seabrook Station voluntarily chose to report its greenhouse gas emissions to the State of New Hampshire for the years 1991 to 2002. The State changed the statute to require voluntary reporting to The Climate Registry. Seabrook Station is participating in the EPA's Federal voluntary greenhouse gas program rather than The Climate Registry.

XIV. Compliance With Applicable Federal Rules

40 CFR 68 Chemical Accident Prevention Provisions

To comply with the Accidental Release Program Requirements, Seabrook Station has a Spill Prevention, Control and Countermeasure ("SPCC") Plan which was last revised in August 2008.

40 CFR 82, Subpart F Protection of Stratospheric Ozone, Recycling and Emission Reduction

This program requires that no person servicing, maintaining, repairing, or disposing of appliances may knowingly vent or otherwise release into the environment any refrigerant or refrigerant substitute from such appliances. Seabrook Station has trained technicians onsite to handle any refrigerant containing appliances.

40 CFR 70.6 (a)(3) Permit Content, Monitoring, Record Keeping, and Reporting Requirements

Seabrook Station is meeting its Permit Deviation and Certification of Accuracy requirements. See section on Env-A 907 for a discussion on Annual Compliance Certification and Semi-Annual Permit Deviation and Monitoring Reports. See section on Env-A 902 for a discussion on Retention of Records.

See the Full Compliance Evaluation Records Review attached.

XV. Enforcement History and Status

Since the last off-site inspection, DES has had no enforcement actions against Seabrook Station.

XVI. Conclusions & Recommendations

The following deficiency was identified during the inspection:

Seabrook Station has not conducted an air toxics compliance determination with the toxics rule in accordance with Env-A 1405.01 (a).

Recommendations:

The following is recommended to return the facility to compliance:

Seabrook Station needs to complete an air toxics compliance determination to be in compliance with Env-A 1400.

Attachments: Appendix 1: Full Compliance Evaluation Records Review.
060209AHM01D – Email from Al Legendre Containing Summary of Eastmount Opacity/CO Emissions Testing Results. (4 Pages)
021810AHM01D – Email from Al Legendre Containing Used Oil Analysis. (2 Pages)
021910AHM01D – Email from Al Legendre Discussing Timing Changes on SEPS Engines. (1 Page)
021910AHM02D – Email from Al Legendre Discussing Toxics Review of Used Oil Burners. (1 Page)
021910AHM03D – Email from Al Legendre Discussing Timing Changes on Sullair Engine. (1 Page)
030410AHM01D – Email from Al Legendre Discussing Env-A 1400 Air Toxics Review. (1 Page)

060209AHMO1D
(4 Pages)

Moulton, Alan

From: al_legendre@nexteraenergy.com
Sent: Tuesday, June 02, 2009 9:48 AM
To: Moulton, Alan
Cc: sabre.a.gagnon@fpl.com; michael_okeefe@nexteraenergy.com
Subject: Eastmount Opacity/CO Emissions Testing for Seabrook Station

Hi Alan,

One of your open items from the Seabrook Station inspection was to provide you with a copy of the opacity/CO emissions testing done by Eastmount for us.

We have received the report and we will formally submit it with the next semiannual Title V report due by July 30, 2009.

A copy of the Eastmount report is attached in response to your open item.

Please let me know if you need anything more on this item.

(See attached file: Emissions Report EU3-9 051809.pdf)

Al Legendre
Principal Engineer - Regulatory Compliance
FPL Energy, Seabrook
P.O. Box 300
Seabrook , NH 03874

Phone: 603 773-7773
Fax: 603 773-7740
E-mail: al_legendre@fpl.com

EASTMOUNT ENVIRONMENTAL SERVICES
Air Quality Specialists

Final Report

Emergency Generator Emission Testing – EU3, EU4, EU5, EU6, EU7, EU8 and EU9

Prepared for . . .

FPL – Seabrook Station
Seabrook, NH

Prepared by . . .

Eastmount Environmental Services, LLC
May 2009
Project No. 08-069

CONTENTS

LIST OF TABLES

APPENDICES

A1 - Corrected CEMS Emission Calculation Sheets
A2 - Raw CEMS Emission Data and Analyzer Calibration Data
A3 - Integration Sample Field Data Collection Sheets
A4 - Opacity emission calculations and Field Data Sheets

B - EU3 and EU4 Facility Process Data

C - Cylinder Gas and Opacity Reader Certification Sheets

D - Facility's Title V Permit

1.0 PROGRAM SUMMARY

1.1 General Overview

Eastmount Environmental Services, LLC of Newburyport, Massachusetts was retained by FPL Energy to conduct emission testing at Seabrook Station in Seabrook, NH. Testing was conducted in order to fulfill the requirements of the facility's Title V Permit (TV-OP-017) dated June 5, 2006. Specifically, each of the facility's seven emergency generators was tested in order to fulfill the requirements of Items 4 and 5 in Table 5 of the facility's Title V Permit. A summary of the primary parties involved in this test program is presented in Table 1-1.

1.2 Emission Summary

Testing for each generator (EU3, EU4, EU5, EU6, EU7, EU8 and EU9) consisted of measurement for Carbon Monoxide (CO) corrected to 15% Oxygen (O_2) and Opacity. CO @15O_2 determinations for each source were made by collecting two 15-minute integrated samples via an evacuated lung collection technique and subsequently analyzing each sample for CO and O_2 in accordance with instrumental analyzer procedures 10 and 3A, respectively. The average of the two samples in units of applicable standard (CO @15%O_2) was then reported as the compliance value for each source. Each source was additionally tested for opacity emissions by taking readings once per 15 seconds for a period of 18-minutes in accordance with EPA Method 9.

A summary of the CO @15%O_2 and opacity emissions for each source are presented in Tables 1-2 and 1-3, respectively. All supporting CO @15%O_2 emission data is presented in Appendices A1 through A3; while all supporting opacity emission data is presented in Appendix A4. In addition, process data for EU3 and EU4 is presented in Appendix B, while process data for all other sources are presented in the comments section of the respective field data sheets presented in Appendix A3. Lastly, copies of all cylinder gas and opacity reader certification sheets are presented in Appendix C, while a copy of the facility's Title V permit is presented in Appendix D.

Table 1-1 Test Program Informational Summary

Station/Source Information	
Facility Name:	FPL / Seabrook Station
Facility Address:	626 Lafayette Rd.
	Seabrook, NH 03874
Facility Contact:	Ms. Sabre Hyland
Phone:	(603) 773-7795
Test Firm Information	
Test Organization:	Eastmount Environmental Services, LLC
Address:	65 Parker Street, Unit 3
	Newburyport, MA 01950
Contact:	Mr. David Caron
Title:	Vice President/Monitoring Services
Phone:	(978) 499-9300 x11
FAX:	(978) 499-9303
State Information	
Organization:	NHDES
Address:	Air Resources Division
	29 Hazen Drive
	PO Box 95
	Concord, NH 03302-0095
Contact:	Mr. Mike O'Brien
Phone:	(603) 271-6546

Table 1-2 CO @15% O_2 Emission Summary

Source	Test Date	Emission Concentrations						
		Run No. 1			Run No. 2			Average CO
		O_2	CO		O_2	CO		
		(%)	(ppm)	(ppm@15%O_2)	(%)	(ppm)	(ppm@15%O_2)	(ppm@15%O_2)
EU3	10/22/08	13.55	223.5	179.4	13.48	220.5	175.5	177.4
EU4	11/5/08	12.28	236.6	162.0	12.19	233.7	158.3	160.1
EU5	2/18/09	12.64	55.2	39.5	12.84	55.2	40.4	39.9
EU6	2/18/09	13.12	45.9	34.8	13.27	44.6	34.5	34.6
EU7	10/24/08	17.10	228.4	354.2	17.20	211.9	338.3	346.2
EU8	10/24/08	17.79	239.0	452.7	17.78	209.3	395.3	424.0
EU9	10/24/08	10.46	167.3	94.5	10.16	177.9	97.8	96.1

Table 1-3 Opacity Emission Summary

Source	Date	Opacity Emission Summary (%)	
		max. 6-min. rolling avg.	max. value
EU3	3/11/09	18.54	25.0
EU4	11/5/08	13.54	15.0
EU5	2/18/09	9.38	10.0
EU6	2/18/09	9.38	10.0
EU7	10/24/08	0.00	0.0
EU8	10/24/08	9.38	10.0
EU9	10/24/08	0.00	0.0

021810 AHMOID
(2 PAGES)

Moulton, Alan

From: Legendre, Al [Al.Legendre@fpl.com]
Sent: Thursday, February 18, 2010 3:52 PM
To: Moulton, Alan
Cc: GAGNON, SABRE; OKeefe, Michael; Haniffy, Fred
Subject: Used Oil Analysis

Al, We just received analytical results from Eastern Analytical for our used oil sampled 1/25/2010. As I indicated the oil that we burn is all generated on site and we test it once a year during the heating season.

LABORATORY REPORT

Eastern Analytical, Inc. ID#: 86215

Client: **NextEra Energy Seabrook, LLC** Client Designation: **Seabrook Sta!**

Sample ID:	HW-1	VM-1	VM-2
Lab Sample ID:	86215.01	86215.02	86215.03
Matrix:	oil	oil	oil
Date Sampled:	1/25/10	1/25/10	1/25/10
Date Received:	1/27/10	1/27/10	1/27/10
% Solid:			
Units:	mg/kg	mg/kg	mg/kg
Date of Extraction/Prep:	2/5/10	2/5/10	2/5/10
Date of Analysis:	2/7/10	2/7/10	2/7/10
Analyst:	JW	JW	JW
Extraction Method:	3580A	3580A	3580A
Analysis Method:	3580/8082	3580/8082	3580/8082
Dilution Factor:	1	1	1
PCB-1016	< 2	< 2	< 2
PCB-1221	< 2	< 2	< 2
PCB-1232	< 2	< 2	< 2
PCB-1242	< 2	< 2	< 2
PCB-1248	< 2	< 2	< 2
PCB-1254	< 2	< 2	< 2
PCB-1260	< 2	< 2	< 2
TMX (surr)	85 %R	90 %R	112 %R
DCB (surr)	67 %R	69 %R	87 %R

2/18/2010

LABORATORY REPORT

Eastern Analytical, Inc. ID#: 86215

Client: **NextEra Energy Seabrook, LLC** Client Designation: **Seabrook Station / Various**

Sample ID:	HW-1	VM-1	VM-2					
Lab Sample ID:	86215.01	86215.02	86215.03					
Matrix:	oil	oil	oil					
Date Sampled:	1/25/10	1/25/10	1/25/10					
Date Received:	1/27/10	1/27/10	1/27/10	**Analytical Matrix**	**Units**	**Date of Analysis**	**Method**	**Analyst**
Arsenic	< 2	< 2	< 2	Oil	mg/kg	2/1/10	6020	DS
Cadmium	< 2	< 2	< 2	Oil	mg/kg	2/1/10	6020	DS
Chromium	< 2	< 2	5	Oil	mg/kg	2/1/10	6020	DS
Lead	< 2	< 2	29	Oil	mg/kg	2/1/10	6020	DS

2/18/2010

LABORATORY REPORT

Eastern Analytical, Inc. ID#: 86215

Client: **NextEra Energy Seabrook, LLC** Client Designation: **Seabrook Station / Various**

Sample ID:	HW-1	VM-1	VM-2	Units	Analysis Date	Time	Method	Analy
Lab Sample ID:	86215.01	86215.02	86215.03					
Matrix:	oil	oil	oil					
Date Sampled:	1/25/10	1/25/10	1/25/10					
Date Received:	1/27/10	1/27/10	1/27/10					
Flashpoint	170	> 200	> 200	°F	02/01/10	8:00	1010	JC

2/18/2010

021910AHM01D
(1 PAGE)

Moulton, Alan

From: Legendre, Al [Al.Legendre@fpl.com]
Sent: Friday, February 19, 2010 7:37 AM
To: Moulton, Alan
Cc: OKeefe, Michael; GAGNON, SABRE
Subject: SEPS Engines and Timing Changes

Hi Al, This is the info I received from our Systems Engineer regarding the engine timing on the SEPs. Certainly sounds like something we want to avoid if at all possible. Can you mull this over with the permit people. Thank You.

The SEPS engine timing is complex. There is both a mechanical timing and electronically controlled timing associated with the fuel injectors. The fuel delivery to the injectors can be affected by timing pressure delivered by computer controlled actuating valves.

Tuning these engines to control emissions would be a major effort that would require a design change and heavy vendor assistance with both the engineering work and any physical work involved.

It seems a lot to do on something that only runs about 30 - 40 hours per year.

Al Legendre
Principal Engineer
NextEra Energy Seabrook, LLC
603 773-7773

O2 1910AHM 02D
(1 Page)

Moulton, Alan

From: Legendre, Al [Al.Legendre@fpl.com]
Sent: Friday, February 19, 2010 11:36 AM
To: Moulton, Alan
Cc: GAGNON, SABRE; OKeefe, Michael; Haniffy, Fred
Subject: RE: Toxics review on used oil burners

Al,

I did go through this with Denuta Lempert and confirmed that all of the exclusion criteria were met for the waste oil burners and Air Toxic (1400) was not applicable. At this point, I'd be hard pressed to find the documentation I gave her, if there was actually any. I do remember getting the spec sheets for the burner models we have from the internet to confirm heat input and fuel consumtion rate. It was after the application was filed so it is not in the application itself. Denuta was here a couple of times while writing the permt and I'm sure we looked at the waste oil burners and confirmed the exclusion criteria were met.

As we are renewing later this year is it appropriate to confirm the exclusion criteria are met in the upcoming renewal application ? Sabre will add it to the list of things to address in the application. She has already added the fire pump diesel engines to the list.

Al Legendre
Principal Engineer
NextEra Energy Seabrook, LLC
603 773-7773

From: Moulton, Alan [mailto:Alan.Moulton@des.nh.gov]
Sent: Friday, February 19, 2010 11:21 AM
To: Legendre, Al
Subject: Toxics review on used oil burners

Al,

If each of the three used oil burners meet all of the criteria listed below, then you don□$BIG□(Bt need to do a toxics review on the waste oil burners. I am guessing that the used oil burners meet all seven of the criteria; however, I don□$BIG□(Bt have the stack information or the annual fuel usage for 2005 through 2009. Please forward documentation on the stacks and fuel usage.

□$B!|□(B Unit is rated at 500,000 Btu/hr or less heat input;
□$B!|□(B Unit is rated at 3.6 gallons/hr or less fuel use;
□$B!|□(B Unit burns 8,640 gallons/yr or less of waste oil;
□$B!|□(B Exhaust stack is 8 inches or less inside diameter;
□$B!|□(B Exhaust stack outlet is 20 feet or more above the ground;
□$B!|□(B The exhaust stack is vertical; and
□$B!|□(B The unit is operated and maintained in accordance with manufacturer□$B!G□(Bs specifications.

3/3/2010

I don□$BIG□(Bt know if you went through this exercise with Danuta Lempert, all of her file notes are gone.

Thanks for the help.

Alan Moulton
Air Pollution Control Engineer
NHDES, Air Resources Division
29 Hazen Dr., PO Box 95
Concord, NH 03302-0095
(603) 271-6797

3/3/2010

021910AHM 03D
(1 PAGE)

Moulton, Alan

From: Legendre, Al [Al.Legendre@fpl.com]
Sent: Friday, February 19, 2010 2:34 PM
To: Moulton, Alan
Cc: GAGNON, SABRE; OKeefe, Michael
Subject: Sullair Engine and Timing Changes

Hi Al,

This is input from the Sullair Air Compressor system engineer. As with the SEPS engines this engine has advanced timing controls not easy to adjust. Hope we can do something with the permit. The system engineer raises a very good point that we are close to 100 ppm already so where do you stop. May be impossible to adjust to hit 100 ppm exactly.

The Sullair engine timing is provided by computer controls. There is an Electronic Control Module that electronically controls the timing of the fuel injectors, based on input from the engine speed and timing sensors, as well as air pressure sensors. Tuning of the engine to control emissions would be complicated and would require significant vendor assistance. The tuning would be trial and error at best, and would just as likely result in exceeding the 100 ppm max limit, given that the CO emissions are currently at 90+ ppm.

Also, there is generally a tolerance applied to any target value, to allow for instrument uncertainties in both the settings and the analysis equipment. In order to ensure that we do not exceed 100ppm, I would say that we are already at our target. I believe that the effort required to pursue any further adjustments is not justified.

In addition, the Sullair only runs ~25 hours per year.

From: Legendre, Al
Sent: Friday, February 19, 2010 7:37 AM
To: 'Moulton, Alan'
Cc: OKeefe, Michael; GAGNON, SABRE
Subject: SEPS Engines and Timing Changes

Hi Al, This is the info I received from our Systems Engineer regarding the engine timing on the SEPs. Certainly sounds like something we want to avoid if at all possible. Can you mull this over with the permit people. Thank You.

The SEPS engine timing is complex. There is both a mechanical timing and electronically controlled timing associated with the fuel injectors. The fuel delivery to the injectors can be affected by timing pressure delivered by computer controlled actuating valves.

Tuning these engines to control emissions would be a major effort that would require a design change and heavy vendor assistance with both the engineering work and any physical work involved.

It seems a lot to do on something that only runs about 30 - 40 hours per year.

3/3/2010

Al Legendre
Principal Engineer
NextEra Energy Seabrook, LLC
603 773-7773

3/3/2010

030410AHMO1D
(1 Page)

Moulton, Alan

From: Legendre, Al [Al.Legendre@fpl.com]
Sent: Thursday, March 04, 2010 10:12 AM
To: Moulton, Alan
Cc: OKeefe, Michael; GAGNON, SABRE; Jaster, Samuel; Robinson, David
Subject: FW: Env-1400 Air Toxics, 11/25/09 Rule Change Review

Hi Alan,

Quantification of our releases of Regulated Toxic Air Pollutants vis-à-vis the deminimus levels in Env A-1400 has not been performed. Our Title V applications have only generalized that we emit certain air toxics from our processes including sulfur hexafluoride, hydrazine, ammonia and glycol.

Quantification of the emissions of these is going to be difficult with the exception of SF6 which is estimated on an annual basis for our reporting under the EPA Voluntary Partnership for SF6 Emission Reduction. The SF6 emissions are substantially below deminimus.

I have spoken to our Engineering Dept and Chemistry Dept and it appears that we would need to go to an outside contractor for assistance with this. The contractor is familiar with our site, recently having updated a NRC-required calculation of potential threats to operators in the control room from toxic gas releases on site and locally. The contractor may be able to calculate our RTAP emissions using atmosperic dispersion models it has used for the other purposes I mentioned.

If quantification is going to be a requirement for us I would like to propose that it be performed in conjunction with the next renewal application due toward year end. That should give us sufficient time to engage the contractor, fully understand the various release mechanisms and perform the calculations.

I'll be out of the office tomorrow, 3/5. I'm available to dicscuss this further next week.

Al Legendre
Principal Engineer
NextEra Energy Seabrook, LLC
603 773-7773

From: Legendre, Al
Sent: Wednesday, February 24, 2010 3:19 PM
To: 'Moulton, Alan'
Cc: OKeefe, Michael; GAGNON, SABRE
Subject: Env-1400 Air Toxics, 11/25/09 Rule Change Review

Alan,

The Air Resources Division has included on the DES website a list of historic changes to Env 1400 Air Toxics listing thru the latest 11/25/09 update. The change listing simplifies the review vice a line by line comparison. The list of changes in the 11/25/09 rule update is attached.

3/5/2010

Page 2 of 2

I have reviewed the 11/25/09 changes and can conclude that there is no impact on our reported emissions of Env A-1400 toxic air pollutants. The toxic air pollutants that Seabrook Station emits in our plant processes (exclusive of exempt maintenance activities and exempt gasoline dispensing) as reported in our October 8, 2003, Title V Permit renewal application are sulfur hexafluoride, ethylene glycol, hydrazine and ammonia. None of these compounds were effected by the 11/25/09 rule change.

I am tracking the required review of the 11/25/09 Env A-1400 rule change in our corrective action system and will document this conclusion therein.

Please let me know if you need further information for this item in your inspection report.

Al Legendre
Principal Engineer
NextEra Energy Seabrook, LLC
603 773-7773

3/5/2010

Appendix 1: Full Compliance Evaluation Records Review

Facility: **NextEra Energy Seabrook, LLC**
Date of FCE: **May 7, 2009**
Reviewer: **Alan Moulton**

Annual Emission Reports (incl. NOx, VOC etc.):

Reporting Period	When Rec'd	Report OK	In Database
2008	4/16/09	Yes	Yes
2007	4/08/08	Yes	Yes

Annual Emissions-Based Fee Payments:

Reporting Period	When Rec'd	In Database
2008	4/16/09	Yes, in DES Emission Section's Spreadsheet.
2007	4/08/08	Yes, in DES Emission Section's Spreadsheet.

TV Annual Compliance Certifications:

Reporting Period	When Rec'd	Report OK	In Database
2008	4/16/09	Yes	Yes
2007	4/15/08 7/07/08 (Revised)	Yes	Yes

TV Semi-Annual Permit Deviation and Monitoring Reports:

Reporting Period	When Rec'd	Report OK	In Database
Jul – Dec 2009	2/01/10 3/31/10 Revision	Yes	Yes
Jan – Jun 2009	7/24/09 3/09/10 Revision	Yes	Yes
Jul – Dec 2008	1/28/09	Yes	Yes
Jan – Jun 2008	7/30/08	Yes	Yes
Jul – Dec 2007	1/23/08	Yes	Yes
Jan – Jun 2007	7/31/07	Yes	Yes

Individual Permit Deviations Reports:

Reporting Period	When Rec'd	Report OK	In Database
None.			

Quarterly Continuous Emission Monitoring Excess Emission Reports (CEM EERs):

Reporting Period	When Rec'd	Report OK	In Database
None.			

CEM Audits (OPAs, CGAs, RAAs, RATAs):

Reporting Period	Report Type	When Rec'd	Report OK	In Database
Not applicable.				

Stack Tests:

Stack Test Date	Device Tested	When Rec'd	Report OK	In Database
8/14/07	Auxiliary Boiler 1A	10/09/07	Yes	Yes
8/15/07	Auxiliary Boiler 1B	10/09/07	Yes	Yes

Other reports:

Reporting Period	Report Type	When Rec'd	Report OK	In Database
None.				

NEXTera ENERGY SEABROOK

November 8, 2010

SBK-L-10150

State of New Hampshire
Department of Environmental Services
Air Resources Division
29 Hazen Drive, P.O. Box 95
Concord, NH 03302-0095
ATTN: Alan Moulton, Compliance Assessment Engineer

Seabrook Station
Air Toxics Compliance Determination

NextEra Energy Seabrook, LLC provides the enclosed "Evaluation of Toxic Air Pollutants at Seabrook Station" and supporting Calculation Summary Sheet in response to the deficiency identified in NH Department of Environmental Services Air Resources Division Inspection Report AFS #3301500047 and our response dated April 19, 2010. The deficiency indicated that "Seabrook Station has not conducted an air toxics compliance determination with the toxics rule in accordance with Env-A 1405.01 (a)."

In response to the deficiency and to achieve full compliance with Env-A 1405.01 (a) NextEra Energy Seabrook contracted the services of AREVA NP Inc. to perform the air toxics compliance determination. AREVA NP routinely performs radiological dose calculations required by the NRC Operating License and chemical release calculations as to their potential impact on plant operators.

AREVA NP evaluated seven air toxic pollutants utilized in Seabrook Station processes including sulfur hexafluoride, ethylene glycol, ethanolamine, hydrazine, ammonia (a byproduct of hydrazine use), sodium hydroxide and sulfuric acid. The evaluation demonstrates that air toxic emission levels are below deminimus values or Ambient Air Limits when subject to dispersion modeling (performed for hydrazine and ammonia as the deminimus levels were exceeded) using the SCREEN3 modeling software.

Should you require additional information, please contact Mr. Allen Legendre, Principal Engineer, at (603) 773-7773.

Sincerely,

NextEra Energy Seabrook, LLC

Michael O'Keefe

Michael O'Keefe
Licensing Manager

Enclosure

Enclosure 1 to SBK-L-10150

20004-017 (09/21/2009)

AREVA

AREVA NP Inc.,

an AREVA and Siemens company

ENGINEERING INFORMATION RECORD

Document No: 51 - 9142596 - 001

Evaluation of Toxic Air Pollutants at Seabrook Station

Safety Related? ☐ YES ☒ NO

Does this document contain assumptions requiring verification? ☐ YES ☒ NO

Does this document contain Customer Required Format? ☐ YES ☒ NO

Signature Block

Name and Title/Discipline	Signature	P/LP, R/LR, A/A-CRF, A/A-CRI	Date	Pages/Sections Prepared/Reviewed/ Approved or Comments
J.H. Snooks	JH Snooks	LP	10/19/2010	Sections 1-3, 5, and 6; Appendix A; Appendix B.4
C.A. Fasano	CA Fasano	P	10-19-2010	Section 4; Appendix B.1–B.3, Appendix C, and Appendix D
C.A. Fasano	CA Fasano	LR	10-19-2010	Sections 1-3, 5, and 6; Appendix A; Appendix B.4
J.H. Snooks	JH Snooks	R	10/19/2010	Section 4; Appendix B.1-B.3; Appendix C, and Appendix D
B Hubbard for J.J. Picard, Technical Manager	[signature]	A-CRI	10/19/2010	All

Note: P/LP designates Preparer (P), Lead Preparer (LP)
R/LR designates Reviewer (R), Lead Reviewer (LR)
A/A-CRF designates Approver (A), Approver of Customer Requested Format (A-CRF)
A/A-CRI designates Approver (A), Approver - Confirming Reviewer Independence (A-CRI)

Record of Revision

Revision No.	Pages/Sections/ Paragraphs Changed	Brief Description / Change Authorization
000	All	Initial release
001	Partial revision - affected pages identified below	Revision 001 addresses NHDES comments, principally the need to use a U.S. EPA-approved air quality model, and corrects clerical errors. The EIR conclusion still remains valid, namely, that regulatory compliance is demonstrated for each RTAP evaluated.
	Section 2.0	Revised discussion of air dispersion modeling and EAB.
	Sections 4.2 and 4.3	Added discussion on emissions from mixing and tank vents.
	Section 4.3	Corrected reference 6.2.5 to 6.24.
	Sections 4.4, 4.5 and 4.6	Replaced "EG" with appropriate chemical name for section (e.g. hydrazine, ammonia and sodium hydroxide).
	Section 4.4	Amended air dispersion modeling results.
	Section 4.5	Corrected ammonia annual de minimus value and amended air dispersion modeling results.
	Section 4.6	Added discussion of NaOH 4% solution emissions.
	Section 4.6	Revised breathing and total emissions for sodium hydroxide and added daily breathing loss to total 24-hr emissions.
	Section 4.7	Revised breathing and total emissions for H_2SO_4. Added "inside" to description of H_2SO_4 tank and removed description of transfer of outside to inside tanks. Clarified that there are no outside tanks and added daily breathing loss to total 24-hr emissions.
	Sections 6.1 and 6.2	Updated references.
	Table 1	Revised emissions for hydrazine, ammonia, NaOH, and H_2SO_4.
	Appendix A.2	Revised Photo 5 description.
	Appendix B.1.5, B.2.3, B.2.4	Revised description of chemical parameters to match values in calculations; added explanation of values for K_c and K_p
	Appendix B.2.3, B.2.4	Added breathing loss from second NaOH and sulfuric acid tanks to annual emissions. Added daily breathing loss to NaOH and sulfuric acid total 24-hr emissions.
	Appendix B.4	Revised entire subsection to describe air dispersion modeling and results.

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1.0 INTRODUCTION

1.1 Purpose

- Provide the technical input necessary to quantify the regulated toxic air pollutants emitted from Seabrook Station..
- Determine if the regulated pollutants are either
  - within the *de minimis* emission levels or
  - meet the Ambient Air Limits (AALs) established by New Hampshire Administrative Rule Env-A 1400, Regulated Toxic Air Pollutants (RTAPs).
- Ensure the adequacy, accuracy, and completeness of the technical input.
- Document the results of the technical input, quantification, and regulatory evaluation of RTAPs.

1.2 Background and Scope

The New Hampshire Department of Environmental Services (NHDES), Air Resources Division, performed a full compliance evaluation at Seabrook Station in May 2009 (Reference 6.2.1). The compliance evaluation identified that Seabrook Station had not conducted an air toxics compliance determination in accordance with Env-A 1405.01(a). To assist in resolving the compliance item, NextEra Seabrook, LLC (Seabrook Station) requested AREVA NP, Inc. (AREVA) to evaluate the RTAPs emitted from Seabrook Station processes and prepare a compliance determination report.

Initially, Seabrook Station had identified five RTAPs to be quantified and evaluated based on its Title V applications and knowledge of processes learned after receipt of the Title V permit. However, subsequent information gathered from a site "walk around" (Appendix A) and regulatory clarification (Appendix C) yielded a revised list that includes the following RTAPs:

- sulfur hexafluoride
- ethylene glycol
- ethanolamine
- hydrazine
- ammonia (a byproduct of hydrazine use),
- sodium hydroxide, and
- sulfuric acid.

This Engineering Information Record (EIR) describes the approach and methods used to quantify and evaluate the above RTAPs as well as summarize the results. Technical data to support the evaluation are located in the appendices.

1.3 Conduct of Quality

This EIR is non-safety related and has been prepared using the applicable procedures to comply with the latest revision of AREVA Quality Management Document 56-5015885, relating to non-safety related work.

2.0 APPROACH AND METHODS

The EIR used a progressive step approach to evaluate the RTAPs identified at Seabrook Station and employed the general methods per Env-A 1405.01 to demonstrate compliance.

First, RTAPs initially identified by Seabrook Station were confirmed by conducting a site "walk around" (Appendix A). This step also included consultation with NHDES to clarify several regulatory issues that arose during the site walk around (Appendix C).

Second, the actual daily (24-hour) and annual emission rate for each confirmed RTAP was quantified. The actual emission rate is the value calculated without consideration for any treatment or pollution control equipment. The actual emission rates were based on the highest annual chemical usage rate over a period of the past five years. Seabrook Station operating capacity factors average 88% with a high of 98%, therefore actual emissions are close to potential emissions.

Third, the RTAP emission rates were then compared to corresponding 24-hour and annual AAL *de minimis* values set in Env-A 1450.1, Table of All Regulated Toxic Air Pollutants. If the RTAP was less than both the 24-hour and annual AAL *de minimis* value, it meets compliance per Env-A 1405.03(b)(2) and no further analysis is required to demonstrate compliance for the RTAP.

Fourth, if either or both the 24-hour and annual emission rate was more than AAL *de minimis* value, then each emission rate was then compared to the 24-hour and annual AAL using air dispersion modeling per Env-A 1405.02. If the RTAP concentration is less than both the 24-hour and annual AAL, it meets compliance per Env-A 1405.01(b)(1) and no further analysis is required to demonstrate compliance for the RTAP.

The air dispersion modeling used SCREEN3 to evaluate the RTAP emissions from normal plant operation. Per Env-A 606.04, SCREEN3 is approved by the U.S. Environmental Protection Agency in accordance with 40 CFR Part 51, Appendix W. The limit of the Seabrook Station Exclusion Area Boundary (EAB) was chosen to represent the compliance boundary. The EAB, which is also the site boundary, provides a minimum distance of 3,000 feet from the Reactor Containment Building to the site boundary. No residences are located inside the EAB, however two facilities inside the EAB allow limited public access. As a result, each facility was included as a model receptor location, which produced a total of three locations at and inside the EAB where RTAP concentrations were estimated.

3.0 ACCEPTANCE CRITERIA

The progressive step approach described in Section 2.0 above is designed to evaluate and determine regulatory compliance conditions have been met per Env-A 1405.01(a) and (b). This EIR serves as the basis to provide documentation of compliance per Env-A 1405.01(c).

4.0 RESULTS

Listed below are the progressive steps undertaken for each RTAP at Seabrook Station identified in Section 1.2 above and evaluations of whether the emissions from RTAP storage containers or processes meet regulatory compliance.

Table 1 summarizes the results of the RTAP quantification and AAL comparison steps.

4.1 Sulfur Hexafluoride

Sulfur hexafluoride (SF_6) is used as a cover gas in on-site electrical equipment such as bus ducts and power circuit breakers. Storage is in cylinders (Reference 6.1.2). Sources of air emissions are through equipment loading and leakage.

Seabrook maintains an inventory of purchases and disbursements to determine annual emissions to the atmosphere as part of U.S. Environmental Protection Agency's SF_6 Emissions Reduction Partnership for Electric Power Systems program. From Appendix C, the largest annual leakage for the period 2007-2009 was 3,919 lbs, or an annual emission rate of 3,919 lbs/yr. The 24-hour emissions rate, based on the actual annual usage divided by 365 days per year, is 11 lbs/day.

The SF_6 actual annual and 24-hour emissions from above are well below the *de minimis* values set in Env-A 1450.1, Table of All Regulated Toxic Air Pollutants, of 385,247 lbs/yr and 1,055 lbs/day shown in Table 1. As a result, SF_6 emissions at Seabrook Station meet compliance per Env-A 1405.01(b)(2) and no further analysis is required.

4.2 Ethylene Glycol

Ethylene glycol (EG) is used in two primary systems: diesel engines and heating and cooling equipment. The diesel engines are located throughout the facility and are both mobile and stationary sources. The engines use an EG/water mixture containing 25 wt% EG. The heating and cooling equipment is used throughout the facility and, depending on the application, contain EG solutions varying from 30 to 60 wt%.

Sources of air emissions are through equipment loading, evaporation from open containers, and spills. There are no tank breathing loss emissions (i.e., emissions due to temperature and pressure changes during prolonged tank storage) because the EG is not stored in atmospheric tanks for a significant amount of time. Instead, the EG is received in closed drums, transferred to a mixing tank, and then transferred to closed systems. EG is received in 55-gallon drums and mixed in a 275-gallon mixing tank located in the Condensate Polisher System (CPS) building (Appendix A, Photo 2). Emissions from the mixing tank vents are considered to be negligible due the low vapor pressure of the solutions and the infrequency of mixing.

Annual purchases of ethylene glycol have averaged 800 gallons per year over the past five years period 2005-2009 (Appendix C). Shipments of waste liquid EG have averaged 759 gallons over the past seven years (Appendix C, 4-28-10 e-mail). Note that a mass balance (emissions estimation method used for SF_6 of purchases and waste disbursements) was not performed for EG since the EG solutions remain in the diesels and heating and cooling equipment for varying amounts of time and the EG is diluted with water for some of the systems.

The highest annual EG usage in the past five years was during 2004 when 1,320 gallons of 100% concentrate was used when the PAB/FSB heating system was drained and refilled. During that same year, 2004, 130 gallons of 60% EG was placed in the Supplemental Emergency Power System diesels (Appendix C, 6-2-10 e-mail with EG amounts). EG emission rates for the three emission sources are as follows:

Equipment (Tank) Loading

The emissions from tank loading were estimated by EPA's working loss Equation 1-29 from AP-42, Chapter 7 (Reference 6.2.4)

$L_W = 0.0010\ M_V\ P_{VA}\ Q\ K_N\ K_P$

where:

Q = annual net throughput, bbl/yr
M_V = vapor molecular weight, lb/lb-mole
P_{VA} = vapor pressure at daily average liquid surface temperature, psia
K_N = working loss turnover (saturation) factor, dimensionless
K_P = working loss product factor, dimensionless

From Appendix B, Section B.1.1, the working loss emissions is multiplied by a factor of two to account for the transfer of ethylene glycol to the mixing tank and the transfer of the EG mixture to the equipment. The total emissions from equipment loading is estimated to be 0.1 lb/yr or

$L_W = 0.05*2 = 0.1$ lb/yr.

Evaporation from Open Containers

EG leaks are collected in containers near the heating and cooling equipment. See Appendix A, Photo 3, depicting a typical arrangement. The EG solutions from the containers are emptied into waste containers and shipped offsite. The emissions from evaporation were based on EPA's Hazardous Waste, Treatment, Storage and Disposal Facilities (TSDF) – Air Emissions Models, Chapter 4 (Reference 6.2.5). From Equation 4-1,

$E_C = KAC_L$

where

E = air emissions from liquid surface, g/sec
K = overall mass transfer coefficient, m/sec
A = liquid surface area, m^2
C_L = concentration of constituent in the liquid phase, g/m^3

From Appendix B, Section B.3,

E_C = 1.41E-6 g/sec

For 10 containers open per day, the emissions from the evaporation from containers are:

E_C = (10)*(1.41E-6 g/sec) /(454g/lb)*(3600 sec/hr)*(24 hr/day) = 0.0027 lb/day

<u>Spills</u>

EG spills are cleaned up as part of site general housekeeping and spill response procedures. Based on the volatility of the ethylene glycol shown in the above open container evaporation calculation, emissions from spills are assumed to be negligible. Therefore,

$E_S = 0$

<u>Total EG Emissions</u>

The total EG emissions are the sum of the tank loading losses, the evaporation from open containers and the evaporation from spills:

$E = L_W + E_C + E_S$

The total 24-hour EG emissions are estimated to be

E = 0.1 lb/yr/365 days/yr + 0.0027 lb/day + 0 = 0.003 lb/day.

The total annual emissions are estimated to be

E = 0.1 lb/yr + 365 days/yr * 0.0027 lb/day + 0 = 1.09 lb /yr.

The EG actual annual and 24-hour emissions from above are well below the *de minimis* values set in Env-A 1450.1, Table of All Regulated Toxic Air Pollutants, of 2,181 lbs/yr and 6.0 lbs/day shown in Table 1. As a result, EG emissions at Seabrook Station meet compliance per Env-A 1405.01(b)(2) and no further analysis is required.

4.3 Ethanolamine

Ethanolamine (ETA) is used in the condensate chemistry system (seeks out wetted systems, dropping out in the turbine moisture drains) and for pH control of the entire steam cycle (Appendix C, Secondary Plant Chemical Usage). ETA is received in 200-gallon totes for the CPS and 55-gallon drums for the steam system of 40% solution for each system (Appendix A, Photos 14 and 10, respectively). The ETA storage supply tanks are located in the turbine building at elevation 21 feet (428-gallon tank of 2.5% solution) and the CPS Building (400 gallons of 40% solution). Emissions from the ETA mixing are considered to be negligible due the low vapor pressure of the solution. The usage rate is approximately one drum per month for the steam system and one tote per year for the CPS (Appendix C, Secondary Plant Chemical Usage).

The majority of the ETA used is chemically consumed through the pH control chemistry in the steam cycle or is dilute in the wastewater (less than 1% ETA in water) so that the vapor pressure of the solution is negligible. Therefore, the sources of air emissions are through tank loading and tank breathing losses. Emissions are estimated as follows:

<u>Tank Loading</u>

The emissions from tank loading were estimated by EPA's working loss Equation 1-29 from AP-42, Chapter 7 (Reference 6.2.4)

$L_W = 0.0010\, M_V\, P_{VA}\, Q\, K_N\, K_P$

where:

Q = annual net throughput, bbl/yr
M_V = vapor molecular weight, lb/lb-mole
P_{VA} = vapor pressure at daily average liquid surface temperature, psia
K_N = working loss turnover (saturation) factor, dimensionless
K_P = working loss product factor, dimensionless

From Appendix B, Section B.1.2, the working loss emissions

$L_W = 0.01330$ lb/yr

<u>Tank Storage Breathing Loss Emissions</u>

The Breathing Loss equation is from Reference 6.2.5, Equation 7-5,

$L_b = 2.26E^{-02} M_V (P_{VA}/P_A - P_{VA})^{0.68}\, D^{1.73}\, H^{0.51}\, \Delta T^{0.5}\, F_p\, C\, K_c$

where,

L_b = breathing storage loss, lb/yr
M_V = vapor molecular weight, lb/lb-mole
P_{VA} = vapor pressure at daily average liquid surface temperature, psia

P_A = average atmospheric pressure at tank location, psia
D = tank diameter (ft)
H = average vapor space height, ft
Δ T = average ambient diurnal temperature change, F
F_p = paint factor, assume 1 since tanks located indoors
C = adjustment factor for small diameter tanks, dimensionless
K_c = product factor, dimensionless

From Appendix B, Section B.2.1

L_b = 0.099 lb/yr. For two tanks, the breathing loss would be

L_b = 2 x 0.099 lb/yr = 0.198 lb/yr.

Total ETA Emissions

The total annual emissions rate of ETA is the sum of the tank loading and breathing losses estimated from above to be

0.198 lb/yr + 0.013 lb/yr = 0.21 lb/yr.

The total 24-hour emission rate is total annual emissions rate of ETA divided the number of days the system operates, which is equivalent to 365 days times the average plant capacity factor of 88.63% (Appendix C, 4-28-10 e-mail). Therefore, the total 24-hour emission rate is

0.21 lb/yr / (365 days/yr x 0.8863) = <0.01 lb/day

The ETA actual annual and 24-hour emissions from above are well below the *de minimis* values set in Env-A 1450.1, Table of All Regulated Toxic Air Pollutants, of 117 lbs/yr and 0.32 lbs/day shown in Table 1. As a result, ETA emissions at Seabrook Station meet compliance per Env-A 1405.01(b)(2) and no further analysis is required.

4.4 Hydrazine

Hydrazine (N_2H_4) is used in the condensate chemistry system for oxygen control of the entire steam cycle. The hydrazine supply tank for the steam cycle is located in the Turbine Building (428-gallon tank of 70,000 ppm solution). Hydrazine is received in 55-gallon drums (see Appendix A, Photo 9) and 200-gallon totes (Appendix A, Photo 14, as a tote example). The hydrazine is injected directly from 35% concentration in drums into the condensate polisher system during plant start-up and after refueling outages. Emissions from hydrazine mixing are considered to be negligible due the low vapor pressure of the solution. (Appendix C, Secondary Plant Chemical Usage)

The majority of the hydrazine used is chemically consumed through the oxygen scavenging in the steam cycle and thermally decomposed to ammonia in the steam cycle (Appendix C, Secondary Plant Chemical Usage). Sources of hydrazine emissions, therefore, are through the storage tank loading and breathing losses, the same as with ETA. As a result, the same tank loading and breathing equations in Section 4.3 can be applied.

From Appendix B, Section B.1.3, the tank loading working loss is

L_W = 0.12 lb/yr

The breathing loss from Appendix B, Section B.2.2, is

L_b = 0.157 lb/yr

The resulting total annual hydrazine emissions rate, therefore, is

0.12 b/yr + 0.16 b/yr = 0.28 lb/yr

The total 24-hour emission rate is the total annual emissions rate of hydrazine divided by the number of days the system operates, which is equivalent to 365 days times the average plant capacity factor of 88.63% (Appendix C, 4-28-10 e-mail). Therefore, the total 24-hour emission rate is

0.28 lb/yr / (365 days/yr x 0.8863) = 0.00068 lb/day

The hydrazine actual annual and 24-hour emissions from above are greater than the *de minimis* values set in Env-A 1450.1, Table of All Regulated Toxic Air Pollutants, of 0.20 lbs/yr and 0.00055 lbs/day shown in Table 1. As a result, hydrazine emissions at Seabrook Station do not meet compliance per Env-A 1405.01(b)(2) and further analysis is required.

Accordingly, atmospheric dispersion modeling was used to evaluate the hydrazine emission rates further (see Section 2.0 above). In addition, the emission rate was based on the pumping rate of the hydrazine drums or totes into mixing tanks, as follows:

(3520 gal/yr) / (20 gal/min) (60 s/min) = 10,560 sec/yr of pumping, or

(0.12 lb/yr)/(10,560 sec/yr)(454,000 µg /lb) = 5.2 µg /sec

From Appendix B, Section B.4, the hydrazine emission rate from above yields a maximum concentration among modeled receptors as follows:

Annual = 0.00108 $\mu g/m^3$

24-hour = 0.00645 $\mu g/m^3$

The hydrazine actual annual and 24-hour emissions, therefore, yield maximum concentrations among the receptors modeled that are significantly less than the AAL values set in Env-A 1450.1, Table of All Regulated Toxic Air Pollutants, of 0.031 $\mu g/m^3$ (annual) and 0.046 $\mu g/m^3$ (24-hour) shown in Table 1. As a result, hydrazine emissions at Seabrook Station meet compliance per Env-A 1405.01(b)(1).

4.5 Ammonia

Ammonia (NH_3) is emitted in the steam cycle as a result of the thermal decomposition of hydrazine. Ammonia emissions are based on the hydrazine usage rate (2 to 2.5 gallons per hour of 70,000 ppm hydrazine in water solution) and the thermal decomposition reaction equation:

$3N_2H_4 \rightarrow 4NH_3 + N_2$ (Appendix C, Secondary Plant Chemical Usage).

Ammonia carries over in the main steam and returns to the main condenser. The feedwater retains approximately 1 ppm ammonia and the remainder of the ammonia is removed from the main condenser via the air removal pumps that are used to maintain condenser vacuum (Appendix A, Photo 13). The exhaust of the air removal pumps is directed to the plant ventilation system and discharged via the plant stack at 2.8E+05 scfm (Appendix C, Secondary Plant Chemical Usage).

To calculate ammonia emissions, the following conservative assumptions are made:

- All of the hydrazine converts to ammonia. This assumption is conservative because the primary purpose of hydrazine is to scavenge for oxygen.
- 2.5 gallons of the 70,000 ppm hydrazine solution is used per hour (Appendix C Secondary Plant Chemical usage).
- The system operates at an average capacity factor 100%, i.e., continuous for the entire year.

The emission rate is based on the thermal decomposition reaction equation yielding 4 moles ammonia per 3 moles hydrazine.

$$\frac{(4 \text{ mol } NH_3)}{(3 \text{ mol } N_2H_4)} * \frac{(2.5 \text{ gal})}{(\text{hr})} * \frac{(70000 \text{ lb } N_2H_4)}{(10\text{^}6 \text{ lb } H_2O)} * \frac{(8.34 \text{ lb } H_2O)(\text{mol } N_2H_4)}{(\text{gal}) \quad (32 \text{ lb } N_2H_4)} * \frac{(24 \text{ hr})}{(\text{day})} * \frac{(17 \text{ lb } NH_3)}{(\text{mol } NH_3)}$$

= 24.8 lb /day of NH_3

The annual emission rate is 24.8 lb /day * 365 days * 1.0 = 9,052 lb/year of NH_3.

The ammonia annual and 24-hour emissions from above are greater than the *de minimis* values set in Env-A 1450.1, Table of All Regulated Toxic Air Pollutants, of 434 lbs/yr and 1.2 lbs/day shown in Table 1. As a result, ammonia emissions at Seabrook Station do not meet compliance per Env-A 1405.01(b)(2) and further analysis is required.

Accordingly, atmospheric dispersion modeling was used to evaluate the ammonia emission rates further (see Section 2.0 above). From Appendix B, Section B.4, the ammonia emission rates from above yield a maximum concentration among modeled receptors as follows:

Annual = 0.0727 μg/m^3

24-hour = 0.363 μg/m^3

The ammonia annual and 24-hour emissions, therefore, yield maximum concentrations among the receptors modeled that are significantly less than the AAL values set in Env-A 1450.1, Table of All Regulated Toxic Air Pollutants, of 100 $\mu g/m^3/yr$ for both the 24-hour and annual emissions shown in Table 1. As a result, ammonia emissions at Seabrook Station meet compliance per Env-A 1405.01(b)(1).

4.6 Sodium Hydroxide

Sodium hydroxide (NaOH) is used in the Steam Generator Blowdown System (SGBS) and Condensate Polishing System (CPS). Sodium hydroxide is also a pH additive to the sodium hypochlorite solution (up to 2% NaOH) used for ocean cooling water system macrofouling and microfouling control.

The 50% by weight solution is delivered to a 4,170 gallon tank stored inside near the CPS. The 50% NaOH is also delivered to a 1,000-gallon tank stored near the SGBS.

In the CPS, the NaOH is diluted to 4% by weight and heated to 120°F to 140°F. Emissions from the 4% NaOH solution, therefore, are considered to be negligible due to the low vapor pressure of the dilute solution. Consequently emissions are calculated for the storage tank loading and breathing losses due to NaOH tank transfer and tank storage, which is the same as with hydrazine and ETA. As a result, the same tank loading and breathing equations in Section 4.3 can be applied.

The highest annual usage of 50% NaOH within the past five years for the CPS and SGBS is 8,260 gallons (Appendix C, 6-2-10 e-mail). The highest annual usage of sodium hypochlorite with 2% NaOH is 900,000 gallons. The specific gravity of the sodium hypochlorite solution is 1.2, therefore approximately 180,144 pounds of NaOH is used as part of the chlorination process. The vapor pressure of the sodium hydroxide solutions below 10% are considered negligible; therefore, the breathing and working losses air emissions are not evaluated for these solutions.

From Appendix B, Section B.1.4, the tank loading working loss emissions L_W = 0.17 lb/yr.

From Appendix B, Section B.2.3, the breathing loss emissions L_b = 1.45 lb/yr.

The resulting total annual emissions rate of sodium hydroxide, therefore, is

0.17 lb/yr + 1.45 lb/yr = 1.62 lb/yr

The highest daily emissions are assumed to be based on the transferring of 1,850 gallons from delivery truck to the 4,170-gallon indoor tank located inside near the CPS and including the breathing loss from two tanks.

Scaling the annual loading loss emissions with the highest amount transferred in one day and adding the daily breathing loss, the daily emissions are estimated to be:

0.17 lb/yr x 1850/8260 + 1.62 lb/yr/365 day/yr = 0.0425 lb/day of NaOH.

The annual and 24-hour NaOH emissions from above are well below the *de minimis* values set in Env-A 1450.1, Table of All Regulated Toxic Air Pollutants, of 143 lbs/yr and 0.39 lbs/day shown in Table 1. As a result, sodium hydroxide emissions at Seabrook Station meet compliance per Env-A 1405.01(b)(2) and no further analysis is required.

4.7 Sulfuric Acid

Sulfuric Acid (H_2SO_4) is used in the SGBS and CPS systems (93% H_2SO_4).

The 93% by weight solution is delivered to a 4,170 gallon tank stored inside near the condensate polishing system (CPS). The 93% H_2SO_4 is also delivered to a 500 gallon tank stored inside near the SGBS.

Emissions are due to H_2SO_4 transfer to inside tanks.

The highest annual usage of 93% H_2SO_4 within the past five years for the CPS and SGBS is 4,641 gallons (Appendix C, 6-2-10 e-mail).

<u>Tank Loading</u>

The emissions from tank loading are estimated by EPA's working loss equation as shown for ethylene glycol, ethanolamine, hydrazine and sodium hydroxide.

$L_W = 0.0010\ M_V\ P_{VA}\ Q\ K_N\ K_P$

From Appendix B, Section B.1.5,

$L_W = 0.00031$ lb/yr

The highest daily emissions are assumed to be based on transferring of 1,850 gallons from delivery truck to the 4,170 gallon indoor tank in the CPS.

Scaling the annual loading loss emissions with the highest amount transferred in one day (1,850 gallons to inside tank), the working loss daily emissions are estimated to be:

0.00031 lb/yr * 1850/4641 = 0.00013 lb/day of H_2SO_4

<u>Breathing Storage Tank Losses</u>

Breathing loss emissions are calculated using the same equation shown for ETA and sodium hydroxide. The tank size is 4,170 gallons, with an assumed diameter of 7 feet and height of 14.5 feet. From Appendix B, Section B.2.4,

$L_b = 2.26E^{-02}(98)(0.000029/14.7\text{-}0.000029)^{0.68}\ 7^{1.73}\ 7.25^{0.51}\ (20)^{0.5}\ (1)\ (0.2824)\ (1)$

$= 0.036$ lb/yr

The breathing loss emissions from the second tank (500 gallons with an assumed diameter of 4 feet and height of 5.25 feet) are:

$$L_b = 2.26E^{-02}(98)(0.000029/14.7\text{-}0.000029)^{0.68}\ 4^{1.73}\ 2.625^{\ 0.51}\ (20)^{0.5}\ (1)\ (0.1542)\ (1)$$

$$= 0.0036 \text{ lb/yr}$$

Total breathing loss emissions are 0.0396 lb/yr

Total Emissions

The total estimated annual emissions rate is the sum of the tank loading and breathing losses, which is

0.0003 + 0.0396= 0.0399 lb/yr

Scaling the annual loading loss emissions with the highest amount transferred in one day and adding the daily breathing loss, the daily emissions are estimated to be:

0.00031 lb/yr x 1850/8260 + 0.0396 lb/yr/365 day/yr = 0.00018 lb/24-hr sulfuric acid

The actual annual and 24-hour sulfuric acid emissions from above are well below the *de minimis* values set in Env-A 1450.1, Table of All Regulated Toxic Air Pollutants, of 3.1 lbs/yr and 0.0084 lbs/day shown in Table 1. As a result, emissions at Seabrook Station meet compliance per Env-A 1405.01(b)(2) and no further analysis is required.

5.0 CONCLUSION

Based on the results described in Section 4.0 above and summarized in Table 1, each RTAP identified and evaluated meets the acceptance criteria described in Section 3.0. As a result, regulatory compliance is demonstrated for each RTAP evaluated.

6.0 REFERENCES

References have been divided into two lists. The first list of references contains internal sources; the second list contains public sources. Internal sources include documents such as system or functional descriptions, calculation files, and site-related plant documents. Public sources include documents such as regulatory guides and standards and documents readily available through the Internet.

6.1 Internal Sources

6.1.1 **AREVA, 2007.** AREVA Document 32-9060848-000, Seabrook Station OCDM Atmospheric Dispersion/Deposition Factors (SBC-44, Rev. 1), September 2007.

6.1.2 **AREVA, 2008**. AREVA Document 32-9098365-001, Evaluation of Onsite and Offsite Toxic Chemicals Control Room Habitability, 2008 Update (SBC-1069).

6.1.3 **AREVA, 2010**. AREVA Document 32-9144304-000, Air Dispersion Modeling to Support the Evaluation of Toxic Air Pollutants at Seabrook Station (SBC-1084), September 2010.

6.2 Public Sources

6.2.1 **NHDES 2010**. Letter, New Hampshire Depart of Environmental Services, Air Resources Division (Alan H. Mouton) to NextEra Energy Seabrook, LLC (Michael O'Keefe), RE: Inspection Report, April 2, 2010.

6.2.2 **EPA 1995**. SCREEN3 Model User's Guide, Report No. EPA-454/B-95-004, September 1995.

6.2.3 **EPA 1992**. Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Report No. EPA-454R-92-0019, October 1992.

6.2.4 **EPA, 2006**. AP-42, Fifth Edition, Vol. 1, Chapter 7, Liquid Storage Tanks.

6.2.5 **EPA, 1989**. Hazardous Waste, Treatment, Storage and Disposal Facilities (TSDF) – Air Emissions Models, Report No. EPA-450/3-87-026, April 1989.

6.2.6 **TTNAT 2010**. Technology Transfer Network Air Toxic Website, http://www.epa.gov/ttn/atw/hlthef/hydrazin.html, accessed June 30, 2010.

6.2.7 **EPA, 1999**. Risk Management Program for Offsite Consequence Analysis, Report No. EPA 550-B-99-009, April 1999.

6.2.8 **CEH 1973**. Chemical Engineers Handbook, Fifth Edition, R.H. Perry and C.H. Chilton (Eds.), McGraw-Hill, 1973.

Table 1: Summary of Evaluated RTAPs at Seabrook Station

RTAP (CAS #)	24-hour De Minimis (lb/day)	Daily Emissions (lb/day)	Below 24-hour De Minimis	Annual De Minimis (lb/yr)	Annual Emissions (lb/yr)[1]	Below Annual De Minimis	24-Hr AAL (μg/m^3)	24-Hr Site Boundary Conc. (μg/m^3)	Annual AAL (ug/m3)	Annual Site Boundary Conc. (ug/m3)
Sulfur hexafluoride (2551-62-4)	1,055	11	Yes	385,247	3,919	Yes	NA	NA	NA	NA
Ethylene Glycol (107-21-1)	6.0	0.003	Yes	2,181	1.09	Yes	NA	NA	NA	NA
Ethanolamine (ETA) (141-43-5)	0.32	<0.21	Yes	117	0.21	Yes	NA	NA	NA	NA
Hydrazine (302-01-2)	0.00055	0.000680	No	0.20	0.28	No	0.046	0.00645	0.031	0.00108
Ammonia (7664-41-7)	1.2	24.8	No	434	8949	No	100	0.363	100	0.073
Sodium Hydroxide (1310-73-2)	0.39	0.042	Yes	143	1.62	Yes	33	NA	20	NA
Sulfuric Acid (7664-93-9)	0.0084	0.00018	Yes	3.1	0.0399	Yes	0.71	NA	0.48	NA

NA-not applicable, emissions are below 24-hr and annual *de minimis* emissions

[1] All annual emissions are based on the highest chemical usage during the 2005 to 2009 period.

APPENDIX A: TRIP REPORT

TRIP REPORT

A.1 DISCUSSION

On April 27, 2010, J.H. Snooks and C.A. Fasano of AREVA NP Inc. visited NextEra Energy Seabrook Station, located in Seabrook, NH. The purpose of the visit was to gather information relating to potential regulated toxic air pollutants (RTAPs) and perform a walk around of the site.

Prior to the walk around, AREVA personnel met with Seabrook Station staff to discuss the potential RTAPs to be evaluated. Those attending the meeting included:

AREVA	Seabrook
J. Snooks	A. Legendre
C. Fasano	S. Jaster
	G. Sessler
	S. Gagnon
	C. Cronin

The following chemicals were discussed in detail, including the quantity used, the devices that use the chemicals, container size, and the processes that produce emissions of:

Hydrazine
Ammonia (a by product of hydrazine usage)
ETA (ethanolamine)
Sodium hydroxide
Gasoline[2]
Ethylene glycol
Sodium hypochlorite

Sulfur hexafluoride (SF_6) was not discussed because it had been previously evaluated by Seabrook staff. However, SF_6 will be included in the RTAP evaluation for completeness.

Following the meeting, a site walk around was conducted. The purpose was to get a better understanding of how the chemicals are used and stored and review the general container type and location of potential emission sources. See included photographs that follow in Section A.2. As a result of the walk around, sulfuric acid was added to the chemical list to be evaluated.

Following the walk around, the group discussed specific technical input information needed to complete the chemical evaluation. [The needed information was provided subsequent to the meeting. See Appendix C.]

[2] Gasoline was subsequently deleted based on follow-up communications with the NHDES (see Appendix C).

A.2 PHOTOGRAPHS

Photo #	Description	Photo #	Description
1	CPS hydrazine chemical action pump	2	E. glycol mixer
3	E. glycol leak collection example	4	E. glycol storage tank
5	Neutralization tank vent stack	6	Hydrazine 428- gal storage tank – Turbine Bldg.
7	Sodium hydroxide storage tank	8	Hydrazine mixing area
9	Hydrazine 55-gal source	10	ETA 55- gal source
11	Portable gasoline tanks	12	Sodium hypochlorite storage tank
13	Air removal system (ammonia source)	14	ETA 200-gal tote

Photo 1

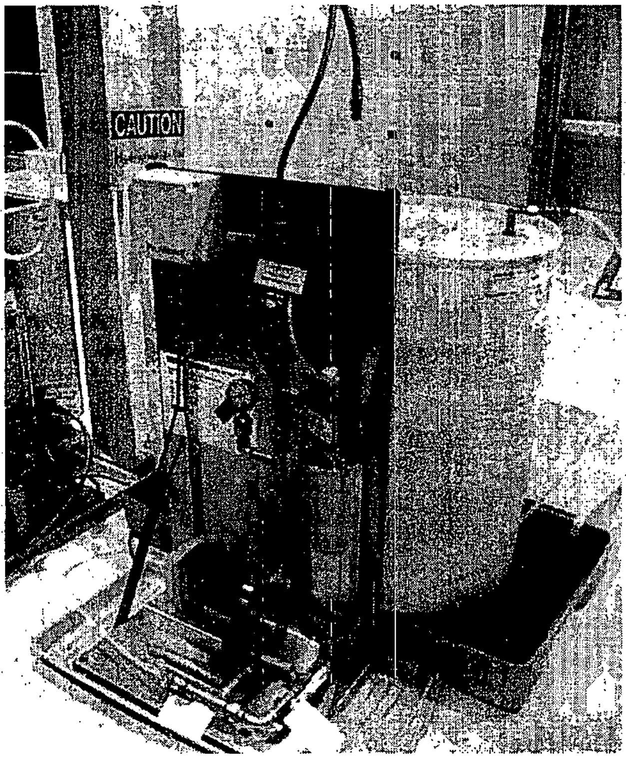


Photo 2

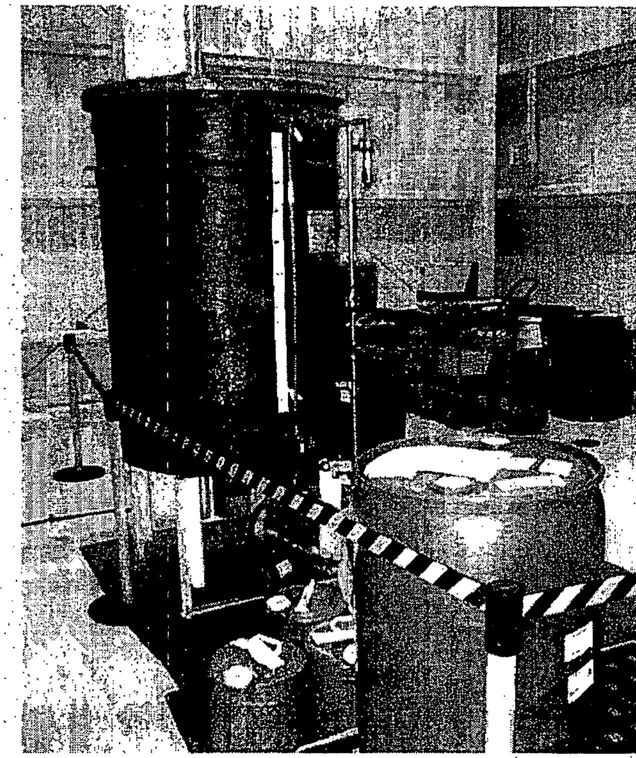


Photo 3

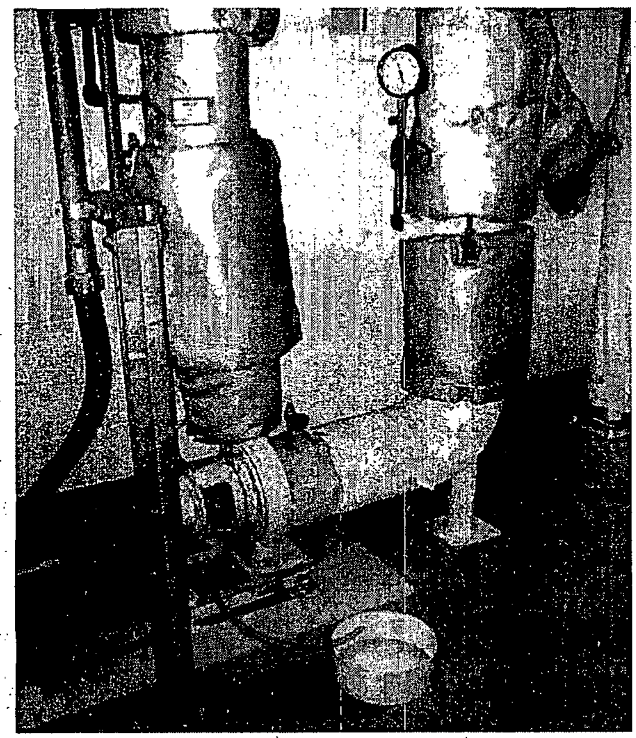
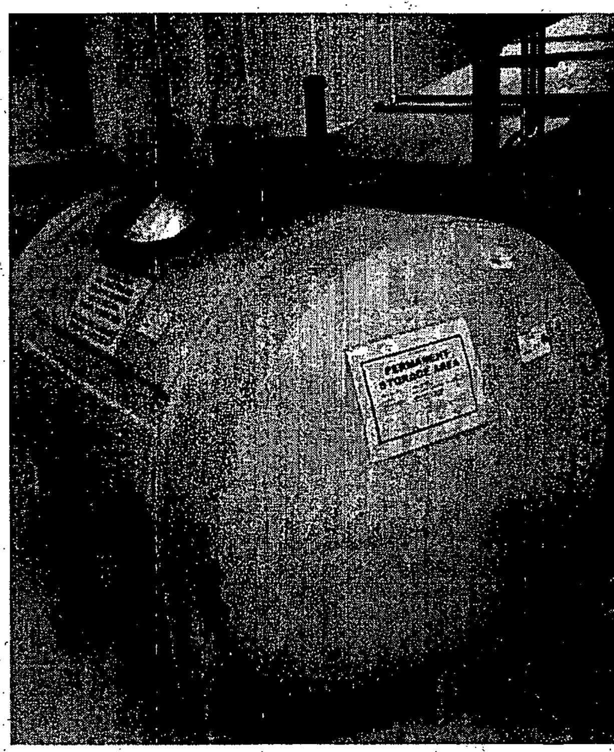


Photo 4



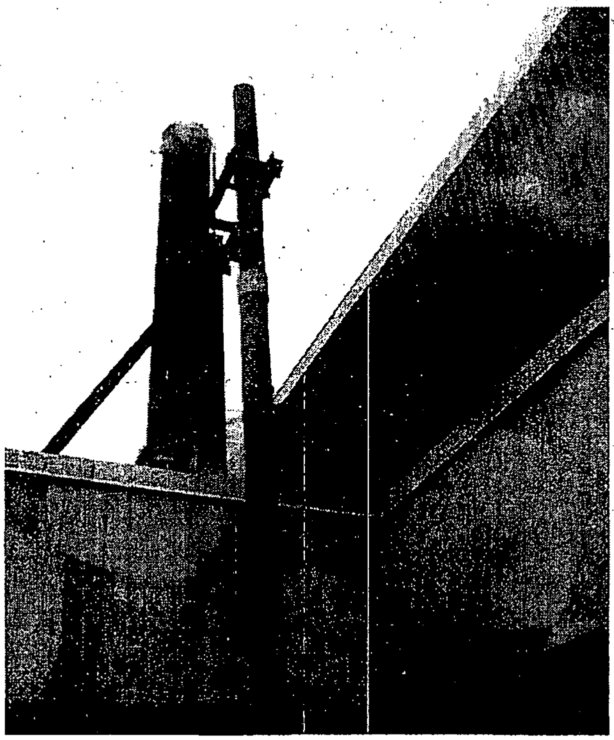


Photo 5

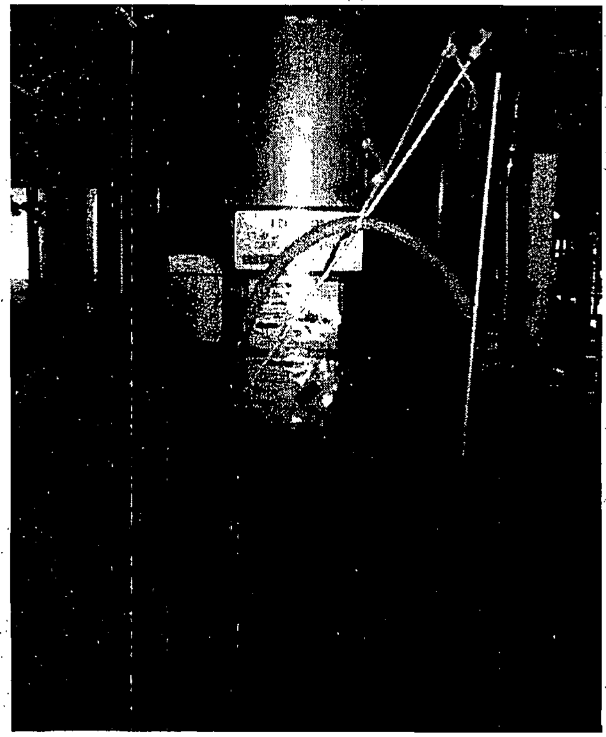


Photo 6

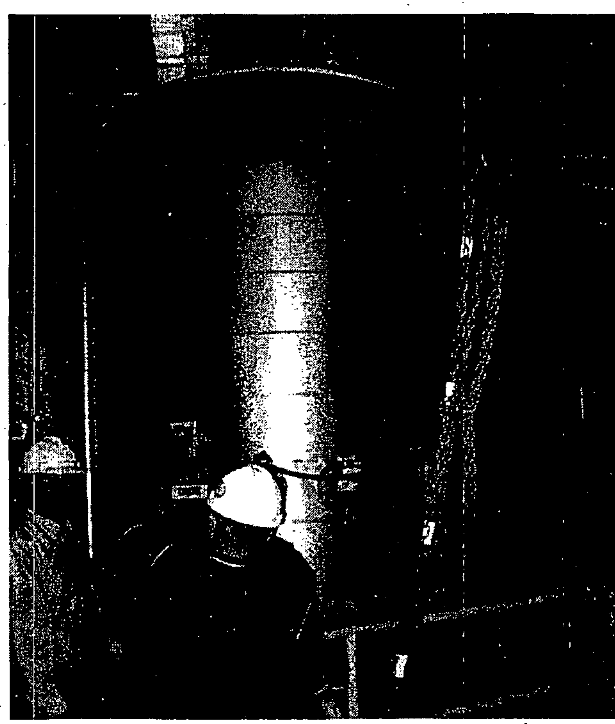


Photo 7

Photo 8

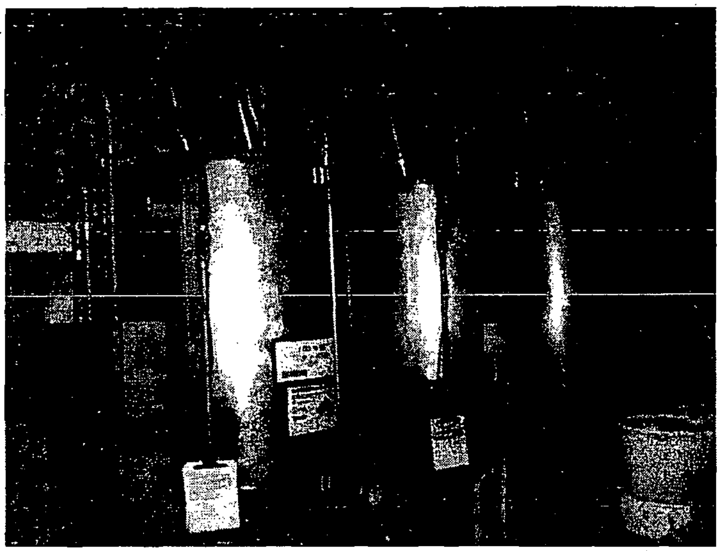


Photo 9

Photo 10

Photo 11

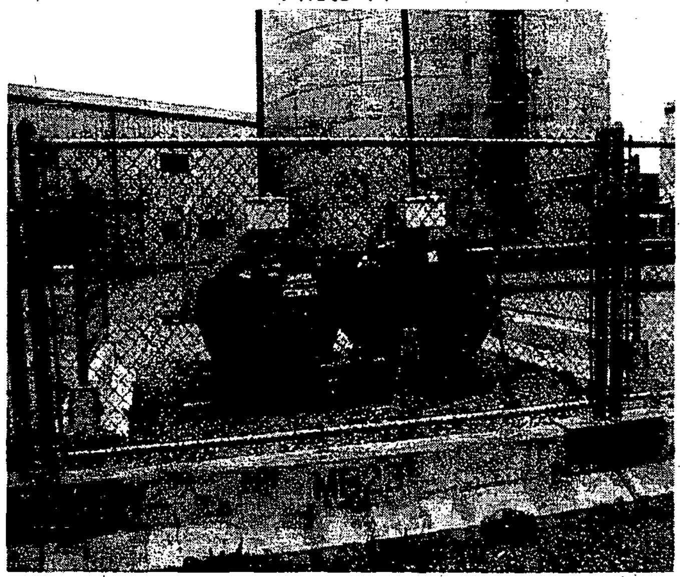


Photo 12

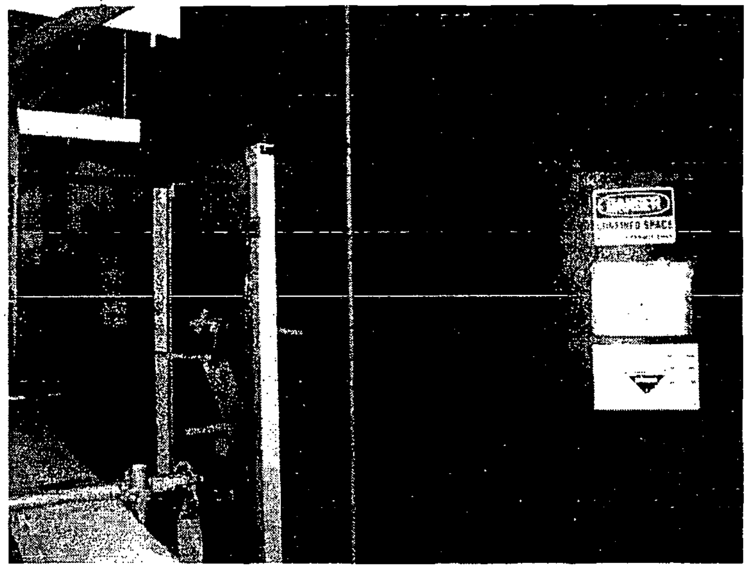


Photo 13

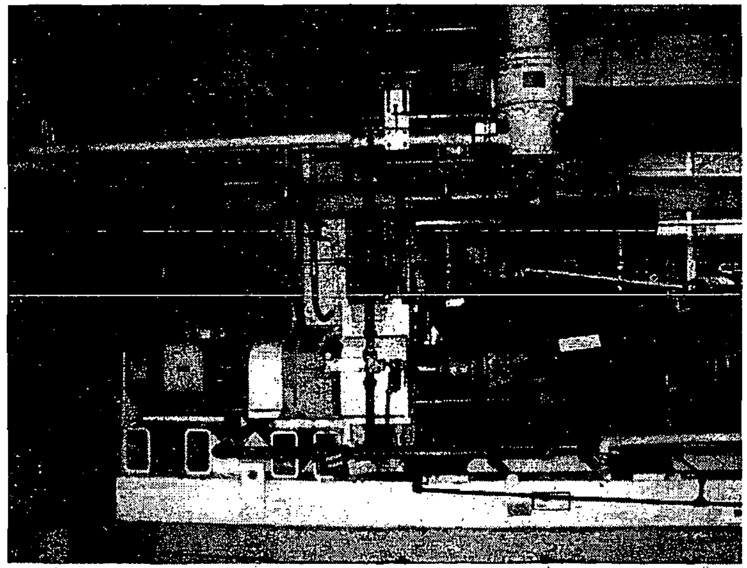
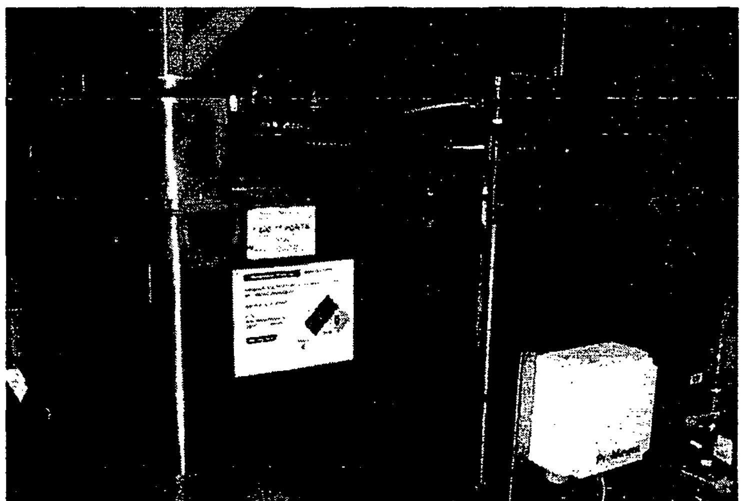


Photo 14



APPENDIX B: EMISSION RATE CALCULATIONS

EMISSION RATE CALCULATIONS

B.1 TANK LOADING

The emissions from tank loading were estimated by EPA's working loss Equation 1-29 from AP-42, Chapter 7 (Reference 6.2.4)

$L_W = 0.0010\ M_V\ P_{VA}\ Q\ K_N\ K_P$

where:

Q = annual net throughput, bbl/yr
M_V = vapor molecular weight, lb/lb-mole
P_{VA} = vapor pressure at daily average liquid surface temperature, psia
K_N = working loss turnover (saturation) factor, dimensionless
K_P = working loss product factor, dimensionless

B.1.1 Ethylene Glycol (EG)

For EG,

M_V = vapor molecular weight, lb/lb-mole, M_V is 62 lb/lb-mole for EG (Appendix D of Reference. 6.2.5,)

P_{VA} = vapor pressure at daily average liquid surface temperature, psia, P_{VA} = 0.023 psia from Appendix D, MSDS for EG (1.2 mm Hg)

K_N = working loss turnover (saturation) factor, dimensionless; for turnovers >36, $K_N = (180 + N)/6N$, for turnovers ≤36, $K_N = 1$

K_P = working loss product factor, dimensionless for crude oils $K_P = 0.75$; for all other organic liquids, conservatively assume $K_P = 1$

Q = (1450 gal/yr) / (42 gal/bbl) = 34.5 bbl/yr

$K_N = 1$, since turnovers < 36, (turnovers = 1450 gallons/yr/275 gallons = 5.3/yr)

$L_W = 0.0010\ M_V\ P_{VA}\ Q\ K_N\ K_P$

$= (0.0010)\ (62)\ (0.023)(34.5)(1)(1) = 0.05$ lb/yr

The working loss emissions is multiplied by a factor of 2 to account for the transfer of EG to the mixing tank and the transfer of the EG mixture to the equipment. The total emissions from equipment loading is estimated to be

$L_W = 0.05*2 = 0.1$ lb/yr.

B.1.2 Ethanolamine (ETA)

For ETA,

M_V = 61.1 lb/lb-mole (Appendix D of Reference 6.2.5)
P_{VA} = 0.0078 psia (from Appendix D, Pretech 7000 MSDS at 0.4 mm Hg).
K_P = for crude oils K_P = 0.75 for all other organic liquids, K_P = 1
Q = (1170 gal/yr) / (42 gal/bbl) = 27.9 bbl/yr (based on Appendix C, Secondary Plant Usage, 2005 usage)
K_N = 1, since turnovers < 36, (turnovers = (1170) gallons/yr/428 gallons =3 /yr)

$L_W = 0.0010\ M_V\ P_{VA}\ Q\ K_N\ K_P$

$= (0.0010)\ (61.1)\ (0.0078)(27.9)(1)(1) = 0.01330$ lb/yr

B.1.3 Hydrazine

For hydrazine,

K_N = for turnovers >36, K_N = (180 + N)/6N, for turnovers ≤36, K_N = 1
K_P = for crude oils K_P = 0.75 for all other organic and inorganic liquids, K_P = 1
M_V = 22.9 lb/lb-mole (for 35% hydrazine in water solution)
P_{VA} = 0.0648 psia (from calculation below)

The vapor pressure for pure hydrazine at 25°C is 14.4 mm Hg (Reference 6.2.6, Technology Transfer Network Air Toxic Website).

From Reference 6.2.7, Chapter 3, Section 3.2.4, and Appendix B, Section B.2, "Mixtures Containing Toxic Liquids," the partial vapor pressure of the solution can be estimated as:

$VP_m = X_r \times VP_p$

where

VP_m	=	Partial vapor pressure of the substance in a mixture (mm Hg)
X_r	=	Mole fraction of the substance
VP_p	=	Vapor pressure of the substance in pure form (mm Hg)

If the weight of each component of the mixture is known, the mole fraction of the substance (hydrazine, ethylene glycol, or hydrogen peroxide) in the mixture may be calculated by:

$$X_r = \frac{\left(\dfrac{W_r}{MW_r}\right)}{\left(\dfrac{W_r}{MW_r}\right) + \left(\dfrac{W_2}{MW_2}\right)}$$

where

X_r	=	Mole fraction of the substance (hydrazine)
W_r	=	Weight of the substance (hydrazine)
MW_r	=	Molecular weight of the substance (hydrazine)
W_2	=	Weight of the second substance (water)
MW_2	=	Molecular weight of the second substance (water)

Based on 100 lbs of a 35% hydrazine solution, using the molecular weight of 32 for hydrazine and 18 for water and substituting, the mole fraction is 0.232 and the partial pressure of the hydrazine in solution is

VP_m = 0.232 x 14.4 = 3.35 mm Hg or 0.0648 psia

Q = (3520 gal/yr for both steam and CPS systems)/ (42 gal/bbl) = 83.8 bbl/yr

K_N = 1, since turnovers < 36, (turnovers = (3520) gallons/yr/428 gallons = 8.2 turnovers/yr)

$L_W = 0.0010\ M_V\, P_{VA}\ Q\ K_N\ K_P$

= (0.0010)(22.9) (0.0648) (83.8) (1)(1) = 0.12 lb/yr

B.1.4 Sodium Hydroxide (NaOH)

For NaOH,

M_V = 29 lb/lb-mole (50% NaOH)
P_{VA} = 0.029 psia (from Appendix D, Dow Chemical MSDS at 1.5 mm Hg)
Q = 8260 gal/yr)/ (42 gal/bbl) = 208.6 bbl/yr (annual net throughput, bbl/yr based on 2009 usage from Appendix C, 6-2-10 e-mail)
K_P = for crude oils K_P = 0.75, for all other organic and inorganic liquids, K_P = 1
K_N = 1, since turnovers < 36, (turnovers = (8260) gallons/yr/1850 gallons = 3.9/yr)

L_W = (0.0010)(29) (0.029)(208.6)(1)(1) = 0.17 lb/yr

B.1.5 Sulfuric Acid (H_2SO_4)

For H_2SO_4,

M_V = 98 lb/lb-mole
P_{VA} = 0.000029 psia (converted to psia from Appendix D, Chemical Engineers Handbook, Reference 6.2.8, for sulfuric acid at 0.0015 mm Hg)
Q = 4641 gal/yr)/ (42 gal/bbl) = 110.5 bbl/yr (annual net throughput, bbl/yr based on 2005 usage from Appendix C, 6-2-10 e-mail)
K_P = for crude oils K_P = 0.75; for all other organic and inorganic liquids, conservatively assume K_P = 1
K_N = 1, since turnovers < 36, (turnovers = (4641) gallons/yr/1850 gallons = 2.5/yr)

L_W = (0.0010)(98) (0.000029)(208.6)(1)(1) = 0.00031 lb/yr

B.2 TANK BREATHING LOSS

The Breathing Loss Equation is from Reference 6.2.5, Equation 7-5,

$$L_b = 2.26E^{-02} M_V (P_{VA}/P_A - P_{VA})^{0.68}\ D^{1.73}\ H^{0.51}\ \Delta\ T^{0.5}\ F_p\ C\ K_c$$

where,

L_b = breathing storage loss, lb/yr

M_V = vapor molecular weight, lb/lb-mole
P_{VA} = vapor pressure at daily average liquid surface temperature, psia
P_A = average atmospheric pressure at tank location, psia
D = tank diameter (ft)
H = average vapor space height, ft
ΔT = average ambient diurnal temperature change, F
F_p = paint factor, assume 1 since tanks located indoors
C = adjustment factor for small diameter tanks, dimensionless
K_c = product factor, dimensionless

B.2.1 Ethanolamine (ETA)

For ETA,

M_V = 61.1 lb/lb-mole (Appendix D of Reference 6.2.5.)
P_{VA} = 0.0078 psia (from Section B.1.2 above)
D = 4 ft
H = 2.5 (assumed to be 1/2 of tank height)
ΔT = 20 F assumed as a typical value
F_p = assume 1 since tanks located indoors
C = for D > 30 ft, C = 1; for D < 30 ft, C = $0.0771D-0.0013D^2-0.1334$. For D=4 ft, C= 0.1542)
K_c = for crude oil K_c= 0.65, for all other organic liquids, K_c = 1

$L_b = 2.26E^{-02}(61.1)(0.0078/14.7-0.0078)^{0.68}\ 4^{1.73}\ 2.5^{\ 0.51}\ (20)^{0.5}\ (1)\ (0.1542)\ (1)$

= 0.099 lb/yr

For two tanks, the breathing loss would be

L_b = 0.198 lb/yr.

B.2.2 Hydrazine

For hydrazine,

M_V = 22.9 lb/lb-mole (for 35% hydrazine in water solution)
P_{VA} = 0.0648 psia (from Section B.1.3 above)
D = 4 ft
H = 2.5 (assumed to be 1/2 of tank height)
ΔT = 20 F assumed as a typical value
F_p = assume 1 since tanks located indoors
C = for D > 30 ft, C = 1; for D < 30 ft, C = $0.0771D-0.0013D^2-0.1334$. For D=4 ft, C= 0.1542)
K_c = for crude oil K_c= 0.65, for all other organic liquids, assumed K_c = 1 since data for inorganics is unavailable.

$L_b = 2.26E^{-02}(22.9)(0.0648/14.7-0.0648)^{0.68}\ 4^{1.73}\ 2.5^{\ 0.51}\ (20)^{0.5}\ (1)\ (0.1542)\ (1)$

= 0.157 lb/yr

B.2.3 Sodium Hydroxide (NaOH)

For, NaOH (50% solution)

M_V = 29 lb/lb-mole
P_{VA} = 0.029 psia (converted from Appendix D, MSDS for sodium hydroxide at 1.5 mm Hg)
D = 7 ft
H = 7.25 (assumed to be 1/2 of tank height of 14.5 ft)
Δ T = 20 F assumed as a typical value
F_p = assume 1 since tanks located indoors
C = for D < 30 ft, C = $0.0771D-0.0013D^2-0.1334$. For D=7 ft, C= 0.3426
K_c = for crude oil K_c= 0.65, for all other organic liquids, K_c = 1 (conservative value used with no other data available for inorganic compounds)

$L_b = 2.26E^{-02}(29)(0.029/14.7-0.029)^{0.68}\ 7^{1.73}\ 7.25^{\ 0.51}\ (20)^{0.5}\ (1)\ (0.3426)\ (1)$

=1.16 lb/yr for 4,170-gallon tank

For 1,000-gallon tank:

$L_b = 2.26E^{-02}(29)(0.029/14.7-0.029)^{0.68}\ 5^{1.73}\ 3.5^{\ 0.51}\ (20)^{0.5}\ (1)\ (0.3426)\ (1)$

=0.29 lb/yr for 1,000 gallon tank

Total breathing loss = 1.45 lb/yr

B.2.4 Sulfuric Acid (H_2SO_4)

For H_2SO_4,

M_V = 98 lb/lb-mole P_{VA} = 0.000029 psia (from Section B.1.5 above)
D = 7 ft
H =7.25 (assumed to be 1/2 of tank height of 14.5 ft)
Δ T = 20 F assumed as a typical value
F_p = assume 1 since tanks located indoors
C = for D < 30 ft, C = $0.0771D-0.0013D^2-0.1334$. For D=7 ft, C= 0.3426
K_c = for crude oil K_c= 0.65, for all other organic liquids, K_c = 1

$L_b = 2.26E^{-02}(98)(0.000029/14.7-0.000029)^{0.68}\ 7^{1.73}\ 7.25^{\ 0.51}\ (20)^{0.5}\ (1)\ (0.3426)\ (1)$

= 0.036 lb/yr

The breathing loss emissions from the second tank (500 gallons with an assumed diameter of 4 ft and height of 5.25 ft) are:

$L_b = 2.26E^{-02}(98)(0.000029/14.7-0.000029)^{0.68}\ 4^{1.73}\ 2.625^{\ 0.51}\ (20)^{0.5}\ (1)\ (0.1542)\ (1)$

= 0.0036 lb/yr

Total breathing loss = 0.0396 lb/yr

B.3 EVAPORATION LOSS

The emissions from evaporation were based on EPA's Hazardous Waste, Treatment, Storage and Disposal Facilities (TSDF) – Air Emissions Models, Chapter 4 (Reference 6.2.5). From Equation 4-1,

$E_C = KAC_L$

where

E = air emissions from liquid surface, g/s
K = overall mass transfer coefficient, m/s
A = liquid surface area, m^2
C_L = concentration of constituent in the liquid phase, g/m^3

The overall mass transfer coefficient is calculated as follows:

$1/K = 1/k_L + 1/(k_G K_{eq})$ (Eq. 4-2)

Where k_L = liquid-phase mass transfer coefficient, m/s

k_G = gas-phase mass transfer coefficient, m/s

K_{eq} = equilibrium constant

$K_{eq} = H/RT$ (Eq. 4-3)

Where H = Henry's Law constant, atm m^3/g mol

R = universal gas constant 8.21E-05 atm m^3/g mol K

T = temperature, K

For standard temperature of 25C, K_{eq} becomes 40.9 * H (Reference 6.2.5, Eq. 4-4)

For low wind speeds above open source

$k_L = 2.78E\text{-}6\ (D_w/D_{ether})^{2/3}$ (Reference 6.2.5, Table 4-1)

$k_G = 4.82E\text{-}3\ U^{0.78}\ Sc_G^{-0.67} d_e^{-0.11}$ (Reference 6.2.5, Table 4-1)

where U = wind speed at 10 m above the liquid surface, m/s (assumed 3 m/s)

Sc_G = Schmidt number on gas side = $\mu_G/\rho_G D_a$ (Reference 6.2.5, Table 4-1)

Where μ_G = viscosity of air, g/cm s or 1.81E-4 g/cm s (Reference 6.2.5, Table 4-2)

ρ_G = density of air, g/cm^3 or 1.2 E-3 g/cm^3 (Reference 6.2.5, Table 4-2)

D_a = diffusivity of constituent in air, cm^2/s or 1.08E-01 cm^2/s (Appendix D of Reference 6.2.5,)

d_e = effective diameter of impoundment, m

Using the following values, the above equations are performed:

$A = \pi D^2/4 = \pi (0.3048m)^2/4 = 0.073m^2$

C_L = (45gEG/100g water) (1g water/ cm^3) (1000 cm^3/m^3) = 450 g/m^3

Diffusivity of EG in water: 1.22E-05 cm^2/s (Appendix D of Reference 6.2.5,)

Diffusivity of ether in water: 8.5E-06 cm^2/s (Reference 6.2.5, Table 4-2)

$k_L = 2.78E\text{-}6\ (1.22E\text{-}05\ cm^2/s\ /8.5E\text{-}06\ cm^2/s)^{2/3} = 3.54E\text{-}06\ m/s$

$U^{0.78} = (3\ m/s)^{0.78} = 2.36\ m/s$

Diffusivity in air: 1.08E-01 (Appendix D of Reference 6.2.5,)

$Sc_G = 1.81E\text{-}4\ g/cm\ s\ /\ (1.2\ E\text{-}3\ g/cm^3)\ (1.08E\text{-}01\ cm^2/s) = 1.40$

$k_G = 4.82E\text{-}3\ (2.36)\ 1.40^{-0.67} 0.3048^{-0.11} = 0.01035$

Henry's Law Constant: 1.03E-07 atm m^3/g mol

$K_{eq} = 40.9 * 1.03E\text{-}07 = 4.21E\text{-}06$

$1/K = 1/k_L + 1/(k_G K_{eq}) = 1/3.54E\text{-}06 + 1/(0.01035 * 4.21E\text{-}06)$

$K = 4.3E\text{-}08$

$E = KAC_L$

$= (4.3E\text{-}08\ m/s)\ (0.073m^2)\ (450\ g/m^3)$

$= 1.41E\text{-}6\ g/s$

B.4 AIR DISPERISON MODELING

The air dispersion modeling to evaluate the RTAP emissions from normal plant operation was performed in a separate calculation (Reference 6.1.3), using SCREEN3 (Reference 6.2.2). A ground-level release was modeled for hydrazine emissions and an elevated (stack) release for ammonia emissions. Results were estimated for each emission source at three receptor locations: the EAB, the Science and Nature Center (S&NC), and the Fitness Center. Both the S&NC and the Fitness Center are located inside the EAB.

From Reference 6.1.3, Table 6-1, the 1-hour maximum concentration of hydrazine and ammonia at each receptor location is

Receptor Location	1-hour Concentration (μg/m³)	
	Hydrazine	Ammonia
EAB	0.4952E-02	0.7313
S&NC	0.1075E-01	0.8483
Fitness Center	0.8139E-02	0.9086

To obtain the estimated 24-hour and annual averaging time concentrations, the ratio between a 1-hour maximum concentration and a longer term concentration was taken from the U.S. EPA (Reference 6.2.3, Section 4.1, Procedure (c), Step 5). The ratios (multiplying factors) presented by EPA are based on general experience from elevated sources. Therefore, EPA has given some flexibility to adjust the multiplying factors to represent more closely any particular point source application. For example, if the emission height is very low, it may be necessary to increase the factors. If, on the other hand, the stack is relatively tall, it may be necessary to decrease the factors. Because hydrazine is a ground release at the Turbine Building, but ammonia is considered to meet EPA's general experience for elevated stack releases at the Containment Build stack, the factors were adjusted as follows:

Averaging Time	Initial Multiplying Factor (EPA recommended limits)	Adjustment*		Final Multiplying Factor	
		Hydrazine (Ground)	Ammonia (Stack)	Hydrazine (Ground)	Ammonia (Stack)
24-hour	0.4 (±0.2)	+0.2	0.0	0.6	0.4
Annual	0.08 (±0.02)	+0.02	0.0	0.1	0.08

The maximum 24- hour and annual concentrations for hydrazine and ammonia at the three receptor locations, therefore, are

Averaging Time	Hydrazine (Ground Release)		
	Receptor Locations		
	EAB	S&NC*	Fitness
24-hour			
Initial Conc. (μg/m^3)	0.4952E-02	0.1075E-01	0.8139E-02
Adjustment	0.6	0.6	0.6
Final Conc. (μg/m^3)	**0.2971E-02**	**0.6450E-02**	**0.4883E-02**
Annual			
Initial Conc. (μg/m^3)	0.4952E-02	0.1075E-01	0.8139E-02
Adjustment	0.1	0.1	0.1
Final Conc. (μg/m^3)	**0.4952E-03**	**0.1075E-02**	**0.8139E-03**

* Maximum concentration among receptors.

Averaging Time	Ammonia (Stack Release)		
	Receptor Locations		
	EAB	S&NC	Fitness*
24-hour			
Initial Conc. (μg/m^3)	0.7313	0.8483	0.9086
Adjustment	0.4	0.4	0.4
Final Conc. (μg/m^3)	**0.2925**	**0.3393**	**0.3634**
Annual			
Initial Conc. (μg/m^3)	0.7313	0.8483	0.9086
Adjustment	0.08	0.08	0.08
Final Conc. (μg/m^3)	**0.5850E-01**	**0.6786E-01**	**0.7269E-01**

* Maximum concentration among receptors.

APPENDIX C: CUSTOMER SUPPLIED INFORMATION

NEXTera ENERGY SEABROOK

MEMORANDUM

LIC-10035

SUBJECT: Transmittal of Data for Evaluation of Toxic Air Pollutants at Seabrook Station

FROM: Allen Legendre
NextEra Energy Seabrook, LLC

DATE: August 11, 2010

TO: John Snooks,
Areva NP Inc.

cc: S. Jaster
M. O'Keefe

The enclosed data and information below are transmitted for Areva's use in support of the Evaluation of Toxic Air Pollutants at Seabrook Station being performed by Areva NP Inc. per Contract 02201909 Amendment 4 Release 00052 Amendment 001 - Seabrook Emergent Work.

Please note the following:

The enclosed unsigned letter dated March 31, 2009 to the Environmental Protection Agency provides our best estimate of year 2008 sulfur hexafluoride releases from the Seabrook Station 345kV electrical switchyard. A signed copy of the letter, if located, will be provided to Areva NP.

In support of the evaluation, discussions were held with NH Department of Environmental Services Air Resources Division personnel Rick Rumba and Pat North. The following clarifications and guidance were provided by the NH DES representatives: (1) VOC emissions from the Seabrook Station gasoline dispensing facility are exempted from air toxic evaluation, (2) ammonia, a byproduct of hydrazine usage for plant water chemistry control, emissions are to be considered in the air toxic evaluation, (3) sodium hypochlorite, utilized for cooling water system biofouling control, is not listed as a NH air toxic chemical and air emissions of such associated with filling storage tanks or tank ventilation need not be considered in the air toxic evaluation and (4) sodium hydroxide, a minor ingredient in sodium hypochlorite to establish desired pH, emissions are to be considered in the air toxic evaluation.

Allen Legendre
Principal Engineer
NextEra Energy Seabrook, LLC

From: Jaster, Samuel
To: SNOOKS John H (AREVA NP INC);
cc: FASANO Cynthia A (AREVA NP INC); Legendre, Al; Robinson, David;
Subject: RE: Data Needs List
Date: Wednesday, June 02, 2010 1:43:12 PM
Attachments: CP0303.doc
Secondary Plant Chemical Usage.doc

John,

See attached file for description of secondary plant chemical usage. Annual throughput for ETA and hydrazine are located there.

The following lists chemical usage for last five years. Usage was determined by review the amount of chemicals received for each year. Since the systems are continuous use, it should give a good approximation of the amount of chemicals used. Note: CID# = Catalog Identification Number.

93% Sulfuric Acid (CID# 83032):
2009 2,731 gallons (1,238 gal. at SGBD, 1,493 gal. at CPS)
2008 3,056 gallons (1,274 gal. at SGBD, 1,782 gal. at CPS)
2007 2,812 gallons (1,510 gal. at SGBD, 1,302 gal. at CPS)
2006 3,126 gallons (1,240 gal. at SGBD, 1,886 gal. at CPS)
2005 4,641 gallons (1,200 gal. at SGBD, 3,441 gal. at CPS - initial tank fill)

50% Sodium Hydroxide (CID# 83031):
2009 8,260 gallons (2,567 gal. at SGBD, 5,693 gal. at CPS)
2008 5,348 gallons (1,683 gal. at SGBD, 3,665 gal. at CPS)
2007 3,879 gallons (2,703 gal. at SGBD, 1,176 gal. at CPS)
2006 4,429 gallons (1,044 gal. at SGBD, 3,385 gal. at CPS)
2005 7,711 gallons (2,142 gal. at SGBD, 5,569 gal. at CPS - initial tank fill)

Ethylene Glycol - Norkool (CID# 1716 - for Building Heating/Cooling System and Emergency Diesels)
2009 14 drums 100% concentrate (770 gallons)
2008 4 drums 100% concentrate (220 gallons)
2007 2 drums 100% concentrate (110 gallons)
2006 7 drums 100% concentrate (385 gallons)
2005 24 drums 100% concentrate (1,320 gallons) Note: 21 drums used for drain and refill of PAB/FSB Heating System.

Fleetguard ES COMPLEAT EG PREMIX (40 - 60% Ethylene glycol / 0 - 5% Diethylene glycol) (CID# 436156, 5-gallon drum - for Fire Pump and SEPS Diesels only):
2009 25 gallons
2008 55 gallons
2007 40 gallons
2006 25 gallons
2005 130 gallons (SEPS Diesels placed in service)

Fleetguard ES COMPLEAT EG PREMIX (40 - 60% Ethylene glycol / 0 - 5% Diethylene glycol) (CID# 439593, 55-gallon drum - for Fire Pump and SEPS Diesels only):
2009 0 gallons
2008 0 gallons
2007 0 gallons
2006 660 gallons (both SEPS Diesel Cooling systems drained and refilled).
2005 0 gallons

Fleetguard ES COMPLEAT EG PREMIX (40 - 60% Ethylene glycol / 0 - 5% Diethylene glycol) (CID# 438799, 1-gallon container - for Fire Pump and SEPS Diesels only):
2005 - 2009 None used. Use started in 2010.

Ethylene Glycol Recycled:

YEAR	GALLONS
2004	987
2005	898
2006	680
2007	747
2008	0
2009	1000

After giving it some thought, I don't know if we can correlate the amount of ethylene concentrate received each year and the amount recycled since Norkool is 100% in the drum and is diluted with demineralized water to match the concentration of the system it goes into. I have also attached a copy of SSCP3.3, "Miscellaneous Systems / Closed Cooling Water Systems Chemistry Control Program". It list the various glycol systems on site and the action level values for each system. Refer to CP 3.3 Figures 5.1 and 5.2

Please review the information above and update the Data Needs List. Also, let me know if you have any questions or required additional information for what I have sent today.

Thank You,

Sam Jaster
Chemistry
Nextera Energy Seabrook
603-773-7445
samuel.jaster@nexteraenergy.com

From: SNOOKS John H (AREVA NP INC) [mailto:John.Snooks@areva.com]
Sent: Tuesday, June 01, 2010 3:04 PM
To: Legendre, Al
Cc: FASANO Cynthia A (AREVA NP INC); Jaster, Samuel
Subject: Data Needs List

Al:

Here is an update to the data needs list for the air toxics evaluation.

Other than Sam's write up, we still need annual throughputs for ETA, hydrazine, ethylene glycol, sulfuric acid and 50% sodium hydroxide.

Thanks,

J.H. Snooks
Senior Environmental Consultant
AREVA NP Inc.
An AREVA and Siemens Company
400 Donald Lynch Blvd.
Marlborough, MA 01752
Work: 508.573.6577
Fax: 508.573.6614
e-mail: john.snooks@areva.com

Secondary Plant Chemical Usage

Hydrazine, Ethanolamine, and Methoxypropylamine are added to the secondary plant for oxygen scavenging and pH control. Chemicals are injected into the condensate pump discharge header from CAS-SKD-90.

Hydrazine is an oxygen scavenger that is used to maintain a reducing environment in the steam generators. There are three competing mechanisms for hydrazine in the secondary plant.

1. Oxygen Scavenging: $N_2H_4 + O_2 \rightarrow N_2 + 2H_2O$
2. Iron Reduction: $N_2H_4 + 6Fe_2O_3 \rightarrow 4Fe_3O_4 + N_2 + 2H_2O$
3. Thermal Decomposition: $3\ N_2H_4 \rightarrow 4NH_3 + N_2$

EPRI PWR Secondary Water Chemistry Guidelines requires feedwater hydrazine to be ≥ 8 times condensate oxygen. Seabrook targets 80 ppb hydrazine in final feedwater to allow up to 10 ppb oxygen in condensate without going below the minimum required feedwater hydrazine concentration.

Hydrazine injection is a one-way trip in the secondary plant. Any remaining hydrazine undergoes thermal decomposition inside the steam generator. There is no measureable hydrazine carried over into the Main Steam system.

Ammonia and nitrogen are formed from the thermal decomposition of hydrazine. Ammonia carries over in Main Steam and returns to the main condenser. Typical feedwater ammonia concentration is approximately 1.0 ppm. The remainder of ammonia is removed from the main condenser via the air removal pumps, used to maintain condenser vacuum.

The exhaust of the air removal pumps is typically 20 – 30 SCFM and is directed into the PAB ventilation. Ultimately it is diluted by plant ventilation systems and is discharged out the plant stack. Plant vent flow rate averages 2.8E+05 SCFM.

Hydrazine is purchased as a 35% solution in 55-gallon drums. It is diluted in a ratio of 8 gallons of 35% hydrazine to 32 gallons of demineralized water. The hydrazine tank contains a maximum 428 gallons of an approx. 70,000 ppm hydrazine solution. The injection rate is 2.0 – 2.5 gallons/hour.

Amine Distribution:

Methoxypropylamine (MPA) is similar to ammonia in its distribution in the secondary plant. With a target feedwater concentration of 5.0 ppm, the exception of the steam generators at a concentration of 4.0 ppm, the MPA in condensate, main steam, and heater drains is typically ± 0.2 ppm of the target feedwater concentration.

MPA is supplied at a 40% concentration in 55-gallon drums. It is diluted in a ratio of 4 gallons of 40% MPA to 44 gallons of demineralized water. The MPA tank contains a maximum 428 gallons of an approximate 33,000 ppm MPA solution. The injection rate is approx. 1.0 gallon/hour.

Ethanolamine (ETA) seeks out wetted systems, dropping out with the turbine moisture drains. With a target feedwater concentration of 1.0 ppm, the typical ETA concentration is: 2.5 ppm in the steam generators, 1.8 ppm in heater drains, and 0.5 ppm in condensate.

ETA is supplied at a 40% concentration in 55-gallon drums. It is diluted in a ratio of 4 gallons of 40% ETA to 60 gallons of demineralized water. The ETA tank contains a maximum 428 gallons of an approximate 25,000 ppm ETA solution. The injection rate is approx. 1.0 gallon/hour.

Chemical 5-Year Usage.

The following lists the number of 55 gallon drums of hydrazine, ETA, and MPA used per year.

Hydrazine:
2009 63 drums
2008 40 drums
2007 64 drums
2006 54 drums
2005 61 drums

ETA:
2009 11 drums
2008 10 drums
2007 13 drums
2006 12 drums
2005 14 drums

MPA
2009 16 drums
2008 14 drums
2007 18 drums
2006 15 drums
2005 16 drums

Condensate Polisher System (CPS):
The CPS system is a standby condensate polisher that is currently used for condensate / feedwater system clean-up during plant startup after refueling outages. The CPS chemical addition equipment injects concentrated hydrazine, ETA, and MPA into the outlet of the mixed

bed polishers for CPS piping corrosion control and to replace the secondary addition chemicals removed from the condensate system when the CPS system is in operation (CPS system flow rate = 7,500 gpm, with two 212 ft^3 cation beds which remove addition chemicals prior to CPS flow through three 150 ft^3 mixed bed demineralizers).
Hydrazine is injected at a 35% concentration directly from a 55-gallon drum. The CPS usage is already accounted for in the hydrazine drums totals listed above.

ETA and MPA are stored in 400 gallon base totes. CPS ETA and MPA base totes are refilled from a 200-gallon tote, gravity drained via transfer hose connected between the 200 gallon transfer tote and 400 gallon base tote. Transfer hose is disconnected after transfer is complete.

CPS ETA Usage:
2005 400 gallons (initial fill of ETA base tote)
2006 200 gallons
2008 200 gallons
2009 200 gallons

CPS MPA Usage:
2005 400 gallons (initial fill of MPA base tote)
2006 1400 gallons
2008 1200 gallons
2009 1400 gallons

Cycle Average Chemistry:

The following operating cycle average data is provided to the Engineering Department for Flow Accelerated Corrosion (FAC) calculations.

	Condensate Oxygen (ppb)	FW HTR 22 Hydrazine (ppb)	Feedwater Hydrazine (ppb)	Feedwater MPA (ppb)	Feedwater ETA (ppb)	Feedwater Ammonia (ppb)
Cycle 11 5/04/05 – 10/01/06	3.33	113	80	5013	1024	908
Cycle 12 11/10/06 – 4/01/08	4.54	130	85	4964	1000	942
Cycle 13 5/08/08 – 10/01/09	4.5	117	82	4988	1005	1007

From: Legendre, Al
To: SNOOKS John H (AREVA NP INC); FASANO Cynthia A (AREVA NP INC);
cc: Jaster, Samuel; Sessler, Gregg; GAGNON, SABRE; OKeefe, Michael;
Subject: Annual Capacity Factors
Date: Wednesday, April 28, 2010 8:04:13 AM

Annual Capacity Factors for annual NH Air Toxics emissions estimates:

2009 80.97% (Refueling 13, Oct 2009)

2008 85.64% (Refueling 12, April 2008)

2007 98.86% (No Refuel)

2006 87.6% (Refueling 11, Oct 2006)

2005 90.1% (Refueling 10, April 2005)

Source: 1 STATUS/Capacity (P drive plant data)

Al Legendre
Principal Engineer
NextEra Energy Seabrook, LLC
603 773-7773

From: Legendre, Al
To: SNOOKS John H (AREVA NP INC); FASANO Cynthia A (AREVA NP INC);
cc: Jaster, Samuel; GAGNON, SABRE; Sessler, Gregg;
Subject: Recycled Glycol Amounts
Date: Wednesday, April 28, 2010 8:22:17 AM

This is the amount of liquid glycol collected and sent for recycle.

YEAR	GALLONS
2004	987
2005	898
2006	680
2007	747
2008	0
2009	1000

In addition, there is approximately 1000 gallons in the waste glycol storage tank that will be sent in the next week or so.

Source: Data from Fred Haniffy, Radiological Protection Dept, Waste Services

Al Legendre
Principal Engineer
NextEra Energy Seabrook, LLC
603 773-7773

P. O. Box 029311, Miami, FL 33102-9311

FPL

March 25, 2008

U.S. Environmental Protection Agency
Attn: Ms. Sally Rand
MC6205J
1200 Pennsylvania Avenue
Washington, DC 20460

345 kV Seabrook Transmission Substation
SF6 Emissions Reduction Partnership for Electric Power Systems
Annual Report for 2007

Florida Power & Light-New England Division (FPL-NED) hereby submits the SF6 Emissions Reduction Partnership for Electric Power Systems Annual Report for the year 2007. FPL-NED is the majority owner of the gas insulated 345kV Seabrook Transmission Substation ("Seabrook Transmission Substation") located in Seabrook, NH. This report is submitted pursuant to Section IV, Paragraph B., of the Memorandum of Understanding between the United States Environmental Agency (EPA) and FPL-NED, effective February 3, 2005 (SF6 MOU).

During the preparation of last year's Annual Report, FPL-NED discovered that the process used to determine the SF6 emissions at Seabrook for that reporting period was inconsistent with the SF6 Emissions Inventory Reporting Protocol prescribed by the SF6 MOU. As reported in last year's report, FPL-NED discovered that the methodology, which was used by the prior facility owner and which had continued in use though 2006, was a method based upon the Ideal Gas Law. Use of this method resulted in a highly accurate accounting of SF6 emissions from the substation bus work and equipment but nonetheless differed from the SF6 MOU prescribed methodology because use of the Ideal Gas Law did not account for gases stored or returned throughout the system. FPL-NED committed to revising its procedures for determining SF6 Emissions for reporting periods covering all future periods. As such, this report covering 2007 reporting period is based on the SF6 MOU prescribed procedures.

Sulfur hexafluoride (SF6) emissions during the year 2007 were calculated in accordance with the SF6 Emissions Inventory Reporting Protocol and Form included in Attachment B to the SF6 MOU. SF6 emissions of 3,919 lbs. were calculated for the year 2007 or 9.25% of the total SF6 system capacity[1]. This usage exceeds the FPL-NED 2007 goal of emitting less than 5% of the total SF6 system capacity, but still represents an emissions reduction of 60.4% from the 1990 baseline emission level of 9,890 lbs. The year 2007 Annual Reporting Form is attached hereto.

[1] Total System Capacity is 42,351 lbs.

an FPL Group company

The SF6 emissions above the 2007 goal were caused in large part, by two equipment failures. One involved the unforeseeable failure of a rupture disk on Gas Bus Zone 4 which caused the complete and sudden evacuation of SF6 Gas from this bus zone. This single failure is estimated to have resulted in 1,022 lbs. of SF6 emissions. The second equipment failure occurred when one of FPL-NED's Gas Carts experienced a hose rupture which is estimated to have contributed 565 lbs. of SF6 emissions.

FPL-NED has undertaken an extensive analysis of the condition of all of its other rupture disks and is making certain system design changes, including the elimination of some rupture disks and replacing or relocating others. In addition, FPL-NED has purchased a new state-of-the-art Gas Cart and repaired the Gas Cart that experienced the hose rupture, which will be now be used only as a backup. Finally, FPL-NED is in the process of performing a complete and thorough system condition assessment of its Seabrook Transmission Substation. It is believed that these efforts will prevent such excessive SF6 emissions going forward and will help ensure FPL-NED's SF6 emissions will remain below its stated annual emission goal of less than 5% of the total SF6 system capacity.

If you have any questions regarding this report, please contact Mr. Mike O' Neil, Director – Substation and Protection & Control Operations whose phone number is (561) 691-2202.

Sincerely,

For CMM

W. C. [signature]

C. Martin Mennes
Vice President, Transmission & Substation
Florida Power & Light Company – New England Division

cc: M. Archer
D. Cleary
B. Locke
S. Garwood
M. O' Neil
M. Powers
M. Murphy
A. Legendre
T. Cooper

SF_6 Emissions Reduction Partnership for Electric Power Systems

Annual Reporting Form

Name:	C. Martin Mennes	Company Name:	FPL-NED
Title:	V.P. Transmission Operations & Planning	Report Year:	2007
Phone:	(305)-552-4138	Date Completed:	31-Mar-08

Change in Inventory (SF_6 contained in cylinders, not electrical equipment)

Inventory (in cylinders, **not** equipment)	AMOUNT (lbs.)	Comments
1. Beginning of Year	2,999.00	20 cylinders @115lbs. Incl. 699lbs. In cart
2. End of Year	5,980.00	40 cyl. in WH & Shop / 1,380lbs. in cart.
A. Change in Inventory (1 - 2)	(2,981.00)	

Purchases/Acquisitions of SF_6

	AMOUNT (lbs.)	Comments
3. SF_6 purchased from producers or distributors in cylinders	6,900.00	60 cylinders @ 115lbs.
4. SF_6 provided by equipment manufacturers with/inside equipment	-	
5. SF_6 returned to the site after off-site recycling	-	
B. Total Purchases/Acquisitions (3+4+5)	6,900.00	

Sales/Disbursements of SF_6

	AMOUNT (lbs.)	Comments
6. Sales of SF_6 to other entities, including gas left in equipment that is sold	-	
7. Returns of SF_6 to supplier	-	
8. SF_6 sent to destruction facilities	-	
9. SF_6 sent off-site for recycling	-	
C. Total Sales/Disbursements (6+7+8+9)	-	

Change in Nameplate Capacity

	AMOUNT (lbs.)	Comments
10. Total nameplate capacity (proper full charge) of new equipment	-	
11. Total nameplate capacity (proper full charge) of retired or sold equipment	-	
D. Change in Capacity (10 - 11)	-	

Total Annual Emissions

	lbs. SF_6	Tonnes CO_2 equiv. (lbs.SF_6x23,900/2205)
E. Total Emissions (A+B-C-D)	3,919.00	42,478.05

Emission Rate (optional)

	AMOUNT (lbs.)	Comments
Total Nameplate Capacity at End of Year	42,351.00	
	PERCENT (%)	
F. Emission Rate (Emissions/Capacity)	9.3%	

March 31, 2009

U.S. Environmental Protection Agency
Attn: Ms. Sally Rand
MC6205J
1200 Pennsylvania Avenue
Washington, DC 20460

345 kV Seabrook Transmission Substation
SF6 Emissions Reduction Partnership for Electric Power Systems
Annual Report for 2008

Florida Power & Light-New England Division (FPL-NED) hereby submits the SF6 Emissions Reduction Partnership for Electric Power Systems Annual Report for the year 2008. FPL-NED is the majority owner of the gas insulated 345kV Seabrook Transmission Substation ("Seabrook Transmission Substation") located in Seabrook, NH. This report is submitted pursuant to Section IV, Paragraph B., of the Memorandum of Understanding between the United States Environmental Protection Agency (EPA) and FPL-NED, effective February 3, 2005 (SF6 MOU).

Sulfur hexafluoride (SF6) emissions during the year 2008 were calculated in accordance with the SF6 Emissions Inventory Reporting Protocol and Form included in Attachment B to the SF6 MOU. SF6 emissions of 1,442 lbs. were calculated for the year 2008 representing 3.4% of the total SF6 system capacity[1]. This usage results in FPL-NED achieving its 2008 goal of emitting less than 5% of the total SF6 system capacity, and represents an emissions reduction of 85.4% from the 1990 baseline emission level of 9,890 lbs. FPL-NED intends to maintain the same emissions goal during calendar year 2009 as was in effect for calendar year 2008. The Annual Reporting Form for 2008 is attached hereto.

If you have any questions regarding this report, please contact Mr. Mike O' Neil, Director – Substation and Protection & Control Operations whose phone number is (561) 691-2202.

Sincerely,

Jim Keener
Vice President, Transmission & Substation
Florida Power & Light Company – New England Division

cc: M. Archer
D. Cleary
B. Locke
S. Garwood
M. O' Neil
M. Powers
G. Birgisson
A. Legendre
T. Cooper

---

[1] Total System Capacity is 42,351 lbs.

SF_6 Emissions Reduction Partnership for Electric Power Systems

Annual Reporting Form

Name:	Tim Cooper	Company Name:	FPL-New England Division
Title:	FPL-NED Project Manager	Report Year:	2008
Phone:	(603) 773-7548	Date Completed:	16-Mar-09

Change in Inventory (SF_6 contained in cylinders, not electrical equipment)

Inventory (in cylinders, **not** equipment)	AMOUNT (lbs.)	Comments
1. Beginning of Year	5,980.00	40 cylinders WH + 1380 lbs in gas cart
2. End of Year	4,307.00	1087lbs in gas carts; 3220lbs in gas bottles
A. Change in Inventory (1 - 2)	1,673.00	

Purchases/Acquisitions of SF_6

	AMOUNT (lbs.)	Comments
3. SF_6 purchased from producers or distributors in cylinders	1,380.00	12 cylinder @ 115lbs for Jan. outage
4. SF_6 provided by equipment manufacturers with/inside equipment	-	
5. SF_6 returned to the site after off-site recycling	1,154.00	To DILO for cleaning; returned all but <20lbs
B. Total Purchases/Acquisitions (3+4+5)	2,534.00	

Sales/Disbursements of SF_6

	AMOUNT (lbs.)	Comments
6. Sales of SF_6 to other entities, including gas left in equipment that is sold	-	
7. Returns of SF_6 to supplier	-	
8. SF_6 sent to destruction facilities	1,591.00	sent with LIMCO Cart off site
9. SF_6 sent off-site for recycling	1,174.00	Returned under "B-5" 20lbs lost in recycling
C. Total Sales/Disbursements (6+7+8+9)	2,765.00	

Change in Nameplate Capacity

	AMOUNT (lbs.)	Comments
10. Total nameplate capacity (proper full charge) of new equipment	-	
11. Total nameplate capacity (proper full charge) of retired or sold equipment	-	
D. Change in Capacity (10 - 11)	-	

Total Annual Emissions

	lbs. SF_6	Tonnes CO_2 equiv. (lbs.SF_6x23,900/2205)
E. Total Emissions (A+B-C-D)	1,442.00	15,629.84

Emission Rate (optional)

	AMOUNT (lbs.)	Comments
Total Nameplate Capacity at End of Year	42,351.00	
	PERCENT (%)	
F. Emission Rate (Emissions/Capacity)	3.4%	

700 Universe Blvd., Juno Beach, FL 33408

FPL

March 31, 2010

U.S. Environmental Protection Agency
Attn: Ms. Sally Rand
MC6205J
1200 Pennsylvania Avenue
Washington, DC 20460

345 kV Seabrook Transmission Substation
SF6 Emissions Reduction Partnership for Electric Power Systems
Annual Report for 2009

Florida Power & Light-New England Division (FPL-NED) hereby submits the SF6 Emissions Reduction Partnership for Electric Power Systems Annual Report for the year 2009. FPL-NED is the majority owner of the gas insulated 345kV Seabrook Transmission Substation ("Seabrook Transmission Substation") located in Seabrook, NH. This report is submitted pursuant to Section IV, Paragraph B., of the Memorandum of Understanding between the United States Environmental Protection Agency (EPA) and FPL-NED, effective February 3, 2005 (SF6 MOU).

Sulfur hexafluoride (SF6) emissions during the year 2009 were calculated in accordance with the SF6 Emissions Inventory Reporting Protocol and Form included in Attachment B to the SF6 MOU. SF6 emissions of 1,540 lbs. were calculated for the year 2009 representing 3.5% of the total SF6 system capacity[1]. This usage results in FPL-NED achieving its 2009 goal of emitting less than 5% of the total SF6 system capacity, and represents an emissions reduction of 84.4% from the 1990 baseline emission level of 9,890 lbs. FPL-NED intends to maintain the same emissions goal during calendar year 2010 as was in effect for calendar year 2009. The Annual Reporting Form for 2009 is attached hereto.

If you have any questions regarding this report, please contact me at phone number (561) 691-2202.

Sincerely,

FOR MIKE O'NEIL

Mr. Mike O' Neil, Director
Substation and Protection & Control Operations
Florida Power & Light Company – New England Division

[1] Total System Capacity is 43,664 lbs., representing an increase of 1,313 lbs. from the prior year's total system capacity. This change in total system capacity results from the retirement / replacement / addition of GIS breakers and Bus Work performed as part of an upgrade to the Seabrook Transmission Substation implemented during 2009.

SF_6 Emissions Reduction Partnership for Electric Power Systems

Annual Reporting Form

Name:	Tim Cooper	Company Name:	FPL-New England Division
Title:	FPL-NED Project Manager	Report Year:	2009
Phone:	(603) 773-7548	Date Completed:	10-Mar-10

Change in Inventory (SF_6 contained in cylinders, not electrical equipment)

Inventory (in cylinders, not equipment)	AMOUNT (lbs.)	Comments
1. Beginning of Year	4,307.00	1087 lb. in Carts / 3220 in bottles lb.
2. End of Year	4,501.00	1281 lb. in Carts / 3220 in bottles lb.
A. Change in inventory (1 - 2)	(194.00)	

Purchases/Acquisitions of SF_6

	AMOUNT (lbs.)	Comments
3. SF_6 purchased from producers or distributors in cylinders	10,543.00	
4. SF_6 provided by equipment manufacturers with/inside equipment	-	
5. SF_6 returned to the site after off-site recycling	-	
B. Total Purchases/Acquisitions (3+4+5)	10,543.00	

Sales/Disbursements of SF_6

	AMOUNT (lbs.)	Comments
6. Sales of SF_6 to other entities, including gas left in equipment that is sold	-	
7. Returns of SF_6 to supplier	80.00	
8. SF_6 sent to destruction facilities	7,416.00	
9. SF_6 sent off-site for recycling	-	
C. Total Sales/Disbursements (6+7+8+9)	7,496.00	

Change in Nameplate Capacity

	AMOUNT (lbs.)	Comments
10. Total nameplate capacity (proper full charge) of new equipment	6,051.00	Breaker Replacement/Reconfiguration Upgrade
11. Total nameplate capacity (proper full charge) of retired or sold equipment	4,738.00	Breaker Replacement/Reconfiguration Upgrade
D. Change in Capacity (10 - 11)	1,313.00	

Total Annual Emissions

	lbs. SF_6	Tonnes CO_2 equiv. (lbs.SF_6x23,900/2205)
E. Total Emissions (A+B-C-D)	1,540.00	16,692.06

Emission Rate (optional)

	AMOUNT (lbs.)	Comments
Total Nameplate Capacity at End of Year	43,664.00	
	PERCENT (%)	
F. Emission Rate (Emissions/Capacity)	3.5%	

From: Legendre, Al
To: SNOOKS John H (AREVA NP INC); FASANO Cynthia A (AREVA NP INC);
cc: GAGNON, SABRE; Jaster, Samuel; Sessler, Gregg; CRONIN, CHRISTINE; Bryant, Bonnie;
Subject: Sodium Hypochlorite Usage
Date: Wednesday, April 28, 2010 9:11:49 AM

Sodium Hypochlorite (Product name; Liquichlor 15%) annual usage for NH Air Toxics chlorine emission annual estimates:

During deliveries the sodium hypochlorite is delivered into the storage tanks using compressed air. This method of delivery must result in forcing air from the storage tank vents for the period of delivery so it probably represents the worst case from the 24 hour chlorine emission standpoint.

2009	900,000 gal
2008	896,000 gal
2007	856,550 gal
2006	749,556 gal
2005	704,531 gal

Source: Commercial Pesticide Applicator License Renewal Applications and Purchasing records

Al Legendre
Principal Engineer
NextEra Energy Seabrook, LLC
603 773-7773

From: Legendre, Al
To: SNOOKS John H (AREVA NP INC);
cc: Jaster, Samuel; GAGNON, SABRE;
Subject: FW: Spill Response Data
Date: Wednesday, July 28, 2010 9:42:33 AM
Attachments: image003.png

Hi John,

I have reviewed the report and will be sending you some comments and responses to questions today. Very good job overall on the report. I have asked Sam to verify the process descriptions.

Here is some data on the total number of spills we have had by year. This would include oil and chemicals. In any given year the majority of spills are small glycol leaks.

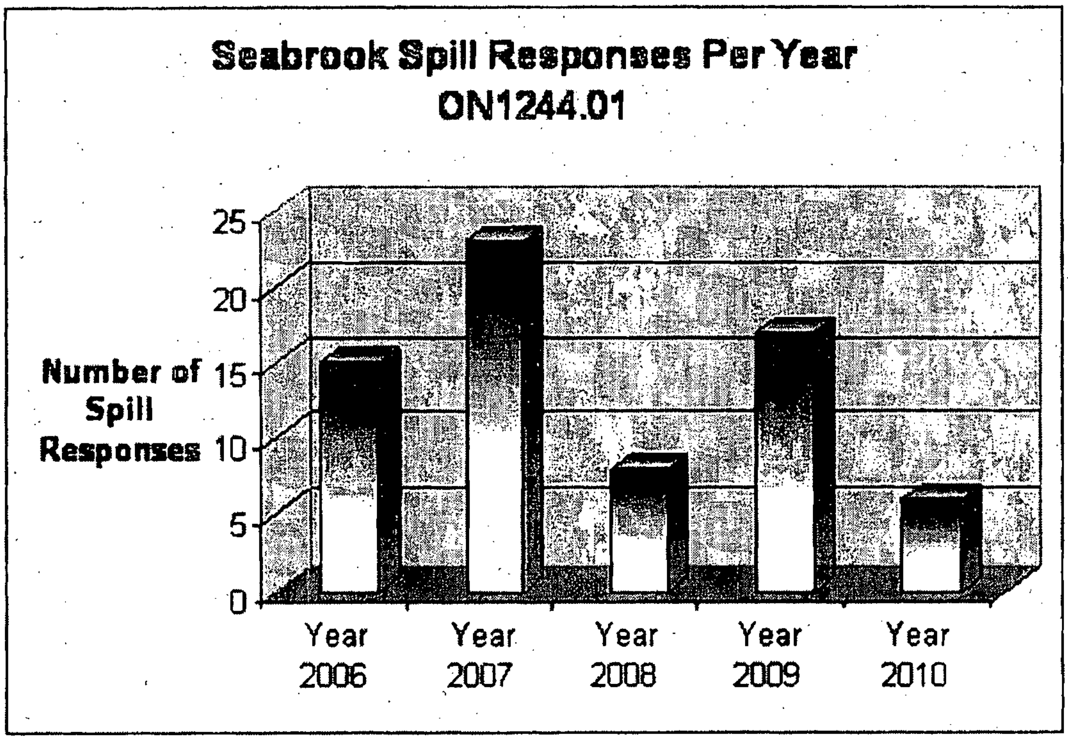
For purposes of the air toxics eval I think it is conservative to estimate 20 glycol spills averaging 5 gallons each for a total of 100 gallons per year. These are spills inside buildings some of which would enter the floor drain system and the remainder would be wiped up.

Al Legendre
Principal Engineer
NextEra Energy Seabrook, LLC
603 773-7773

From: GAGNON, SABRE
Sent: Thursday, April 08, 2010 8:56 AM
To: Jones, John
Cc: Legendre, Al
Subject: Spill Response Data

John,

Here is the trending I have for how many times we enter into Spill Response Procedure ON1244.01. Let me know if you need anything else.



Year 2006	15
Year 2007	23
Year 2008	8
Year 2009	17
Year 2010	6

Sabre Gagnon
Environmental Compliance
NextEra Energy Seabrook LLC
Phone: 603-773-7795
Cell: 603-397-7010

From: Kim Jaster
To: al.legendre@nexteraenergy.com;
cc: SNOOKS John (EP/PE); FASANO Cindy (EP/PE);
Subject: Comments on Seabrook Draft Toxics Air Report
Date: Friday, July 30, 2010 2:09:08 AM

Al,

I have reviewed the draft report you forwarded and I have the following comments:

1. Section 4.3 - ETA dilution: the concentrated solution from the CAS-SKD-90 tanks is injected at 1 - 2 gallons per hour to obtain a 1 ppm solution in Feedwater. I agree that ETA is either consumed/broken down as part of the pH control process and exists at 1 - 3 ppm in secondary system leakage. The only possible locations were ETA exists in higher concentrations is either the Waste Hold-up Sump (WHUS) or Water Treatment Neutralization Tank after a SGBD Demineralizer or CPS cation bed regeneration. However, it is difficult to predict/estimate/calculate the concentration in either sump/tank due to we cannot measure how much ETA is broken down when it comes into contact with 93% sulfuric acid during the regeneration process. Samples from the Neutralization tank are diluted at 1,000:1 or 10,000: 1 to prevent damaging the resin columns in our cation ion chromatography systems. Estimate of ETA concentration in either sump is on the order of 1,000 - 10,000 ppm. It is my opinion that ETA is dilute enough in the sump that vapor pressure should not come into play in the calculations.
2. Section 4.6 SGBD definition: SGBD is the abbreviation for Steam Generator Blowdown. In this paragraph, sodium hydroxide is used for the regeneration of SGBD and CPS mixed bed demineralizer regeneration and for neutralization of regeneration waste in the Waste Hold-up Sump (WHUS) and Water Treatment Neutralization Tank.
3. Section 4.6, 4.7, tank sizes: I am confused with the wording regarding outside tanks for sodium hydroxide and sulfuric acid being transferred to the CPS and SGBD tanks located indoors. The 1,850 gallons of either sulfuric acid or sodium hydroxide is the typical order volume for either CPS tank. It is delivered in a tanker truck (is this what you mean by an outside tank?), connected to transfer connections outside the building, and the truck is pressurized to provide the motive force to fill the tanks. The process is the same for the SGBD sulfuric acid and sodium hydroxide tanks. The typical order volume for SGBD acid is 250 gallons. The typical order volume for SGBD sodium hydroxide is 500 gallons. SGBD acid tank is 500 gallons capacity max. SGBD caustic tank is 1,000 gallons max.

Both CPS acid and caustic tanks are nominal 4,000 gallon tanks. If I previously provided the capacity at 4,170 gallons as part of the On-Site Control Room Habitability evaluation, then use the higher value.

4. Appendix A Section 2.0 Photographs: Photo #1 is not a mixer and should be labeled CPS hydrazine chemical addition pump. It is a direct inject of 35% hydrazine without any mixing or dilution. Photo #6 needs to be annotated Turbine Building 50ft. elevation. Photos #8,9,&10 should be annotated Turbine Building 21ft. elevation. Photo #14 should be annotated CPS ETA 200-gal tote.

When I return to the office on Monday, 8/02/10, I can answer any questions you may have or provide any additional information.

Thank You,

Sam Jaster
Chemistry
Nextera Energy Seabrook
603-773-7445
smuel.jaster@nexteraenergy.com

APPENDIX D: OTHER TECHNICAL INPUT

Harcros Chemicals Inc

Kansas City, Kansas

MATERIAL SAFETY DATA SHEET Page 1

PRODUCT NAME : NORKOOL SLH-224C COOLANT   Date: 23-JAN-2002 13:36:00.90
PRODUCT CODE : 04452   55 GAL FACT

CAS #: N/A   MSDS No. 000948 Revision No./Date 01 930630
Detail Number 00451/01

FORMULA: Proprietary
CHEM. FAMILY: organic-inorganic mixtures
CHEMICAL NAME AND SYNONYMS:
Norkool N209 Conc & Norkool SLH-224 Coolant;
PM 209 & PM 224;
Aqueous Inhibited Ethylene Glycol Solution;
MSDS 000948 DETAIL 00451
SUPPLIERS NAME : Harcros Chemicals Inc.
5200 Speaker Road
Kansas City KS 66106-1095

SUPPLIERS PHONE NUMBER : 913-321-3131
TRANSPORTATION EMERGENCY PHONE NUMBER : 1-800-424-9300

S.A.R.A. INFORMATION

HAZARDS : Acute Chronic
PHYSICAL DATA : Mixture Liquid

SECTION I HAZARDOUS INGREDIENTS

Ingredient Cas Number	MAX % W/W	SARA APPLIES 312	313	372	AIR CONTAMINENT LEVELS TWA/TLV (ppm)	STEL (ppm)	CEIL (ppm)	SKIN	AGENT
Ethylene Glycol 1,2 Ethanediol (CAS # 107-21-1)	95.0	Y	Y	Y			50 50	N N	OSHA ACGIH
Dipotassium Phosphate Potassium Phosphate Dibasic (CAS # 7758-11-4)	3.0	Y	N	N	PARTICULATES NOT OTHERWISE REGULATED Total TWA 15 mg/m3 OSHA Total TLV 10 mg/m3 ACGIH Respirable TWA 5 mg/m3 OSHA				
Caustic Potash Potassium Hydroxide (CAS # 1310-58-3)	2.0	Y	N	N	As Potassium Hydroxide TWA/TLV 2 mg/m (ceiling) OSHA/ACGIH				

SECTION II HEALTH HAZARDS

POTENTIAL EFFECTS OF EXPOSURE

Continued On Page 2

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Document No.: 51-9142596-000

Harcros Chemicals Inc

Kansas City, Kansas

MATERIAL SAFETY DATA SHEET Page 2

PRODUCT NAME : NORKOOL SLH-224C COOLANT Date: 23-JAN-2002 13:36:01.48
PRODUCT CODE : 04452 55 GAL FACT

SECTION II HEALTH HAZARDS (CONTINUED)

EYES
Eye contact with product may cause irritation tears redness
SKIN
Skin contact may cause irritation redness excess fluid retention (edema, blistering)
INHALATION
Inhalation may cause irritation headache nausea vomiting dizziness imparied vision
Prolonged or repeated overexposure by inhalation may cause Symptoms of early to moderate central nervous system (CNS) depression include giddiness, dizziness, confusion, drunken behavior, headache, nausea, diarrhea, vomiting, tiredness and drowsiness.
INGESTION
Ingestion may cause pain nausea vomiting diarrhea excess fluid retention (edema) central nervous system (CNS) depression
Symptoms of early to moderate central nervous system (CNS) depression include giddiness, dizziness, confusion, drunken behavior, headache, nausea, diarrhea, vomiting, tiredness and drowsiness. In extreme cases, symptoms of central nervous system (CNS) depression include stupor, convulsions, unconsciousness, coma, and even death.
TARGET ORGANS
OVEREXPOSURE MAY CAUSE DAMAGE TO,
heart kidneys
FIRST AID
FIRST AID EYES
Immediately flush eyes with plenty of water for at least 15 minutes, while holding eyelids apart to ensure flushing of entire surface. Call a physician.
FIRST AID SKIN
Immediately flush skin with plenty of water for at least 15 minutes, while removing contaminated clothing and shoes. Thoroughly clean clothing and shoes before reuse. Call a physician.
FIRST AID INHALATION
Remove to fresh air. If not breathing give artificial respiration, preferably mouth to mouth. If breathing is difficult give oxygen. Call a physician.
FIRST AID INGESTION
If swallowed, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Never give anything by mouth to an unconscious person. Call a physician.
OTHER INFORMATION
ROUTES OF ENTRY
eye contact skin contact inhalation ingestion
OVEREXPOSURE MAY AGGRAVATE DISORDERS OF THE
kidneys
CARCINOGEN STATUS
WARNING: This product contains a chemical known to the state of California to cause cancer and birth defects or other reproductive harm.

SECTION III SPECIAL PROTECTION

PROTECTIVE EQUIPMENT
PROTECTIVE EQUIPMENT EYES

Continued On Page 3

Page 449

Document No.: 51-914296-000

Harcros Chemicals Inc

Kansas City, Kansas

MATERIAL SAFETY DATA SHEET Page 3

PRODUCT NAME : NORKOOL SLH-224C COOLANT Date: 23-JAN-2002 13:36:02.01
PRODUCT CODE : 04452 55 GAL FACT

SECTION III SPECIAL PROTECTION (CONTINUED)

faceshield chemical goggles Do Not wear contact lenses when working with chemicals.
PROTECTIVE EQUIPMENT SKIN
impervious gloves
PROTECTIVE EQUIPMENT INHALATION
If exposure limits are exceeded, or if exposure may occur, use a NIOSH/MSHA respirator approved for your conditions of exposure. Refer to the most recent NIOSH publications concerning chemical hazards, or consult your safety equipment supplier. Respiratory protection programs must be in compliance with OSHA requirements in 29 CFR 1910.134. For emergencies, a NIOSH/MSHA approved positive pressure breathing apparatus should be readily available.
VENTILATION REQUIRED:
Adequate ventilation is required to minimize exposure or to maintain exposure levels below OSHA/ACGIH requirements.
ADDITIONAL PROTECTIVE MEASURES
Safety shower, eye wash fountain, and washing facilities should be readily available.

SECTION IV FIRE & EXPLOSION HAZARD DATA

Flash Point (METHOD): > OR = 260 deg. F (PMCC)
Flammable Limits (% Volume in Air) UPPER: N/D Lower: N/D

EXTINGUISHING MEDIA
water spray carbon dioxide dry chemical alcohol foam universal foam
FIRE FIGHTING PROCEDURES
Prevent human exposure to fire, fumes, smoke, and products of combustion. Evacuate non essential personnel. Firefighters should wear full face, self contained breathing apparatus and impervious protective clothing.
UNUSUAL FIRE & EXPLOSION HAZARDS
none currently known

SECTION V PHYSICAL DATA

Boiling Point: > OR = 329 deg. F
Freezing Point: -12 deg. F
Specific Gravity (H(2)O=1): > OR = 1.1330 @ 68 deg. F
Vapor Pressure (MM HG.): > OR = 1.200 @ 68 deg. F
Vapor Density (AIR=1) : > OR = 2.10000
Evaporation Rate (N-Butyl Acetat =1): > OR = 0.1000
Solubility in Water: COMPLETE
Percent Volatile by Volume: N/D
pH: aqueous approx. N/D
Appearance:
COLORED LIQUID

Odor :
MILD

HARCROS

5038800685

01/22/2002 12:04

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Page D-4

Document No.: 51-914296-000

Harcros Chemicals Inc

Kansas City, Kansas

MATERIAL SAFETY DATA SHEET Page 4

PRODUCT NAME : NORKOOL SLH-224C COOLANT Date: 23-JAN-2002 13:36:02.70
PRODUCT CODE : 04452 55 GAL PACT

SECTION V PHYSICAL DATA (CONTINUED)

SECTION VI REACTIVITY DATA

STABILITY
Stable
INCOMPATABILITY
inorganic acids inorganic bases bleaching agents (oxidizers) Avoid contact with bleaching agents and oxidizers which include chlorine, oxygen, permanganates, perchlorates, percarbonates, peroxides, chromates, hypochlorites, nitric acid, and sulfuric acid.
HAZARDOUS DECOMPOSITION PRODUCTS
carbon monoxide carbon dioxide Miscellaneous organic compounds, some possibly toxic.
HAZARDOUS POLYMERIZATION
Will not occur

SECTION VII SPILL AND LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED:
Evacuate non essential personnel, elimnate ignition sources, and wear protective equipment (See Section III). Shut off source of leak only if safe to do so. Contain spill. Recover free product. To clean up residue, flush sparingly with water or use an absorbent. Avoid runoff to ground water, surface waters, and sewers. It may be necessary to remove contaminated soil. If product is flammable or combustible, use non sparking tools. If acidity (low pH) is a problem, neutralize with hydrated lime, soda ash, or sodium bicarbonate. If alkalinity (high pH) is a problem neutralize with dilute acetic acid or dilute hydrochloric (muriatic) acid. If required, notify state and local authorities.
DISPOSAL METHOD
Solids must be disposed of in a permitted hazardous waste management facility. Recovered liquids may be reprocessed or incinerated. Incineration must be handled in a permitted hazardous waste management facility. Dispose of material in accordance with all Federal, State and local regulations. Local regulations may be more stringent than Federal or State.

SECTION VIII

Proper Shipping Name:

Hazard Class:	UNCLASSIFIED
Label Requirements:	NONE
Reportable Quantity:	None

SECTION IX ADDITIONAL INFORMATION

PRECAUTIONS
Do Not breathe vapor or mist. Do Not get in eyes, on skin, or clothing. Do not swallow. Wash thoroughly after handling.

Continued On Page 5

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Document No.: 51-9142596-000

Harcros Chemicals Inc

Kansas City, Kansas

MATERIAL SAFETY DATA SHEET Page 5

PRODUCT NAME : NORKOOL SLH-224C COOLANT Date: 23-JAN-2002 13:36:03.35
PRODUCT CODE : 04452 55 GAL FACT

SECTION IX ADDITIONAL INFORMATION (CONTINUED)

HANDLING
ATTENTION: This container hazardous when emptied. Since emptied container contains product residues (vapor or liquid), all labeled hazard precautions must be observed.
STORAGE
Keep container closed when not in use. Store in a cool dry place. Keep out of reach of children.

NAME: GENE TURNER

DATE ISSUED: 930830
DATE REVISED: 930830

< = LESS THAN
> = MORE THAN
N/A = NOT APPLICABLE
N/D = NOT DETERMINED
N/E = NOT ESTABLISHED
UNK = UNKNOWN

The information provided in this Material Safety data sheet has been obtained from sources believed to be reliable. Harcros Chemicals Inc provides no warranties, either expressed or implied and assumes no responsibility for the accuracy or completeness of the data contained herein. This information is offered for your information, consideration , and investigation. You should satisfy yourself that you have all current data relevant to your particular use. Harcros Chemicals Inc knows of no medical condition, other than those noted on this material safety data sheet, which are generally recognized as being aggravated by exposure to this product.

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http://www.epa.gov/ttn/atw/hlthef/hydrazin.html
Last updated on Tuesday, November 06, 2007

Technology Transfer Network
Air Toxics Web Site

You are here: EPA Home Air & Radiation TTN Web - Technology Transfer Network Air Toxics Web site Hydrazine

Hydrazine

302-01-2

Hazard Summary-Created in April 1992; Revised in January 2000

Individuals may be exposed to hydrazine in the workplace or to small amounts in tobacco smoke. Symptoms of acute (short-term) exposure to high levels of hydrazine may include irritation of the eyes, nose, and throat, dizziness, headache, nausea, pulmonary edema, seizures, and coma in humans. Acute exposure can also damage the liver, kidneys, and central nervous system in humans. The liquid is corrosive and may produce dermatitis from skin contact in humans and animals. Effects to the lungs, liver, spleen, and thyroid have been reported in animals chronically (long-term) exposed to hydrazine via inhalation. Increased incidences of lung, nasal cavity, and liver tumors have been observed in rodents exposed to hydrazine. EPA has classified hydrazine as a Group B2, probable human carcinogen.

Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS), which contains information on the carcinogenic effects of hydrazine including the unit cancer risk for inhalation exposure, EPA's *Health and Environmental Effects Profile for Hydrazine*, and the Agency for Toxic Substances and Disease Registry's (ATSDR's) *Toxicological Profile for Hydrazines*.

Uses

- Hydrazine is used in agricultural chemicals (pesticides), chemical blowing agents, pharmaceutical intermediates, photography chemicals, boiler water treatment for corrosion protection, textile dyes, and as fuel for rockets and spacecraft. (4,6,8,10)

Sources and Potential Exposure

- Individuals may be occupationally exposed to hydrazine in the workplace. (1,2,10)
- Accidental discharge into water, air, and soil may occur during storage, handling, transport, and improper waste disposal. However, hydrazine rapidly degrades in the environment and is rarely encountered. (2,3)
- Small amounts of hydrazine have been detected in tobacco smoke. (2,10)

Assessing Personal Exposure

- Hydrazine may be detected in the blood of exposed individuals. (1,2)

Health Hazard Information

Acute Effects:

- Symptoms of acute exposure to high levels of hydrazine include irritation of the eyes, nose, and throat, temporary blindness, dizziness, headache, nausea, pulmonary edema, seizures, and coma in humans. Acute exposure can also damage the liver, kidneys, and the central nervous system (CNS) in humans. (2-4)
- The liquid is corrosive and may produce chemical burns and severe dermatitis from skin contact. (1,4)
- Acute animal tests in rats, mice, rabbits, and guinea pigs have demonstrated hydrazine to have high acute toxicity from inhalation and ingestion and extreme acute toxicity from dermal exposure. (5)

Chronic Effects (Noncancer):

- Information is not available on the chronic effects of hydrazine in humans.
- In animals chronically exposed to hydrazine by inhalation, effects on the respiratory system, liver, spleen, and thyroid have been observed. (10)
- EPA has not established a Reference Concentration (RfC) or a Reference Dose (RfD) for hydrazine. (4)
- The California Environmental Protection Agency (CalEPA) has calculated a chronic inhalation reference exposure level of 0.0002 milligrams per cubic meter (mg/m^3) based on liver and thyroid effects in hamsters. The CalEPA reference exposure level is a concentration at or below which adverse health effects are not likely to occur. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At lifetime exposures increasingly greater than the reference exposure level, the potential for adverse health effects increases. (11)
- ATSDR has calculated an intermediate inhalation minimal risk level (MRL) of 0.005 mg/m^3 (0.004 parts per million [ppm]) based on liver effects in mice. The MRL is an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse noncancer health effects over a specified duration of exposure. (10)

Reproductive/Developmental Effects:

- Information is not available on the reproductive or developmental effects of hydrazine in humans.
- Data regarding developmental effects in animals are limited to a study in which hydrazine injected into pregnant rats resulted in fetotoxicity including increased fetal and neonatal mortality. (6,10)
- Inhalation of hydrazine for a year resulted in effects to the ovaries, endometrium, and uterus in female rats and to the testes in male hamsters. (10)

Cancer Risk:

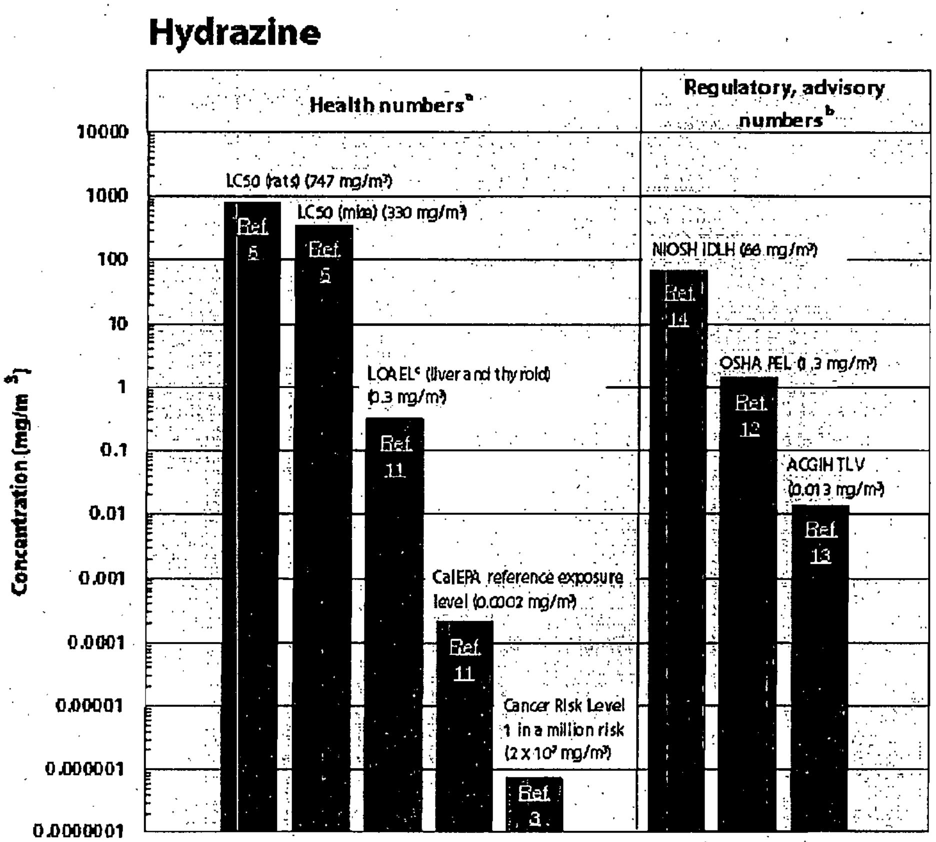
- Adequate information is not available on the carcinogenic effects of hydrazine in humans. (4)
- Increased incidences of lung and liver tumors have been observed in mice exposed to hydrazine by inhalation, in their drinking water, via gavage and injection. Tumors in the nasal cavity were observed in rats and hamsters exposed by inhalation. (4,6,7)
- EPA has classified hydrazine as a Group B2, probable human carcinogen. (4)
- EPA uses mathematical models, based on human and animal studies, to estimate the probability of a person developing cancer from breathing air containing a specified concentration of a chemical. EPA calculated an inhalation unit risk estimate of 4.9×10^{-3} $(\mu g/m^3)^{-1}$. EPA estimates that, if an individual were to continuously breathe air containing hydrazine at an average of 0.0002 $\mu g/m^3$ (2.0×10^{-7} mg/m^3) over his or her entire lifetime, that person would theoretically have no more than a one-in-a-million increased chance of developing cancer as a direct result of breathing air containing this chemical. Similarly, EPA estimates that breathing air containing 0.002 $\mu g/m^3$ (2.0×10^{-6} mg/m^3) would result in not greater than a one-in-a-hundred thousand increased chance of developing cancer, and air containing 0.02 $\mu g/m^3$ (2.0×10^{-5} mg/m^3) would result in not greater than a one-in-ten thousand increased chance of developing cancer. For a detailed discussion of confidence in the potency estimates, please see IRIS. (4)
- EPA has calculated an oral cancer slope factor of 3.0 $(mg/kg/d)^{-1}$. (4)

Physical Properties

- The chemical formula for hydrazine is H_4N_2, and its molecular weight is 32.05 g/mol. (6)
- Hydrazine occurs as a colorless, oily, flammable liquid that is miscible with water. (6,8)
- Hydrazine has a penetrating odor, resembling that of ammonia, with an odor threshold of 3.7 ppm. (8,9)
- The vapor pressure for hydrazine is 14.4 mm Hg at 25 °C, and its log octanol/water partition coefficient (log K_{ow}) is 0.08. (6)

Conversion Factors:
To convert concentrations in air (at 25 °C) from ppm to mg/m³: mg/m³ = (ppm) × (molecular weight of the compound)/(24.45). For hydrazine: 1 ppm = 1.31 mg/m³.

Health Data from Inhalation Exposure



ACGIH TLV--American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.
LC_{50} (Lethal Concentration$_{50}$)--A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined

experimental animal population.
LOAEL--Lowest-observed-adverse-effect level
NIOSH IDLH--National Institute of Occupational Safety and Health's immediately dangerous to life or health limit; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.
OSHA PEL--Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in December 1999.
[a] Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.
[b] Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH and ACGIH numbers are advisory.
[c] The LOAEL is from the critical study used as the basis for the CalEPA chronic reference exposure level.

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DOW Caustic Soda

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Physical Properties

Caustic soda is also known as sodium hydroxide, caustic, and lye. Anhydrous (100%, solid) sodium hydroxide has a chemical formula of NaOH and a molecular weight of 40.00.

Basic Properties of Caustic Soda Solution 50%

Vapor pressure	1.5 mmHg @ 68°F (0.20 kPa @ 20°C)
Boiling point	Approximately 293°F (145°C)
Freezing point	Approximately 58°F (14°C)
pH	14
Specific gravity	1.52 g/ml @ 68°F (20°C)*

*Based upon pure (salt-free) caustic soda solutions data from *International Critical Tables of Numerical Data, Physics, Chemistry and Technology, Volume III, First Edition, page 79.* Refer to Density Tables listed in "Additional physical property information" that is provided later in this section for other concentrations and temperatures.

Caustic soda, as a 50% solution, is an odorless and colorless liquid. In all forms, caustic soda is highly corrosive and reactive. Caustic soda solution reacts readily with metals such as aluminum, magnesium, zinc, tin, chromium, bronze, brass, copper, and tantalum. Galvanized (zinc coated) materials should be avoided. Contact with acids, halogenated organics, organic nitro compounds, and glycol should be avoided. It reacts with most animal tissue, including leather, human skin, and eyes. It also reacts readily with various reducing sugars (i.e., fructose, galactose, maltose, dry whey solids) to produce carbon monoxide.

Upon cooling, the viscosity of the solution increases rapidly as the temperature falls below 65°F (18°C). For additional information, see Viscosity Table for Pure (salt-free) Caustic Soda Solution (16KB PDF)

Stability and Storage Life
Caustic soda solution is a stable product but its storage life is dependent upon the storage conditions. If the caustic is exposed to air, a change in the product quality will be seen over time, since the caustic soda solution will pick up carbon dioxide to form sodium carbonate (Na_2CO_3) solids. In addition, iron pick up is common in carbon steel storage vessels or in lined carbon steel storage vessels where the liner has been damaged. Therefore, minimizing its exposure to air and its direct contact with iron containing metals will extend the storage life of caustic soda solution.

Additional physical property information:
Freezing Point Curve for Caustic Soda Solutions (16KB PDF)
Densities of Pure (salt-free) Caustic Soda Solution at Various Concentrations and Temperatures (16KB PDF)
Densities of Dow 50% Caustic Soda Solution, Commerical and Membrane Grades, at 30°C (86°F) (16KB PDF)
Densities of Pure (salt-free) Caustic Soda Solution (volumetric units) at 20°C (68° F) (21KB PDF)
Enthalpy-Concentration Table for Pure (salt-free) Caustic Soda Solution (17KB PDF)
pH Versus Concentration Table for Caustic Soda Solution (16KB PDF)
Dilution Temperature Curves for 50% Caustic Soda Solution at Three Initial Temperatures (22KB PDF)

Chemical Engineers' Handbook

FIFTH EDITION

Prepared by a staff of specialists
under the editorial direction of

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Consultant

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Table 3-13. Vapor Pressures, Normal Boiling Points, and Latent Heats of Vaporization for Aqueous Solutions of H_2SO_4*

Percentages are wt. % H_2SO_4 in the solution

A and *B* are constants in the equation $\log_{10} p\text{mm.} = A - \frac{B}{T}$

l = total heat of vaporization in g.-cal. per g. of water evaporated

B. P. = *normal boiling point*, °C.

For bibliography and discussion of data, see Greenewalt, *Ind. Eng. Chem.*, 17:522, 1925.

Per cent	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	10
A	9.790	9.255	9.239	9.293	9.034	9.032	8.853	8.841	8.827	8.832	8.809	8.844	8.873	8.864		8.922	8.925
B	3888	3390	3175	3040	2810	2688	2533	2458	2400	2357	2322	2299	2286	2271		2268	2259
l	987	861	806	772	713	682	643	624	609	598	590	584	580	577		576	574
B. P.	290	255	225	202	182	165	151	140	130	123	118	114.	110	108	106	104	102
°C.	Total vapor pressure, mm. Hg																
0	....	....	0.00418	0.0144	0.0550	0.154	0.377	0.686	1.08	1.55	2.07	2.55	3.06	3.43	3.72	4.02	4.38
5	....	0.00118	.00680	.0230	.0867	.235	.558	1.03	1.60	2.26	2.99	3.69	4.40	4.94	5.33	5.87	6.30
10	....	.00196	.0108	.0358	.128	.342	.800	1.46	2.26	3.19	4.19	5.22	6.23	6.91	7.46	8.05	8.80
15	....	.00318	.0169	.0555	.195	.506	1.15	2.05	3.19	4.50	5.85	7.27	8.65	9.65	10.5	11.3	12.3
20	....	.00497	.0257	.0835	.284	.723	1.61	2.87	4.43	6.20	8.10	9.95	11.8	13.2	14.5	15.4	16.6
25	....	.00765	.0390	.124	.408	1.03	2.24	3.97	6.15	8.45	10.9	13.5	15.8	17.8	19.4	20.8	22.4
30	....	.0117	.0585	.183	.580	1.44	3.09	5.41	8.29	11.3	14.7	18.0	21.2	23.8	26.0	27.8	30.0
35	0.00150	.0179	.0860	.265	.822	2.00	4.23	7.39	11.2	15.4	19.7	24.3	28.6	31.9	35.0	37.2	40.1
40	.00235	.0265	.125	.381	1.14	2.75	5.66	9.85	14.8	20.3	26.0	31.8	37.3	41.7	45.6	48.6	52.9
45	.00370	.0395	.181	.540	1.57	3.73	7.60	13.0	19.5	26.7	33.0	41.0	48.6	54.7	59.0	63.3	68.1
50	.00580	.0580	.260	.770	2.20	5.17	10.2	17.5	26.0	35.2	44.7	53.9	63.0	71.3	76.7	82.2	88.5
55	.00877	.0840	.367	1.06	2.95	6.89	13.4	22.7	33.7	45.3	57.5	69.0	80.2	91.0	98.2	106	113
60	.0133	.120	.411	1.47	3.98	9.12	18.6	29.3	43.0	58.0	73.0	87.3	102	116	124	133	143
65	.0196	.169	.707	2.00	5.30	10.2	22.7	37.7	55.1	73.7	92.3	110	127	145	156	167	178
70	.0288	.236	.960	2.68	7.02	15.6	29.0	48.0	69.6	92.5	116	138	159	180	195	207	223
75	.0415	.327	1.31	3.60	9.26	20.3	37.0	60.2	87.0	115	144	171	198	222	240	256	274
80	.0606	.450	1.77	4.77	12.0	26.0	47.0	75.3	108	143	179	211	244	273	295	314	337
85	.0879	.618	2.37	6.35	15.6	33.4	59.7	94.3	136	178	211	261	300	333	360	385	413
90	.123	.823	3.14	8.30	20.0	42.5	74.6	117	167	217	271	319	369	404	437	468	498
95	.172	1.12	4.18	10.8	25.7	53.9	92.7	144	205	268	335	390	450	493	531	580	608
100	.237	1.49	5.39	13.9	32.0	67.0	114	178	253	326	405	474	540	590	637	678	720
105	.321	1.93	6.95	17.6	40.0	82.3	140	213	302	393	484	568	642	702	758	812	
110	.437	2.52	9.00	22.5	50.0	103	172	260	367	471	580	679	768				
115	.590	3.23	11.4	28.3	62.0	126	207	313	435	562	684	800					
120	.788	4.19	14.5	35.6	76.5	153	251	377	522	670	812						
125	1.07	5.43	18.3	44.7	94.5	188	304	452	625	797							
130	1.42	6.97	23.2	56.0	117	230	370	544	744								
135	1.87	8.85	29.1	69.0	142	277	440	647									
140	2.40	11.2	36.3	85.5	173	332	525	760									
145	3.11	13.9	44.3	104	208	397	622										
150	4.02	17.5	54.6	127	248	471	730										
155	5.13	21.9	68.2	157	299	564											
160	6.47	27.7	82.0	188	354	665											
165	8.39	33.2	99.5	226	422	790											
170	10.3	39.8	119	267	496												
175	12.9	48.4	143	319	585												
180	15.9	59.0	169	378	685												
185	20.2	71.2	206	450	810												
190	24.8	85.0	245	535													
195	30.7	102	291	637													
200	36.7	120	340	735													
205	45.3	143	402														
210	55.0	170	472														
215	66.9	203	557														
220	79.8	240	647														
225	95.5	279	750														
230	115	326															
235	137	380															
240	164	450															
245	193	520															
250	229	604															
255	268	700															
260	314	800															
265	363																
270	430																
275	500																
280	580																
285	682																
290	790																

*The data in Tables 3-13, 3-14, and 3-15 are not always consistent. Later tables have been computed by Gmitro and Vermeulen, *Am. Inst. Chem. Engrs. J.*, 10, 741 (1964) and Document 8041, American Documentation Institute, Photoduplication Service, Library of Congress, Washington, D.C., but these also apparently contain some inconsistencies.

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PASSPORT MSDS
6472

MATERIAL SAFETY DATA SHEET

PRODUCT 1 of 7

PRE-TECT® PT7000

EMERGENCY TELEPHONE NUMBER
(800)463-3216 (24 Hours)

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME : PRE-TECT® PT7000

APPLICATION : WATER TREATMENT

CHEMICAL DESCRIPTION : Amine, Water

COMPANY IDENTIFICATION : Nalco Canada Inc.
1055 Truman Street
Burlington, Ontario
L7R 3Y9

EMERGENCY TELEPHONE NUMBER : (800)463-3216 (24 Hours)

NFPA 704M/HMIS RATING
HEALTH : 3 / 3 FLAMMABILITY : 1 / 1 REACTIVITY : 0 / 0 OTHER :
0 = Insignificant 1 = Slight 2 = Moderate 3 = High 4 = Extreme

2. COMPOSITION/INFORMATION ON INGREDIENTS

Our hazard evaluation has identified the following chemical substance(s) as hazardous.

Hazardous Substance(s)	CAS NO	% w/w)
Monoethanolamine	141-43-5	30.0 - 60.0

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

DANGER
Corrosive. May cause tissue damage. Harmful if absorbed through skin. Vapors may have a strong offensive odor which may cause sensory response including headache, nausea and vomiting.
Do not get in eyes, on skin, on clothing. Do not take internally. Use with adequate ventilation. Keep container tightly closed and in a well-ventilated place. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. After contact with skin, wash immediately with plenty of water.
Wear a face shield. Wear chemical resistant apron, chemical splash goggles, impervious gloves and boots.
May evolve oxides of carbon (COx) under fire conditions. May evolve oxides of nitrogen (NOx) under fire conditions.

HUMAN HEALTH HAZARDS - ACUTE :

EYE CONTACT :
Corrosive. Will cause eye burns and permanent tissue damage. Exposure to low vapor concentrations can result in foggy or blurred vision, objects appearing bluish and appearance of a halo around lights. These symptoms are temporary.

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MATERIAL SAFETY DATA SHEET

PRODUCT

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PRE-TECT® PT7000 6472

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SKIN CONTACT :
May cause severe irritation or tissue damage depending on the length of exposure and the type of first aic administered. Harmful if absorbed through skin.

INGESTION :
Not a likely route of exposure. Corrosive; causes chemical burns to the mouth, throat and stomach.

INHALATION :
Irritating, in high concentrations, to the eyes, nose, throat and lungs. Vapors may have a strong offensive odor which may cause sensory response including headache, nausea and vomiting.

AGGRAVATION OF EXISTING CONDITIONS :
A review of available data does not identify any worsening of existing conditions.

HUMAN HEALTH HAZARDS - CHRONIC :
Certain amines in contact with nitrous acid, organic or inorganic nitrites or atmospheres with high nitrous oxide concentrations may produce N-nitrosamines, many of which are cancer-causing agents to laboratory animals.

4. FIRST AID MEASURES

EYE CONTACT :
PROMPT ACTION IS ESSENTIAL IN CASE OF CONTACT. Immediately flush eye with water for at least 15 minutes while holding eyelids open. Get immediate medical attention.

SKIN CONTACT :
Immediately flush with plenty of water for at least 15 minutes. For a large splash, flood body under a shower. Remove contaminated clothing. Wash off affected area immediately with plenty of water. Get immediate medical attention. Contaminated clothing, shoes, and leather goods must be discarded or cleaned before re-use.

INGESTION :
DO NOT INDUCE VOMITING. If conscious, washout mouth and give water to drink. Get immediate medical attention.

INHALATION :
Remove to fresh air, treat symptomatically. Get medical attention.

NOTE TO PHYSICIAN :
Probable mucosal damage may contraindicate the use of gastric lavage. Based on the individual reactions of the patient, the physician's judgement should be used to control symptoms and clinical condition.

5. FIRE FIGHTING MEASURES

Flash Point : > 93.3 °C (PMCC)

EXTINGUISHING MEDIA :
Apply alcohol-type or all purpose-type foam by manufacturer's recommended techniques for large fires., Use carbon dioxide or dry chemical media for small fires.
Keep containers cool by spraying with water.

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MATERIAL SAFETY DATA SHEET

PRODUCT 3 of 7

PRE-TECT® PT7000 6472

EMERGENCY TELEPHONE NUMBER
(800)463-3216 (24 Hours)

FIRE AND EXPLOSION HAZARD :
May evolve oxides of carbon (COx) under fire conditions. May evolve oxides of nitrogen (NOx) under fire conditions.

SPECIAL PROTECTIVE EQUIPMENT FOR FIRE FIGHTING :
In case of fire, wear a full face positive-pressure self contained breathing apparatus and protective suit.

SENSITIVITY TO MECHANICAL IMPACT :
Not expected to be sensitive to mechanical impact.

SENSITIVITY TO STATIC DISCHARGE :
Not expected to be sensitive to static discharge.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS :
Restrict access to area as appropriate until clean-up operations are complete. Ensure clean-up is conduc ed by trained personnel only. Ventilate spill area if possible. Do not touch spilled material. Stop or reduce any l aks if it is safe to do so. Use personal protective equipment recommended in Section 8 (Exposure Controls/Person l Protection). Notify appropriate government, occupational health and safety and environmental authorities.

METHODS FOR CLEANING UP :
SMALL SPILLS: Soak up spill with absorbent material. Place residues in a suitable, covered, properly lab led container. Wash affected area. LARGE SPILLS: Contain liquid using absorbent material, by digging tren hes or by diking. Reclaim into recovery or salvage drums or tank truck for proper disposal. Wash site of spillage thc oughly with water. Contact an approved waste hauler for disposal of contaminated recovered material. Dispose f material in compliance with regulations indicated in Section 13 (Disposal Considerations).

ENVIRONMENTAL PRECAUTIONS :
Do not contaminate surface water.

7. HANDLING AND STORAGE

HANDLING :
Do not get in eyes, on skin, on clothing. Do not take internally. Do not breathe vapors/gases/dust. Use wi h adequate ventilation. Avoid generating aerosols and mists. Keep away from acids and oxidizing agents. eep the containers closed when not in use. Have emergency equipment (for fires, spills, leaks, etc.) readily availab e.

STORAGE CONDITIONS :
Store the containers tightly closed. Store separately from acids. Store separately from oxidizers. Amine a d sulfite products should not be stored within close proximity or resulting vapors may form visible airborne particles.

UNSUITABLE CONSTRUCTION MATERIAL :
Copper, Brass, Bronze, Aluminum, Cast iron

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

OCCUPATIONAL EXPOSURE LIMITS :
Exposure guidelines have not been established for this product. Available exposure limits for the substanc (s) are shown below.

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MATERIAL SAFETY DATA SHEET

PRODUCT 4 of 7

PRE-TECT® PT7000 6472

EMERGENCY TELEPHONE NUMBER

(800)463-3216 (24 Hours)

ACGIH/TLV :
Substance(s)

Monoethanolamine	TWA: 3 ppm , 7.5 mg/m3 STEL: 6 ppm , 15 mg/m3

OSHA/PEL :
Substance(s)

Monoethanolamine	TWA: 3 ppm , 8 mg/m3 STEL: 6 ppm , 15 mg/m3

ENGINEERING MEASURES :
General ventilation is recommended. Use local exhaust ventilation if necessary to control airborne mist ar d vapor.

RESPIRATORY PROTECTION :
If significant mists, vapors or aerosols are generated an approved respirator is recommended. An organic vapor cartridge with dust/mist prefilter or supplied air may be used. In event of emergency or planned entry into unknown concentrations a positive pressure, full-facepiece SCBA should be used. If respiratory protection is required, institute a complete respiratory protection program including selection, fit testing, training, maintenance and inspection.

HAND PROTECTION :
Butyl gloves, Neoprene gloves, Nitrile gloves, Viton™ gloves

SKIN PROTECTION :
Wear chemical resistant apron, chemical splash goggles, impervious gloves and boots. A full slicker suit is recommended if gross exposure is possible.

EYE PROTECTION :
Wear a face shield with chemical splash goggles.

HYGIENE RECOMMENDATIONS :
Eye wash station and safety shower are necessary. If clothing is contaminated, remove clothing and thoroughly wash the affected area. Launder contaminated clothing before reuse.

9. PHYSICAL AND CHEMICAL PROPERTIES

PHYSICAL STATE	Liquid
APPEARANCE	Clear Colorless
ODOR	Mild, Ammoniacal

SPECIFIC GRAVITY	0.96 - 0.98 @ 25 °C
SOLUBILITY IN WATER	Complete
pH (100 %)	12.5 - 13.5
FREEZING POINT	-27 °C
BOILING POINT	170 °C

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MATERIAL SAFETY DATA SHEET

PRODUCT	5 of 7
PRE-TECT® PT7000	6472

EMERGENCY TELEPHONE NUMBER
(800)463-3216 (24 Hours)

VAPOR PRESSURE	0.3 - 0.4 mm Hg @ 20 °C
VAPOR DENSITY	2.1

10. STABILITY AND REACTIVITY

STABILITY :
Stable under normal conditions.

HAZARDOUS POLYMERIZATION :
Hazardous polymerization will not occur.

CONDITIONS TO AVOID :
High temperatures

MATERIALS TO AVOID :
Contact with strong acids (e.g. sulfuric, phosphoric, nitric, hydrochloric, chromic, sulfonic) may generate heat, splattering or boiling and toxic vapors. Contact with strong oxidizers (e.g. chlorine, peroxides, chromates, nitric acid, perchlorate, concentrated oxygen, permanganate) may generate heat, fires, explosions and/or toxic vapors. Avoid contact with SO2 or acidic bisulfite products, which may react to form visible airborne amine salt particles. Certain amines in contact with nitrous acid, organic or inorganic nitrites or atmospheres with high nitrous oxide concentrations may produce N-nitrosamines, many of which are cancer-causing agents to laboratory animals. Contact with reactive metals (e.g. aluminum) may result in the generation of flammable hydrogen gas.

HAZARDOUS DECOMPOSITION PRODUCTS :
Under fire conditions: Oxides of carbon, Oxides of nitrogen

11. TOXICOLOGICAL INFORMATION

The following results are for the hazardous components.

ACUTE ORAL TOXICITY :

Species	LD50	Tested Substance
Rat	1,720 mg/kg	(Monoethanolamine)

Rating : Non-Hazardous

ACUTE DERMAL TOXICITY :

Species	LD50	Tested Substance
Rabbit	1,000 mg/kg	(Monoethanolamine)

Rating : Non-Hazardous

SENSITIZATION :
This product is not expected to be a sensitizer.

CARCINOGENICITY :
None of the substances in this product are listed as carcinogens by the International Agency for Research on Cancer (IARC), the National Toxicology Program (NTP) or the American Conference of Governmental Industrial Hygienists (ACGIH).

NALCO

MATERIAL SAFETY DATA SHEET

PRODUCT

PRE-TECT® PT7000

6 of 7

6472

EMERGENCY TELEPHONE NUMBER

(800)463-3216 (24 Hours)

HUMAN HAZARD CHARACTERIZATION :
Based on our hazard characterization, the potential human hazard is: High

12. ECOLOGICAL INFORMATION

ECOTOXICOLOGICAL EFFECTS

The following results are for the hazardous components.

ACUTE FISH RESULTS :

Species	Exposure	LC50	Tested Substance
Fathead Minnow	96 hrs	125 mg/l	(Monoethanolamine)
Bluegill Sunfish	96 hrs	75 mg/l	(Monoethanolamine)
Rainbow Trout	96 hrs	150 mg/l	(Monoethanolamine)

Rating : Slightly toxic

ACUTE INVERTEBRATE RESULTS :

Species	Exposure	LC50	EC50	Tested Substance
Daphnia magna	24 hrs	140 mg/l		(Monoethanolamine)

Rating : Essentially non-toxic

13. DISPOSAL CONSIDERATIONS

In Ontario, the waste class under Regulation 347 is: 268C

Dispose of wastes in an approved incinerator or waste treatment/disposal site, in accordance with all applicable regulations. Do not dispose of wastes in local sewer or with normal garbage.

14. TRANSPORT INFORMATION

Proper Shipping Name / Hazard Class may vary by packaging, properties, and mode of transportation. Typical Proper Shipping Names for this product are:

ETHANOLAMINE SOLUTION, Class 8, UN2491, PG III

15. REGULATORY INFORMATION

NATIONAL REGULATIONS, CANADA :

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS) :
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all the information required by the CPR.

WHMIS CLASSIFICATION :
E - Corrosive Material, D1B - Materials Causing Immediate and Serious Toxic Effects - Toxic Material

NALCO

MATERIAL SAFETY DATA SHEET

PRODUCT

PRE-TECT® PT7000

7 of 7

6472

EMERGENCY TELEPHONE NUMBER

(800)463-3216 (24 Hours)

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) :
All substances in this product are listed on the Domestic Substances List (DSL), are exempt, or have been reported in accordance with the New Substances Notification Regulations.

NATIONAL POLLUTANT RELEASE INVENTORY (NPRI) :
This product does not contain any substances listed in Schedule I of the NPRI at a concentration of one percent or more by weight.

NATIONAL REGULATIONS, USA :

TOXIC SUBSTANCES CONTROL ACT (TSCA) :
The chemical substances in this product are on the TSCA 8(b) Inventory (40 CFR 710).

16. OTHER INFORMATION

This product material safety data sheet provides health and safety information. The product is to be used in applications consistent with our product literature. Individuals handling this product should be informed of the recommended safety precautions and should have access to this information. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to insure safe workplace operations. Please consult your local sales representative for any further information.

Prepared By : Responsible Care Department
Date issued : 2000/07/24
Replaces :

RASSPORT MSDS
5063

MATERIAL SAFETY DATA SHEET

PRODUCT IDENTITY: Sodium Hypochlorite: Wilclor 1, Wilclor 2, Wilclor 3

SECTION I.

MANUFACTURER'S NAME: GEORGE MANN & CO., INC.
ADDRESS: P.O. BOX 9066
PROVIDENCE, RI 02940

EMERGENCY TELEPHONE NUMBER: CHEMTREC 1-800-424-9300
INFORMATION TELEPHONE NUMBER: 401-781-5600
EFFECTIVE DATE: 11/10/94 Replaces 07/16/90
CHANGES: Wilclor 3 added. Sections VI, VII, VIII, & IX updated.

SECTION II. HAZARDOUS INGREDIENTS/IDENTITY INFORMATION

COMPONENTS	CAS NO.	OSHA PEL	ACGIH TLV	OTHER LIMITS	%
Sodium Hypochlorite	7681-52-9	None Established			15%
Sodium Hydroxide	1310-73-2	2 mg/m^3 ceiling			0.2-2.0%
Water	7732-18-5	None Established			72%
Sodium Chloride	7647-14-5	None Established			12%

HAZARD CLASSIFICATION: 0 to 4 0 = MINIMAL 4 = SEVERE
Health: 3 Flammability: 0 Reactivity: 1

SECTION III. PHYSICAL/CHEMICAL CHARACTERISTICS

BOILING POINT: 219°F (104°C) SPECIFIC GRAVITY (H2O=1): 1.15-1.25

VAPOR PRESSURE (mmHg) VP of water plus variable decomposition products

MELTING POINT: -10°C EVAPORATION RATE: 1
(Water = 1.0)

VAPOR DENSITY(AIR=1): NA pH: 12.5-13.5 @ 25°C

SOLUBILITY IN WATER: Complete

APPEARANCE AND ODOR: Light yellow to green liquid with characteristic chlorine odor.

SECTION IV. FIRE & EXPLOSION HAZARD DATA

FLASH POINT: NA

FLAMMABLE LIMITS: LEL: NA
UEL: NA

EXTINGUISHING MEDIA: Suitable for surrounding fire. Keep material cool using a water spray.

SPECIAL FIRE FIGHTING PROCEDURES: Wear self-contained breathing apparatus and full protective clothing. Avoid inhalation of fumes and body contact.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Many reactions can cause fire and explosion. Reacts vigorously with oxidizable materials. Toxic fumes can be liberated by heat. Will react with some metals to release oxygen.

SECTION V. REACTIVITY DATA

STABILITY: Relatively stable below 10%. Stability decreased with exposure to heat, light, acids, metals,& ammonia.

CONDITIONS TO AVOID: Excessive exposure to heat and light.

INCOMPATIBLE MATERIALS: Acids, Ammonia, Metals (Nickel, Cobalt, Copper, Aluminum and Iron), Oxidizable materials, and Chlorinated isocyanurates.

HAZARDOUS DECOMPOSITION PRODUCTS: Chlorine, Hydrochloric Acid, Hypochlorous Acid, and Oxygen.

HAZARDOUS POLYMERIZATION: Will not occur.

SECTION VIa. HEALTH HAZARD DATA

ROUTES OF ENTRY
Skin Contact: Causes severe irritation and reddening of skin.

Eye Contact: Causes severe irritation.

Inhalation: Causes coughing and irritation of the respiratory tract.

Ingestion: Can cause corrosion of mucous membranes, perforation of esophagus and stomach, laryngeal edema; may lead to convulsion, coma and death.

SARA TITLE III HAZARDS:	Health:	Acute (immediate)	Yes
		Chronic (delayed)	Yes
	Physical Properties:	Fire	No
		Pressure	No
		Reactivity	No

SECTION VIa. HEALTH HAZARD DATA

CARCINOGENICITY
NTP: No IARC Monographs: No OSHA Regulated: No

SIGNS AND SYMPTOMS OF OVEREXPOSURE: Skin & Eyes: Severe irritation and reddening. Respiratory tract: Coughing and irritation. Ingestion: Convulsions, coma, and death.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY OVEREXPOSURE: Normally none but vapors may aggravate respiratory ailments.

SECTION VIb. EMERGENCY AND FIRST AID PROCEDURES

EYE CONTACT: Flush with water for at least 15 minutes; get prompt medical attention.

SKIN CONTACT: Remove contaminated clothing and wash skin with plenty of soap and water. If skin is burned, get medical attention.

INHALATION: Remove victim to fresh air. Call a physician if breathing is difficult.

INGESTION: Drink large quantities of milk or water. DO NOT induce vomiting. Call a physician or Poison Control Center immediately.

SECTION VII. PRECAUTIONS FOR SAFE HANDLING AND USE

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Isolate the area; wear appropriate personal protective equipment; contain the spill and mop or soak up with absorbent material; residues may be toxic to fish and aquatic life. Keep spills from entering sewers, streams, storm drains. Neutralize large spills and test for residual chlorine with a chlorine test kit before disposal.

WASTE DISPOSAL METHOD: Dispose of residue in accordance with Federal, State and local regulations.

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING: Store in a cool, well ventilated area away from heat and direct sunlight.

OTHER PRECAUTIONS: Do not use cleaning agents containing acids or ammonia in cleanup of spills. Mixing with these materials can release chlorine gas which is irritating to the eyes, lungs and mucous membranes.

SECTION VIII. SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION: Not required under normal use conditions. In the event of a spill, use a NIOSH approved acid gas chemical cartridge respirator or full face respirator with canister. For confined spaces or unknown concentrations, use self-contained breathing apparatus.

VENTILATION:

LOCAL EXHAUST: Should be used when necessary to remove irritating fumes.

MECHANICAL: Recommended for worker comfort.

PROTECTIVE GLOVES: Use chemically resistant PVC gloves.

EYE PROTECTION: Wear chemical splash goggles and face shield.

OTHER PROTECTIVE EQUIPMENT: Wear rubber boots and protective clothing to avoid skin contact. Install an eye wash/safety shower in the work area.

WORK/HYGENIC PRACTICES: Wash equipment with soap and water following use. Remove and wash any clothing which has been in contact with the product.

SECTION IX. ADDITIONAL INFORMATION

TSCA INVENTORY: All components are listed.
SARA 313 LIST: No components are listed.

DOT PROPER SHIPPING NAME:	HYPOCHLORITE SOLUTION
DOT HAZARD CLASS:	Corrosive Material
DOT ID NUMBER:	8, UN 1791, PG III
DOT HAZARDOUS SUBSTANCE:	RQ 100 lbs.
DOT HAZARD GUIDE:	#154

When empty, returnable containers must be shipped in accordance with Federal, state, and DOT regulations. All residual product must be removed be triple rinsing the container with water.

This product is regulated by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) if used as a sanitizer or disinfectant. Repackagers must obtain EPA Registration and Establishment numbers.
The information contained herein is furnished without warranty of any kind. Users are responsible for proper use and disposal of this product and the safety and health of employees and customers.

FPL Energy
Seabrook Station

FPL Energy Seabrook Station
P.O. Box 300
Seabrook, NH 03874
(603) 773-7000

August 4, 2008

SBK-L-08128

Mr. Damien Houlihan
Office of Ecosystem Protection
U.S. EPA Region I
One Congress Street, Mail Code CIP
Boston, MA 02114-2023

Seabrook Station
Cooling Water Intake Structure Information Document

FPL Energy Seabrook, LLC ("Seabrook") has enclosed a Cooling Water Intake Structure (CWIS) Information Document in response to EPA's Supplemental Information Request[1] pursuant to Section 308 of the Clean Water Act. The CWIS Information Document supports the renewal application for the Seabrook Station National Pollutant Discharge Elimination System Permit (NH0020338) submitted in September 2006. Seabrook Station is currently operating under an administrative continuance of its NPDES Permit. The submittal date for the CWIS Information Document was initially January 7, 2008. EPA subsequently extended the submittal date to August 4, 2008[2].

The Seabrook Station CWIS Information Document achieves the following goals pursuant to EPA's Supplemental Information Request:

- characterizes impingement, impingement-induced mortality, and entrainment by Seabrook Station's CWISs;
- describes the operation of the facility's cooling water intake structures;
- evaluates both the existing technologies and operational measures, as well as possible additional technologies and operational measures, as potential components of the Best Technology Available (BTA) under § 316(b); and
- establishes whether the technologies and/or operational measures already installed, or that the station proposes to install, at the facility reflect the BTA under CWA § 316(b).

[1] EPA Letter dated July 31, 2007, Stephen S. Perkins to Allen L. Legendre, "Supplemental Information Request Pursuant to Section 308 of the Clean Water Act to Supersede Previous Letter dated December 30, 2004 for Seabrook Station NPDES Permit Reissuance – [NPDES Permit No: NH0020338]"
[2] EPA Letter dated April 22, 2008, Stephen S. Perkins to James M. Peschel, Extension of Information Due date From May 6, 2008 to August 4, 2008"

FPL Energy Seabrook engaged a team of experts to fully evaluate the technical feasibility, public safety impact, and monetary and societal impacts vis-à-vis the environmental benefits of alternative cooling water intake technologies and/or operational practices specified in EPA's request. The technologies and/or operational practices evaluated each presented highly complex and in some cases unprecedented design, constructability and operational challenges. Our team's report entitled "Cooling Water Intake System Information Document" is enclosed.

FPL Energy Seabrook strongly believes that the existing CWIS technology, composed primarily of three offshore intake structures with velocity caps, reflects BTA under CWA § 316(b). Thus Seabrook is not proposing the implementation of any new technology or operational measure at Seabrook Station.

The CWIS Information Document evaluates a number of conceptual technologies, and concludes such technologies are not viable options considering factors including, but not limited to, environmental benefits, operating experience under equivalent conditions, constructability, maintainability, reliability, capital cost, operating & maintenance costs, generation loss, nuclear security considerations, and potential air permitting issues for salt water cooling towers. In addition, none of these technologies has been implemented under conditions as they exist at Seabrook Station. Accordingly, there is an extremely high degree of uncertainty as to their feasibility and ability to provide significant incremental environmental benefits.

The Seabrook team has concluded that the cost of each of the evaluated technologies is prohibitively high when compared to the calculated environmental benefit (IM&E reduction) at a facility that already has a CWIS with relatively low IM&E as detailed in the report. Seabrook Station has operated for eighteen years during which time offshore fish abundance and the in-plant levels of fish impingement and egg/larval entrainment by the CWIS have been closely monitored and reported annually to the EPA, New Hampshire Department of Environmental Services, and National Marine Fisheries Service. These monitoring activities demonstrate minimal environmental impacts to the surrounding marine environment.

The "Analysis of a Cooling Tower Retrofit Option" comprises a significant portion of the enclosed CWIS Information Document. This conceptual analysis concludes that mechanical draft, closed cycle cooling towers would require three separate strings of salt water cooling tower cells (54 cells with a total length of 2700 feet) at two separate locations within the plant property boundaries in close proximity to nearby residences. The impacts associated with this technology include the following:

- An estimated capital cost of $217 million ($2008).
- Reduction of the electrical output and thermal efficiency of Seabrook Station, a major source of energy in the ISO New England regional power grid, due to increased turbine backpressure as well as added electrical loads for the operation of pumps and fans associated with the tower cells.
- Projected additional annual costs for lost generation, approximately and additional electrical load of $31.4 million.

- Increases in regional air emissions; a reduction of 416,000 MWh annual generation from Seabrook Station, replaced by a fossil fueled source, gas, oil or coal, would result in an annual air emissions increase from 140 to 6,514 tons of SO_x; 285 to 1,374 tons of NO_x; and 335,680 to 572,230 tons of CO_2.

- The operation of a salt water cooling tower would create particulate emission levels that would exceed all current NHDES air quality thresholds for new or modified sources and the ability to obtain permits from them is uncertain.

- Modifications to the method for cooling Seabrook Station would require review and approval by the U.S. Nuclear Regulatory Commission.

Due to the high level of risk of operating a relatively unproven technology in the electrical generating industry, the significant reduction in net generation, reduction in plant thermal efficiency, uncertainty regarding permitting requirements due to high particulate emission issues and prohibitive costs, this option is not considered a viable alternative at Seabrook Station.

Seabrook believes that the CWIS at Seabrook Station will continue to satisfy EPA's standards for minimizing adverse environmental impacts under CWA § 316(b). The FPL Energy Seabrook staff and our consultants will be available should you wish to meet to discuss your questions or comments.

Sincerely,

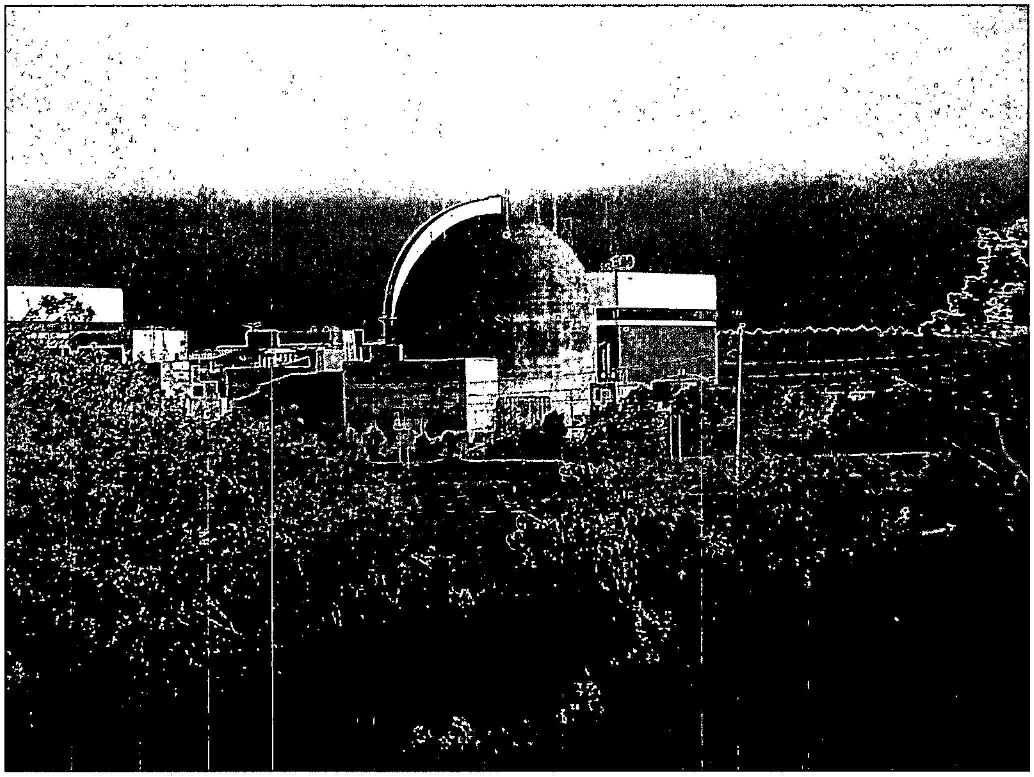
Gene St. Pierre
Site Vice President

cc:

NH Department of Environmental Services
Attn.: Harry T. Stewart, P.E., Director
Water Division
29 Hazen Drive
P.O. Box 95
Concord, NH 03302-0095

NEXTera ENERGY SEABROOK

Seabrook Station



Cooling Water Intake Structure Information Document

SBK-L-08128

FPL Energy Seabrook, LLC

Cooling Water Intake Structure Information Document

Seabrook Nuclear Power Station

July 2008

Technical Consultants:
ARCADIS
Normandeau Associates, Inc.
Wayne C. Micheletti, Inc.
Harris Group, Inc.

Cooling Water Intake Structure Information Document

Seabrook Nuclear Power Station

Prepared for:
FPL Energy Seabrook, LLC

Prepared by:
ARCADIS
Normandeau Associates, Inc.
Wayne C. Micheletti, Inc.
Harris Group, Inc.

Our Ref.:
B0090430.001 #10

Date:
July 2008

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Cooling Water Intake Structure Information Document

Seabrook Nuclear Power Station, Seabrook, NH

Executive Summary

This Cooling Water Intake Structure Information Document (CWIS ID) is being submitted to the United States Environmental Protection Agency (USEPA) and the New Hampshire Department of Environmental Services (DES) by FPL Energy Seabrook, LLC (FPLE) in response to two USEPA letters (dated December 6, 2006 and July 31, 2007). The EPA letters, respectively, (1) provided comments on the Proposal for Information Collection (PIC) submitted by FPLE in May 2006 in compliance with the Phase II Rule of Section 316(b) of the federal Clean Water Act, and, (2) requested supplemental information regarding the cooling water intake structure (CWIS) at the Seabrook Nuclear Power Station and an evaluation of other potential technologies or operational measures that could reduce cooling water intake flow requirements. Following the USEPA's decision to suspend its Phase II regulations (July 9, 2007) with the exception of 40 CFR 125.90(b), the USEPA indicated that the determination of best technology available (BTA) for cooling water intake structures would be based on the best professional judgment of the USEPA or state agencies responsible for issuing National Pollutant Discharge Elimination System (NPDES) permits for these facilities. This CWIS ID provides FPL's responses to both USEPA letters.

In response to the December 6, 2006 USEPA letter, several sections of the PIC have been expanded and revised to provide updated and additional information regarding: the source water body (Atlantic Ocean); applicable performance standards, including impingement mortality and entrainment (IM&E) reductions from a baseline intake (calculation baseline) due to existing intake characteristics; methodology for calculating baseline intake flow and current operational intake water flow reductions; proposed operational and/or restoration measures and associated costs; a discussion of methodology and QA/QC procedures associated with past and on-going IM&E study efforts. The revised PIC document is provided in Appendix A.

One of the revisions to the PIC is the addition of the 1976 physical model study which estimated the Hydraulic Zone of Influence (HZI) for the intake structure. The modeling was performed under projected flow conditions for two operating units and the HZI was estimated to be between 15 and 30 feet, depending upon ambient current conditions. The small HZI for the CWIS is a contributing factor to the relatively low levels of IM&E at Seabrook Station.

Based on EPA's determination that the recirculation of cooling water for the purpose of optimizing condenser backpressure was an existing operational practice and not

specifically intended for the reduction of IM&E, the flow reduction due to recirculation was removed from the calculation of IM&E with existing technologies and operational measures. With the removal of recirculation and the use of design intake flow, the impingement mortality at Seabrook is 83 percent less than the calculation baseline and entrainment is 25 percent less than the calculation baseline. These reductions are solely due to the design and location of Seabrook's off-shore intake.

In response to the July 31, 2007 USEPA letter, additional information is provided regarding: the source water-body flow, including the hydraulic zone of influence around the intakes which were determined to extend less than 30 feet out from each of the three intake structures based on pre-construction plant hydraulic modeling; description of the cooling water system and its operation, including the age of the equipment and facilities, major equipment upgrades since January 2001, projected retirement date of the station, an overview of the processes used to generate electricity, an evaluation of intake technologies and operational measures for impingement mortality and entrainment reduction, fisheries data collected over the past 5 years of entrainment and impingement sampling events at the Station (provided on a separate CD attached to this document); and entrainment and impingement adult equivalency estimates associated with the data collected over the past 5 years. The evaluated intake technologies and operational measures include conversion of the once-through cooling system to a closed cycle system using mechanical draft cooling towers, addition of cylindrical wedgewire screens to the off-shore intakes, use of water supplied from discharge of local waste water treatment plants (grey water) for cooling water at Seabrook, reduction of cooling water intake flow through the use of recirculation, reduced pump operation and the use of variable frequency drives (VFD) for the circulating water pumps.

Based on the evaluation of the various technologies and operational measures that could potentially be used to reduce intake water flow at Seabrook Station, the following conclusions have been reached:

- A conceptual study has concluded that mechanical draft, closed cycle cooling towers would require three separate strings of salt water cooling tower cells (54 cells with a total length of 2700 feet) at two separate locations within the plant property boundaries in close proximity to nearby residences. This technology could potentially reduce the station intake flow, as well as IM&E by approximately 88% from the levels that would occur at the current intake design flow and 87% from the current actual levels of IM&E. This technology would be prohibitively expensive with an estimated capital cost of $217 million ($2008) Cooling towers would also reduce the electrical output and efficiency due to increased turbine backpressure as well as the additional electrical loads for the operation of pumps and fans associated with the tower cells. The estimated annual cost for lost generation and increased electrical load is $31.4 million. Replacement of the lost generation with a fossil fueled source would have the effect of increasing regional air emissions. It is estimated that the replacement of 416,000 MWh annually from Seabrook Station, if replaced by a fossil fueled source, (gas, oil or coal), the overall annual increase in air emissions would be 140 to 6,514 tons of SO_x, 285 to 1,374 tons of NO_x, and 335,680 to 572,230 tons of CO_2. There is also minimal industry experience with the retrofit of mechanical draft cooling towers at nuclear generating facilities. In addition, since there is insufficient fresh water available from the local municipal water supply for potential use in the tower cells, use of salt water in the cells would be required. The operation of a salt water cooling tower would create particulate emission levels that would exceed all current NHDES air quality thresholds for new or modified sources. Due to the high level of risk associated with an extended construction period (3 years) at a nuclear generating facility, significant reduction in net generation, reduction in plant thermal efficiency, uncertainty regarding permitting requirements due to high particulate emission issues, lack of industry experience with salt water-based mechanical draft cooling tower systems and prohibitive costs, this option is not considered a viable alternative at Seabrook.

- Wedgewire screens would require the installation of three cylindrical, 84" diameter, 28-foot long screens with ¼" slot openings that would have to be installed by divers on each of the three off-shore velocity cap intakes (9 screens total) to reduce the through screen velocities to 0.5 feet per second (fps). Due to the small size slot openings (1/4"), an airburst system would be needed to reduce fouling of the screens. Installation of an air-burst system would require directional drilling from the plant intake structure to the shoreline and then trenching to the velocity caps - a total distance of approximately 3 miles. Due to the circular orientation of the screens on the intakes, sufficient ambient currents along the longitudinal axis of the screens may not be available to assist in keeping debris off the screens. In addition, storm surges typically push heavy submerged aquatic vegetation into the offshore intake location, potentially causing clogging of the screens and requiring plant shutdown to allow for divers to physically clean the screens. There currently are no known domestic offshore wedgewire screen installations located at sea water intakes; however, there is a shoreline sea water installation using wedgewire screens and biofouling of the screens has been a significant problem requiring frequent removal of the screens for cleaning. With the installation of wedgewire screens impingement mortality would essentially be eliminated. Since wedgewire screens with slot widths small enough to prevent the physical exclusion of eggs and larvae cannot be considered for use on the off-shore intakes at Seabrook, it is anticipated that entrainment of eggs and larvae would be unchanged from the current intake configuration that provides an intake velocity of 0.8 fps and also has a small HZI. The estimated capital cost to install this system is $26 million ($2008), not including the cost of lost generation due to the extended outage that would be needed to install the system. Due to the high cost, the significantly increased operational challenges at the remote, offshore location of the system and the potentially high risk of system failure due to plugging of the screens, this option is not considered a viable alternative at Seabrook.

- The potential use of grey water from three water pollution control plants (WPCP) ranging in location from 2.2 miles to 15 miles from Seabrook could potentially provide approximately 5-6 million gallons per day (mgd) of cooling water to Seabrook. This would be less than 1% of the 682 mgd cooling water flow required for the station. The construction routes for the piping and pumping systems needed to transport the grey water to the station would require the acquisition of rights-of-way, an extended permitting process, construction in wetland and salt marsh areas, remote power requirements for the pumping stations and ongoing maintenance of the systems. The estimated capital cost for this system would be in excess of $12 million ($2008). Since this system would only decrease the amount of cooling water drawn into the system by 1%, the reduction in impingement mortality and entrainment would be essentially imperceptible. This option is not considered a viable alternative at Seabrook.

- Potential operational measures include flow reduction through recirculation of cooling water discharge, reduced pump operation and the use of variable frequency drives. The majority of flow reduction due to recirculation of condenser discharge water, reduced pump operation, and the use of VFDs would occur during the months when lower temperature cooling water is available (December – April). Use of re-circulated condenser discharge water is a current operating practice at Seabrook and the resultant decrease in annual flow from design conditions provides an 11% reduction in impingement mortality and a 10% reduction in entrainment (some reduction from design flow is also attributable to station outages). The operation of two versus three circulating water pumps can only be instituted during the months with lower cooling water temperatures and would not provide any further reduction in IM&E from the current operating practice using recirculation. While two pump operation would not provide any incremental decrease in IM&E, it would create significant operational concerns and increased potential for plant trips. Installation of VFDs on the three pumps at Seabrook would reduce flow from the current actual levels. With the use of VFDs on all three pumps it was estimated that entrainment could be reduced an additional 4% from current levels if current maximum allowed cooling water temperature differential can be increased. Without an increase in the temperature differential, the projected decrease in entrainment with the use of VFDs would be reduced to 3%. While impingement reduction is typically assumed to be proportional to reductions in flow, past observations at Seabrook have indicated that storm events and other environmental conditions have the greatest impact on impingement rates. Therefore, the small reduction in flow through the use of VFDs was assumed to provide very little, if any, reduction in impingement mortality. While flow reductions by recirculation and reduced pump operation are operational measures that would not require capital investment, the installation of VFDs would require a capital investment of $7.7 million ($2008). The use of VFDs for flow reduction would carry significant risks associated with potential cooling water temperature variations outside the permit limits due to fluctuations in pump operations as well as back pressure variations that could impact turbine operation. The current use of re-circulated condenser discharge water will continue to be a reliable flow reduction method at Seabrook. Potential flow reduction through the reduced use of the existing pumps or through the installation of VFDs for all three pumps poses unknown risks and would require further evaluation to determine viability.

The evaluation of impingement and entrainment over the past 5 years (2002 through 2006) is based on actual, periodic sampling events over this time period. This information is provided on the attached CD. The evaluation compares the IM&E impacts with the calculation baseline. The baseline condition was developed in the PIC; a theoretical shoreline intake structure which would be located in shallower water than the current offshore intakes and would have associated higher intake water temperatures and generally higher densities of all species/ life stages of fish. In comparison to the existing offshore intake that has a full load flow of 682 mgd, the theoretical shoreline intake would have a full load flow of 744 mgd to compensate for the higher ambient intake water temperatures. The difference between the Seabrook intake and a baseline intake results in an 83% reduction in impingement mortality and a 25% reduction in entrainment from baseline conditions.

The evaluation includes the development of the Adult Equivalency (AE) of fish which is a procedure that applies the mortality rates for each life stage to the numerical estimates of entrainment and impingement losses of early life stages to estimate the equivalent number of fish that would have been lost if these early lifestages had survived to adulthood. Of the total estimated annual number of fish eggs entrained (1,103 million), an AE loss of 106,000 adult fish was estimated. Out of a total estimated number of larvae entrained (448 million), an AE loss of 388,000 adult fish was estimated. Out of the total estimated number of juvenile and adult fish impinged, (29,876) an AE loss of 17,000 was estimated. The AE losses for most commercial fish ranged from less than 500 (American plaice, Atlantic cod, Atlantic herring, Atlantic mackerel, haddock, hakes, and pollock) to approximately 3,200 (winter flounder) per year. To put these numbers in perspective it is estimated that a small inshore commercial trawler can capture about 4,000 adult winter flounder in less than 3 days of fishing effort. The development of the estimates of the numbers of organisms impinged or entrained is based on the typical operating conditions at Seabrook.

The overall conclusion of our evaluations is that none of the technologies evaluated would provide environmental effectiveness, cost effectiveness, and operational reliability in reducing IM&E at Seabrook. Under the site specific conditions at Seabrook Station, none of the technologies or additional operational measures evaluated would provide a significant decrease in the current levels of IM&E achieved by the existing intake without the creation of other environmental impacts and high levels of operational risk and uncertainty. Based on the site-specific considerations and uncertainty of the technologies and operational measures considered, it is concluded that the current configuration of the Seabrook Station intake, which is located at an off-shore location of low biological activity and employs the use of velocity caps, along with the use of recirculation as an operational measure, is the best technology available (BTA) for minimizing adverse environmental impact.

1. Introduction

The Seabrook Nuclear Power Station (Seabrook), owned by FPL Energy Seabrook, LLC (FPL), is located in Seabrook, New Hampshire on the western Gulf of Maine, an embayment of the North Atlantic Ocean.

Seabrook is a single unit, base-loaded plant with a total net capacity of 1,245 MW and is among the largest generating stations in New England. Seabrook began commercial operation in August 1990. The unit uses a once-through cooling water system that withdraws water from the Atlantic Ocean. The cooling water intake system was designed and built to accommodate two units at the plant. Only one unit was built and commissioned at the site. The facility has a lifetime capacity factor of 85% (94% excluding refueling outages).

In May 2006, Seabrook submitted the Proposal for Information Collection (PIC) for the Seabrook Station to the United States Environmental Protection Agency (USEPA), in compliance with the Phase II Rule under Section 316 (b) of the Clean Water Act. In December 2006, the USEPA provided comments to Seabrook on the PIC. As a result of legal actions regarding the Phase II Rule under Section 316 (b) of the Clean Water Act, the USEPA suspended the Rule in July 2007. Subsequent to suspension of the Phase II Rule, the USEPA issued another comment letter to Seabrook requesting additional information in July 2007.

In its July 2007 letter to Seabrook the USEPA requested that Seabrook provide a Cooling Water Intake Structure Information Document that incorporates the responses to the USEPA's December 2006 and July 2007 letters to Seabrook.

The following sections provide: a brief history of the NPDES permit for the Seabrook Station; a summary of the recent changes to the Phase II Rule; and the detailed information requested in USEPA's December 2006 and July 2007 letters. A revised version of the PIC is also attached which incorporates the various revisions requested by the USEPA. The Revised PIC is provided in Appendix A.

1.1 NPDES Permit No. NH0020338 - Permitting History for the Seabrook Station

Seabrook operates under the National Pollutant Discharge Elimination System (NPDES) Permit NH0020338, which expired on April 1, 2007. The permit has been administratively continued since Seabrook timely applied to the USEPA for permit reissuance in September 2006. The Seabrook station remains subject to the existing permit conditions until the USEPA issues a new permit.

As part of the permit re-issuance process, the USEPA issued a letter (dated December 30, 2004) to Seabrook requesting additional information pertaining to the Phase II Rule under Section 316 (b) of the Clean Water Act. The Phase II Rule was issued by the USEPA on September 7, 2004. In response to the USEPA's December 30, 2004 letter, Seabrook submitted its PIC on May 4, 2006.

On December 6, 2006, the USEPA issued a letter to Seabrook providing comments on the PIC and requesting additional information on several sections of the PIC. The responses were due on January 7, 2008.

As discussed further in Section 1.2, the USEPA formally suspended the Phase II Rule on July 9, 2007. As a result of the Rule's suspension, the USEPA issued a letter to Seabrook on July 31, 2007 requesting supplemental information, with the responses also due on January 7, 2008. The July 31, 2007 letter incorporated the comments and submittal requirements contained in the December 6, 2006 letter.

Seabrook subsequently requested, and was granted a 120 day extension by the USEPA for filing the information requested in their December 6, 2006 and July 31, 2007 letters. On April 22, 2008, FPL was granted an additional 90 day extension for submittal requirements of the information. The combined responses to both letters are due on August 4, 2008.

1.2 USEPA § 316 (b) Rule Background

The Clean Water Act of 1972 [33USC § 1326(b)], states, "[a]ny standard ... applicable to a point source shall require that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available (BTA) for minimizing adverse environmental impact." The USEPA promulgated the Section 316(b) Phase II (large existing electric generation facilities) regulations on September 7, 2004 (69 Fed. Reg. 131, 41687; Phase II Rule).

The Phase II Rule was the second phase of a three-phase rule making. Phase II applied to existing power-generating facilities that have the design capacity to withdraw at least 50 million gallons per day (50 mgd) of cooling water from waters of the United States and use at least 25 percent of the water they withdraw exclusively for cooling purposes. These regulations contained requirements, among others, regarding the contents of the Comprehensive Demonstration Study (CDS), which was to be submitted by a facility on a prescribed schedule and subsequently with each NPDES permit renewal.

These regulations were challenged by several groups, including environmental and utility industry groups and several state governments. Major sections of the Phase II Rule were either remanded or overturned by the Second Circuit Court of Appeals (Riverkeeper, Inc. v. USEPA, No. 04-6692 [2d Cir. 2007]). In light of this action, the USEPA suspended the entire Phase II Rule effective July 9, 2007 (72 Fed. Reg. 130, 37107-37109).

In the Federal Register suspension of the final Phase II Rule action, the USEPA directed permitting authorities to develop Best Professional Judgment (BPJ) controls for existing facility cooling water intake structures (CWIS) that reflect the BTA for minimizing adverse environmental impact (AEI).

As a result of their July 9, 2007 actions, USEPA Region 1 issued their July 31, 2007 letter to Seabrook requesting the additional information required in response to the USEPA's comments to the PIC as well as submittal of a Cooling Water Intake Structure Information Document.

2. Additional Information Requested in USEPA's December 6, 2006 Letter to FPL

2.1 Introduction

The USEPA issued a letter to Seabrook, dated December 6, 2006 which provided comments on the PIC document that Seabrook submitted to the USEPA on May 4, 2006.

Normandeau Associates, Inc. (NAI) revised the May 4, 2006 version of the PIC to address and incorporate the USEPA's comments. The Revised PIC is attached in Appendix A.

Sections 2.2.1 through 2.2.7 respond directly to the sections of the PIC that the USEPA commented on/requested additional information for in their December 6, 2006 letter to Seabrook. A copy of the USEPA's December 6, 2006 letter is provided in Appendix B.

2.2 Revised Sections in the PIC

Sections 2.2.1 through 2.2.7 present the comments or questions provided by the USEPA in their December 6, 2006 letter to FPL, followed by FPL's response. As a result of the response to the USEPA's comments, some sections of the PIC have been substantially revised and are provided in the Revised PIC (Appendix A).

2.2.1 PIC Section 3.2: Source Water Physical Data [40 CFR § 122.21 (r) (2)]

USEPA's comment: *"The source water description included in this section of the PIC is very brief, cursory, and provides very little information not already discussed in earlier sections (i.e., location of the CWIS). Given that the PIC does not include a plan to do any further biological sampling and the Permittee is attempting to demonstrate that they are in full compliance with required IM&E reductions, more information on the physical nature of the source waterbody is necessary in order to make determinations on the validity of the reduction calculations and compliance conclusions."*

FPL response: Section 3.2 has been significantly expanded to provide more information on water temperature, salinity, dissolved oxygen, bathymetry, water circulation, the hydraulic zone of influence around the intake structures and a location map of the site. Prior to construction of the Seabrook Station, physical model studies of the proposed intakes were performed that provided, in addition to other information, the expected hydraulic zone of influence around the intakes for the ambient current and tidal influences expected at the site. Under lowest ambient current conditions (0.1m/sec) the hydraulic zone of influence extends approximately 30 ft. horizontally around the intakes (one intake diameter). A copy of the physical model testing report by March and Nyquist (1976) is provided in Appendix C. The revised section 3.2 is provided in the Revised PIC (Appendix A).

2.2.2 PIC Section 4.1: Applicable Performance Standards

USEPA's comment: *Seabrook plans to claim IM&E reduction credits based on deviations from a baseline configuration (shoreline intake with traveling screens). These deviations are:*

- *Offshore intake*
- *Velocity caps*
- *Reductions in flow volume due to withdrawing cooler offshore water as compared to withdrawing water from an onshore location*
- *Re-circulation of some discharge water back into the intake*

These credits are quantified in the PIC from comparisons with IM&E at the Pilgrim Station, which has a shoreline intake on allegedly the same waterbody (calculations in Appendices A, B and C). Such a comparison is allowed by the Phase II Rule, specifically, "...the calculation baseline could be estimated by evaluating existing data from a facility nearby without impingement and/or entrainment control technology (if relevant) or by evaluating the abundance of organisms in the source waterbody in the vicinity of the intake structure that may be susceptible to impingement and/or entrainment." However, the Phase II Rule further requires. "If you propose to use existing data, you must demonstrate the extent to which the data are representative of current conditions and that the data were collected using appropriate quality assurance/quality control procedures." Data were presented in the PIC to establish the appropriateness of the comparison between these facilities, but information was lacking on the source(s) of these data, how the samples were collected, quality assurance/quality control (QA/QC) procedures, or how the data might be representative of current conditions. A complete complement of this type of information would allow a determination of the validity of the comparison, calculations, and conclusions made from these data. Examples of required information (to evaluate the *validity of comparisons between the sites) include: sampling methods used in collection of existing data, QA/QC procedures applied during the process, the relationship of existing data to current conditions (e.g., age of data and, if necessary, relationship to community structure documented in more recent studies), and any other useful information regarding the physical and ecological similarities between the waters in the vicinity of the intake for the Seabrook and Pilgrim facilities.*

In addition, the baseline reduction credits that Seabrook cites (indicating that the facility is already compliant in IM&E reductions) are at the lower limit of the mandated performance range (i.e., 80% reduction for IM and 60% reduction for E). Given that no information is provided to establish the appropriateness or validity of the data used in these calculations, no estimates of error or confidence intervals are given for the reduction estimates, and that no additional biological studies are planned, more information should be provided in the Comprehensive Demonstration Study (CDS) to support these assertions before any determinations of compliance can be made. The appendices that detail the calculations (Appendix A, B and C) do not completely address these concerns.

Furthermore, USEPA has not yet determined what limits within the performance ranges are potentially achievable at Seabrook Station. In the preamble to the Phase II Regulations, USEPA indicates that many facilities can and have achieved a percent reduction in the "higher end of the range" and that "[i]n specifying a range, USEPA anticipates that facilities will select the most cost-effective technologies or operational measures ***to achieve the performance level (within the stated range) based on conditions found at their site****, and that Directors will review the facility's application to ensure that appropriate alternatives were considered" (emphasis added). 69 Fed. Reg. 41600 (July 9, 2004).*

<u>FPL's response</u>: Section 4.1 has been revised to remove reference to the effects of the recirculation flow on impingement mortality and entrainment (IM&E) controls at Seabrook Station. More information on the data collection methods and QA/QC methods used for the Pilgrim Station data that was used for the baseline configuration information for Seabrook is provided. (Note: Seabrook requested the detailed SOP for the Pilgrim impingement and entrainment program but was not able to obtain this information as it has been classified as Confidential Business Information. The Pilgrim SOPs are in Appendix 2 of the Pilgrim Station PIC and are discussed in more detail in Section 2.2.3). Section 4.1 references information on the physical and ecological similarities between the source water bodies for the cooling water systems at the Seabrook and Pilgrim Stations. This information supports the baseline reduction credits

that Seabrook cites and is discussed in greater detail in Section 2.2.3. The revised Section 4.1 is provided in the Revised PIC document (Appendix A).

2.2.3 PIC Section 4.2: Existing Technology, Operational and/or Restoration Methods

The USEPA's comments on this section of the PIC discuss intake flow reduction due to recirculation of cooling water flow from the condensers and differences in cooling water intake flows due to intake water temperatures. These comments are addressed in Sections 2.2.3.1 and 2.2.3.2.

2.2.3.1 Flow Reduction Due to Recirculation

<u>USEPA's comment</u>: *During the winter months, a portion of the heated cooling water is recirculated to the transition structure to prevent subcooling. Subcooling occurs when cold cooling water passing through the condensers reduces the steam condensate temperature to a point where additional heat is required to bring the temperature back up to generate steam when it is returned to the boiler. This results in an overall loss in generating efficiency when the intake water temperature is excessively cold. Since the cooling water pumps are single speed, subcooling is prevented by recirculating a portion of the condenser effluent to the transition structure. The result is a reduction in intake flow volume equal to the volume of recirculated water.*

The Phase II regulations dictate that the Station must reduce impingement mortality by 80 to 95 percent, and reduce entrainment by 60 to 90 percent, of the facility's "calculation baseline". [40 C.F.R. § 125.94 (b)]. The PIC indicates that the recirculation of cooling water discharge is an operational measure, already being implemented at Seabrook Station, that reduces IM&E and that the facility's calculation baseline should be based on an estimate of the IM&E that would occur without this measure.

USEPA must disagree. The calculation baseline for Seabrook Station must be based on impingement mortality and entrainment levels that reflect this existing operational step. The calculation baseline is defined in 40 C.F.R. § 125.93 as "... an estimate of impingement mortality and entrainment that would occur at your site assuming that ...[among other things] the baseline practices, procedures, and structural configuration are those that your facility would maintain in the absence of any structural or operational controls, including flow or velocity reductions, implemented in whole or in part for the purposes of reducing impingement mortality and entrainment." The above-mentioned recirculation of heated condenser water is a baseline operational practice that the Station has historically implemented for power plant operational reasons (to *prevent subcooling) and not for the purpose (or partial purpose of) reducing impingement mortality and entrainment. As a result, the Permittee may not consider the reduction in flow by recirculation in the calculation of baseline flow.*

USEPA does, however, acknowledge that a reduced volume of cooling water is withdrawn due to the colder water at the offshore location of the intakes compared to an inshore location and that this difference can be taken into account when calculating baseline.

FPL's response: The reduction in baseline flow associated with recirculation has been removed in the revised PIC. Seabrook has used the reduction in flow associated with the cooler water temperatures of the intake cooling water (due to the existing offshore location of the intake structures) to re-calculate baseline flow associated with a theoretical shoreline intake facility. An expanded discussion of the calculation baseline for impingement and entrainment for a theoretical shoreline intake as compared to the existing offshore intake for Seabrook Station has been added. Revisions to Section 4.2 incorporating these changes are provided in the Revised PIC document (Appendix A).

2.2.3.2 Differences Due to Intake Water Temperatures

USEPA's comment: *The volume of flow recirculation varies as the surface water temperature and cooling requirements vary. When the intake water temperature drops below the threshold of 46-47° F, recirculation begins and typically occurs from mid to late November to mid to late May. A baseline configuration (shoreline intake) would experience similar periods of reduced cooling water flow demand due to subcooling and, because there is an economic incentive to do so, would also have similar recirculation measures in the cooling system design.[1] So, when comparing to a baseline configuration, the flow volume reduction associated with the difference between the two should be based on the much less pronounced difference in inlet temperatures between these two locations during the colder months.*

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[1] Recirculation is not the only means of achieving flow reduction to prevent subcooling; variable speed pumps provide an alternative to recirculation with similar results in terms of intake flow volume reduction and would be accompanied by reduced pumping energy requirements.

In fact, while the average maximum monthly intake temperature for the baseline intake is 6.6° F higher than for the existing submerged inlet, the baseline intake temperature is only 1.1° F lower during the coldest month; thus, the baseline intake would actually experience a period of slightly higher recirculation rates during the very coldest part of the year. Since the difference in temperature is inverted at the coldest period, gradually increasing from mid-winter to mid-summer, and is most pronounced when no recirculation occurs, the overall difference in recirculation between the existing configuration and baseline configuration is much smaller than the 16.4% maximum and 7.4% overall reduction cited in the PIC. This needs to be clarified in the CDS.

During the summer, the PIC estimated that the baseline intake maximum monthly average intake temperature would be 62° F as opposed to the value of 55.4° F at the existing submerged offshore location. The PIC analysis in Section A-1 assumes that the existing calculated maximum effluent temperature of 94.4°F, based on a change in temperature or "delta-T" (ΔT) of 39°F and an intake temperature of 55.4°F, would be the equivalent permit limit for a system using the shoreline intake. Using this assumption, the PIC estimated the ΔT limit would be 32.4°F, resulting in a design flow that would need to be 8.1% higher. This analysis assumes that the baseline system would also employ single speed pumps and, therefore, the increased flow volume needed at the baseline intake during the summer would apply year-round.

This assumption may have some validity, since single speed pumps were common at the time of initial plant construction. However, depending on the basis for the existing NPDES permit ΔT limit of 39°F, the calculated baseline ΔT limit of 32.4°F may be lower than what would have been applied. Since the 39°F ΔT limit is based on a 316 (a) variance and a higher than 94.4°F maximum effluent temperature may have been applied, then the 8.1% reduction may not be a valid estimate of the difference between the existing and baseline intake. In the CDS, the facility needs to clarify the assumptions used to estimate an 8.1% reduction.

<u>FPL's Response:</u> The intake flow reduction due to recirculation has been removed from the evaluation of the current flow at Seabrook for the purpose of comparing to the calculation baseline. For this reason, it is our opinion that recirculation should not be an operational measure considered when calculating the intake flow associated with the theoretical baseline intake. When determining the intake flow for the baseline intake, it is assumed that single speed circulating water pumps would be used (common engineering design for the majority of electric generating stations) and that the intake design flow would be the actual flow throughout the year. Since design would typically be based on a maximum source water body temperature that would be

exceeded less than 1% or 2% of the time, the maximum average monthly temperatures for the off shore and shoreline locations were used in determining the design flows.

In developing the possible permitting criteria for the theoretical shoreline intake, the maximum cooling water differential temperature currently in place for the Seabrook Station was used. The determination of actual criteria would require significant engineering, modeling, and negotiations which were not done for this effort. It is our opinion that the use of the maximum temperature differential is appropriate for this analysis.

These changes are reflected in Section 4.2 of the revised PIC (Appendix A)

2.2.4 PIC Section 4.3: Proposed Technology, Operational and/or Restoration Measures

<u>USEPA's comment</u>: *Appendix D of the PIC provides a summary of available impingement and entrainment reduction technologies initially evaluated for consideration. The PIC assumes that the intake technologies would be used in conjunction with the existing submerged intake. One important aspect of the submerged intake that affects the technology selection is the stress placed on fish as they pass through the intake tunnel system. Fish are exposed to rapid changes in pressure that occur after they enter the intake and quickly descend to a depth of 160 ft, then travel laterally for about an hour to a depth of 240 ft, and then quickly rise back to the surface. The PIC asserts that this results in significant fish mortality even before fish encounter the traveling screens. It is probably a reasonable assumption that such rapid changes in pressure would result in significant fish mortality. As such, all technology improvements located downstream of the intake tunnel (e.g., Conventional Traveling Screens with a Fish Return System, Modified Traveling Screens, and Angled Screens) are correctly considered as being potentially ineffective, as many fish will have already been killed prior to reaching the transition structure.*

The PIC's conclusion that cylindrical wedgewire screens would cost approximately $8 million is similar to USEPA estimates. And while feasible, the screens would pose a significant risk for loss of flow due to plugging of the intake with debris if an airburst system was not included. While the intake location results in a generally lower risk of high debris loading compared to a shoreline intake, the relative inaccessibility of the screens increases the difficulty of executing corrective actions in a timely manner. Thus, an airburst system is probably a necessary safety feature. However, the PIC *cost estimate for an airburst system of $24 to $100 million appears to be high. A more detailed cost review of the airburst system must be provided in the CDS.*

USEPA agrees that the two flow reduction measures (adding variable frequency drives and increased flow recirculation) should be evaluated further as having a potential for added flow reduction.

FPL's response: The cost for an airburst system has been re-evaluated and is discussed further in Section 3.2.3.2.

2.2.5 PIC Section 4.4: Cost Estimates for Compliance

USEPA's comment: *The PIC refers to Appendix A of the Phase II Rule and noted that zero costs were estimated for Seabrook. The PIC also cites the preamble language explaining the zero cost facilities,"...some entries in Appendix A have NA indicated for the USEPA assumed design intake flow in column 2. These are facilities for which USEPA projected that they would already meet otherwise applicable performance standards based on existing technologies and measures. USEPA projected zero compliance costs for these facilities... These facilities should use $0 as their value for the costs considered by the USEPA for a like facility in establishing the applicable performance standard." (69 FR 41646). The PIC asserts that this language suggests that Seabrook Station already meets the applicable performance standards based on existing installed technologies and operational measures. However, although zero compliance costs were estimated for Seabrook Station as part of the national-level costing for the Phase II regulation, this value should not be used as an indicator of compliance on a facility-specific basis. Rather, the rule requires that the facility "demonstrate" compliance through one of the five compliance alternatives (40 CFR 125.94 (a)).*

FPL's response: FPL has removed the language in the PIC that states that the Seabrook Station is currently in compliance with the Phase II Rule and that $0 is the cost associated with Rule compliance. The existing conditions at the Station that demonstrate compliance with 40 CFR 125.94 (a) are discussed in the revised PIC.

2.2.6 PIC Section 5.0: Ecological Studies and Historical Impingement Mortality and Entrainment Studies

USEPA's comment: *The summary of IM&E studies, which are the basis of the IM&E reduction credit calculations, provide no information on methodology, QA/QC* *procedures, or relevance of the data to current conditions. This information must be provided for compliance to be evaluated.*

FPL response: Section 5.0 was expanded to provide information on the periodic aquatic organism sampling efforts that are part of standard Seabrook Station operations, including the QA/QC measures associated with those efforts. The QA/QC measures are described in detail in a new appendix for this section of the PIC. The sampling information results have also been updated through 2006, the latest year with completed lab analysis and QA/QC checking of collected samples and information. The revised Section 5.0 is provided in the Revised PIC document (Appendix A).

2.2.7 PIC Section 7.0: Sampling Plans

USEPA comment: *Seabrook Station believes it is in compliance for IM&E reductions, and therefore has not planned any additional sampling. As stated above, the appropriateness of this conclusion cannot be evaluated with the information provided in this PIC. Further verification monitoring may be required to support the facility's belief that it is in compliance with Phase II performance standards.*

FPL response: As noted in the response to item 2.2.6, the Seabrook Station conducts periodic sampling of aquatic organisms during the entire calendar year as part of standard procedures. This comprehensive, ongoing sampling effort will also be able to provide the information needed for verification monitoring if required. The revised Section 7.0 is provided in the Revised PIC document (Appendix A).

3. Supplemental Information Requested in Attachment A to USEPA's July 31, 2007 Letter to FPL

3.1 Introduction

The USEPA issued an additional letter to Seabrook, dated July 31, 2007 which requested supplemental information relative to the USEPA's previously issued December 30, 2004 letter.

This section provides responses to the supplemental information that the USEPA requested in their July 31, 2007 letter to Seabrook. A copy of the USEPA's July 31, 2007 letter is provided in Appendix D.

3.2 USEPA July 31, 2007 Letter Attachment A Information Requirements

The USEPA's letter to Seabrook, dated July 31, 2007 requested supplemental information and requested the compilation of a Cooling Water Intake Structure Information Document.

The balance of this response section provides the specific information requested by the USEPA in their July 31, 2007 letter. Responses are provided as direct response text in this document. The appendices provide supplemental information to the direct responses.

3.2.1 Source Waterbody Flow

3.2.1.1 Waterbody Description

The source waterbody for the Seabrook Station cooling water intakes is the Western Gulf of Maine, an embayment of the North Atlantic Ocean. A more in-depth description of the source waterbody is provided in Section 3.2.1 of the Seabrook Station Source Water Physical Data section (Section 3.2 of the PIC, included in Appendix A).

3.2.1.2 Waterbody Circulation

The regular currents in the vicinity of the intakes have a reversing northward flowing flood component and a southward flowing ebb component. Tidal amplitude ranges from about 9 to 12 feet. In the vicinity of the intakes, the average net current velocity is approximately 0.1 meters per second (m/sec). Additional information regarding flow patterns and mean current velocities, including a figure (Figure 3.2-9) showing these parameters, is provided in Section 3.2.3 of the Seabrook Station Source Water Physical Data, Section 3.2 of the PIC (included in Appendix A).

3.2.1.3 Hydraulic Zone of Influence

The three velocity cap intakes are located in about 60 feet of water approximately 7,000 feet offshore of coastal New Hampshire. The top of the circular intakes are approximately 18 feet above the seabed and the openings around the periphery of each intake are approximately 7 feet high. The intakes are approximately 30 feet in diameter. The intake structures are spaced approximately 110 feet apart.

Prior to construction of the station, a scaled physical model of the intakes was developed and tested (March and Nyquist, 1976) under a two operating unit scenario and an associated cooling water flow of 1,177.6 mgd. Only one unit was built and commissioned at the Seabrook station so the modeled flow is about twice the average actual flow. The intakes were modeled at 0 m/sec, 0.1 m/sec and 0.2 m/sec ambient current levels. At zero ambient current, which would correspond to slack tide conditions, the intakes draw water from the entire water column. At an ambient current of 0.1 m/sec (0.2 knots [kt]), the intakes withdraw water from the lower 35 feet of the water column. At an ambient current of 0.2 m/sec (0.4 kt), the intakes withdraw water from the lower 25 feet of the water column.

The hydraulic zone of influence (HZI) of the intakes was also modeled under several ambient current conditions: 0 m/sec, 0.1 m/sec and 0.2 m/sec velocities, at a south ambient current direction and a southwest ambient current direction, using plan view dye streak lines. At a velocity of 0.1 m/sec the HZI was limited to about one intake diameter (30 ft) to either side of the periphery of the intake. At a velocity of 0.2 m/sec the HZI was limited to about ½ intake diameter (15 ft) to either side of the intake. Because the intake models were tested using the anticipated flow for two units at Seabrook, the actual HZI around the intakes for the one unit that was actually built could be estimated to be ½ the HZI determined for a two unit installation. Figures 3-1 and 3-2 from the March and Nyquist report (1976) are attached and depict the HZI streak lines from the modeling efforts at each intake assuming full, two unit cooling water flow of 1,822 cubic feet per second (cfs) which apportions to 607 cfs per intake structure.

3.2.2 Technology and Biological Assessment Information

3.2.2.1 Description of Cooling Water System

USEPA comment: *Please provide a detailed description of Seabrook Station's cooling system, including:*

a. *the cooling water intake structure and related equipment*

b. *the discharge canal or pipe*

c. *a cooling process flow diagram depicting the flow of cooling water through the facility*

d. *all pumps of any type used in the cooling system*

e. *any equipment for adding disinfectant or biocide to the cooling water*

f. *any equipment used for chilling the cooling water after it has been heated up in the power plant*

g. *design calculations showing the velocity at the entrance to each intake structure at minimum ambient source water surface elevations*

FPL Response: Note: Several items in the USEPA's comment list are discussed elsewhere in this document and the response for these items is directed to the specific location of the information.

a. Cooling Water Intake Structure (CWIS) and related equipment. A complete description of the CWIS is provided in section 3.3.1 of the Revised PIC in Appendix A.

b. Discharge Pipe or Canal. Cooling water that has been used to condense the steam as well as service water that has been used to remove heat from various pieces of equipment in the auxiliary plant systems is routed to the Discharge Transition Structure. A vertical, concrete-lined shaft with an inside diameter of 19 feet routes the water from the Discharge Transition Structure into the horizontal discharge tunnel that is also 19 feet in diameter and approximately 3.12 miles long. The discharge tunnel routes through rock below the ocean floor level. At the end of the horizontal tunnel, eleven (11) vertical shafts with two (2) nozzles/shaft and spaced approximately 100 feet on center and approximately 5 feet in (inside) diameter, rise to the ocean floor level and return the discharge water to the Atlantic Ocean. Figure 3-3 provides a profile of the cooling water discharge system.

c. <u>Cooling Process Flow Diagram</u>. Figure 3-8 in Section 3.3 of the revised PIC (Appendix A) provides the flow distribution and water balance diagram for the cooling water system.

d. <u>All Pumps of Any Type Used in the Cooling System</u>. Table 3-1 provides the identification numbers and operating characteristics of the pumps in the cooling water system at the Seabrook Station. These include the circulating water pumps, the service water pumps, the screen wash pumps, the cooling tower pumps, the circulating water lube water pumps (for cooling the circulating water pump bearings), the chlorination system metering pumps and the anti-scalant injection pump.

e. <u>Any Equipment for Adding Disinfectant or Biocide to the Cooling Water</u>. The chlorination and anti-scalant systems are discussed in Section 3.3.1 of the Revised PIC (Appendix A). As discussed in Section 3.3.1 of the Revised PIC, there are five locations in the cooling water system where sodium hypochlorite can be applied.

f. <u>Any Equipment Used for Chilling the Cooling Water After It Has Been Heated Up in the Power Plant</u>. The once-through cooling water system at the Seabrook Station does not require chilling any cooling water as it moves through the plant.

g. <u>Design Calculations Showing the Velocity at the Entrance to Each Intake Structure at Minimum Ambient Source Water Surface Elevations</u>.

At the time of initial construction, 1.5 inch square vertical bars spaced at approximately 17 inches center to center were installed in each of the twelve (12) openings in each of the three velocity cap intake structures at Seabrook. In 1999, to help deter seals from the intakes, additional 1 inch square vertical bars were installed in each velocity cap opening, reducing the bar spacing to approximately 6 inches center to center.

The new sets of bars were installed as two panels measuring a total of 6.5 feet in width and 7 feet in height (the opening height of the intake bays) for a total gross opening area of 45.5 square feet (ft^2). Ten (10) one-inch square bars and four (4) 1.5 inch square bars have been installed vertically in each 6.5 foot wide panel.

The area of the bars in each opening is:

$$(10)(1/12 \text{ ft.})(7 \text{ ft}) + (4)(1.5/12 \text{ ft})(7 \text{ ft}) = 9.33 \text{ ft}^2.$$

The net open area for each velocity cap opening is: 45.5 ft^2 - 9.33 ft^2 = 36.17 ft^2.

There are 12 openings in each velocity cap so the net open area in each velocity cap is: (12)(36.17 ft^2) = 434.04 ft^2.

For three (3) velocity caps, the net open area is: (3)(434.04 ft^2) = 1,302.12 ft^2.

The following flow levels are representative of conditions at Seabrook:

Design flow:	413,000 gpm (920.16 cfs)
Maximum flow (estimated):	491,000 gpm (1,095.8 cfs)
Maximum average daily flow:	475,000 gpm (1,058.3 cfs)

Based on these three levels of flow, the intake velocity through the velocity caps at Seabrook is:

At design flow:	920.16 cfs/1,302.12 ft^2 = 0.71 ft/sec.
At maximum flow:	1,095.8 cfs/1,302.12 ft^2 = 0.84 ft/sec.
At maximum average daily flow:	1,058.3 cfs/1,302.12 ft^2 = 0.81 ft/sec.

Note: gpm is gallons per minute; cfs is cubic feet per second.

Under average daily flow levels, the intake velocity is approximately 0.8 ft/sec.

3.2.2.2 Description of Cooling Water System Operation

<u>USEPA comment</u>: *You must also provide a narrative description of the operation of the Station's cooling water system, the role of each CWIS in the overall cooling water system, the proportion of the design intake flow of each CWIS that is used in the system, the number of days of the year the cooling water system is in operation, and any seasonal changes in the operation of the system.*

In addition, you must include design and engineering calculations prepared by a qualified professional and relevant data to support your description of your cooling water system.

FPL response: A complete description of the cooling water system operation is provided in Sections 3.3.3 and 3.4.1 of the Revised PIC in Appendix A. There is a single CWIS at the Seabrook Station that provides all the cooling water for the steam condensing operation as well as other auxiliary plant equipment serviced by the service water system.

The design intake flow for the Seabrook Station is 413,000 gpm as discussed in Section 3.3.3 of the PIC (Appendix A). The average CWIS intake flow during the 2002-2006 time period was 422,830 gpm. This exceeded the design intake flow (413,000 gpm) by approximately 2.4%. The original design flow for the cooling water intake system at Seabrook was 854,000 gpm to accommodate a 2 unit installation. Because only one unit was constructed at Seabrook, the head losses under current operating conditions are less than design for the intake system, causing the pumps to operate at a lower head loss and higher flow output than their original design point.

Since the Seabrook Station is a nuclear-fueled station, there is a constant need for cooling water to maintain proper temperature control of the spent fuel pool as well as other plant systems, requiring operation of the cooling/service water systems for 365 days per year.

Typically, during the winter months a portion of the cooling water is re-circulated to maintain optimum steam condenser backpressure levels. This, in turn, maximizes turbine efficiency levels. This results in a seasonal reduction of intake flows during these periods of time. When the ambient temperature of the intake water drops to approximately 46° to 47°F, recirculation usually begins. This typically occurs at the Seabrook station in the November to May time period. Figure 3-10 in the Revised PIC shows the monthly cooling water flow usage for the 2002 to 2006 time period and shows generally lower flows during the winter and spring months when re-circulation typically occurs.

3.2.2.3 Age of Equipment and Facilities

USEPA comment: *Identify the age of the equipment and facilities involved.*

FPL response: Construction on the Seabrook Station began in 1976. Equipment was installed and tested (Hot Functional Testing) by Novermber 1985. The station began commercial operation in August 1990. The age of the equipment and facilities is considered to date from 1990.

3.2.2.4 Major Upgrades/Repairs to Cooling Water System since January 2001

USEPA comment: Provide a brief description of all major upgrades and repairs to this (Station) equipment accomplished since January 2001.

FPL response: On a periodic basis, the cooling water pump motors are changed out to provide reliable service. Periodic, minor repairs are done to traveling screen systems. In 2004, an anti-scalant pump and tank were installed to control scale build-up in the system.

3.2.2.5 Projected Retirement Date of Seabrook Station's Existing Operation

USEPA comment: Please identify the projected retirement date, if any, of Seabrook Station's existing operation.

FPL response: The Seabrook Station Facility Operating License NPF-86 was issued on March 15, 1990. The license expiration date is March 15, 2030.

3.2.2.6 Processes at Seabrook Regarding Boiler Operation, Condenser Operation, CWIS Operation, and Effluent Treatment Operations

USEPA comment: *Provide a description of the processes employed at Seabrook Station with regard to boiler operation, condenser operation, CWIS operation, and effluent treatment operations (including any chilling or cooling of heated cooling water).*

FPL response: A brief description of each of these systems is given below. The Seabrook Station Facility Description Document, which is provided in Appendix E, provides a much more detailed discussion of all the various systems and their operational characteristics that constitute the Seabrook Nuclear Station.

- Boiler operation: The Seabrook Station is a single unit nuclear-fueled facility. The heat source for generating the steam that drives the turbines and generator is a nuclear reactor. The nuclear reactor is part of the nuclear steam supply system (NSSS) that provides steam to one high pressure turbine and three low pressure turbines. The steam that exits the low pressure steam turbines enters the condensers where it is condensed back into feedwater as it comes into contact with the condenser tubing. The feedwater then cycles back through the NSSS.

- Condenser Operation: The condenser is arranged in three de-aerating, double pass, single pressure, radial flow shells. Each one-third capacity condenser shell is located beneath one of the three low pressure turbine cylinders. Exhaust steam from the turbine cylinders discharges down into the condenser shells from exhaust openings in the bottom of each low pressure turbine casing. The condenser shells contain 1" outside diameter titanium tubing containing seawater that has been drawn into the intake system via the circulating water pumps located in the circulating water pumphouse. The water velocity in the condenser tubing is approximately 7 fps. The steam is condensed back into feedwater that cycles back through the NSSS.

- CWIS Operation: The operation of the Cooling Water Intake Structure is completely described in section 3.3.3 of the Revised PIC. The Revised PIC is provided in Appendix A.

- Effluent Treatment Operations (Including Any Chilling or Cooling of Heated Cooling Water): The water that is discharged from the station (effluent), consists primarily of the heated circulating water that has been discharged from the condensers as well as heated service water that has been used to cool various auxiliary systems in the Seabrook Station. All of this effluent is collected in the Discharge Transition Structure from which it enters the discharge tunnel and routes to eleven vertical shafts and then discharges through diffusers at the top of the shafts back into the Atlantic Ocean (Figure 3-3).

  Effluent treatment consists mainly of chlorination. The chlorination system is described in detail in Section 3.3.1 of the Revised PIC in Appendix A. The injection of sodium hypochlorite can occur at five locations in the circulating water system. The metered rate of chlorination injection into the cooling water system is controlled such that a concentration of 0.2 ppm total residual oxidant, measured as Cl_2 equivalent, is not exceeded in the Discharge Transition Structure.

  The cooling water discharge does not undergo any cooling prior to being returned to the Atlantic Ocean via the Discharge Transition Structure and discharge tunnel.

3.2.3 Describe Engineering Aspects/Considerations for the Following Technologies at Seabrook Station

<u>USEPA comment</u>: *Please provide the engineering aspects or considerations pertinent to considering the possible application of the following technologies at Seabrook Station;*

a. *Mechanical draft or natural draft cooling towers for use in a re-circulating (or "closed cycle") cooling system for the generating unit and service water system at Seabrook Station. The analysis must specify the number of cooling tower cells required based on the facility's heat balance space requirements, a discussion of the major components that would need to be added and the major modifications to the facility that would need to be undertaken to retrofit Seabrook Station with this technology.*

b. *CWIS screening systems or barrier technology that will minimize entrainment, impingement, and impingement mortality. Each analysis must include a discussion of the major components that would need to be added, and the major modifications to the facility that would need to be undertaken to retrofit Seabrook Station with this technology.*

c. *The use of "grey" water for cooling purposes. Potential sources of grey water include the Seabrook Wastewater Treatment Plant and the Portsmouth Wastewater Treatment Plant.*

d. *The reduction of cooling water flow (i.e., "capacity") by using variable speed pumps and/or by reducing pumping operations from the current three pump operation.[2] Such evaluation shall include consideration of any configuration, and/or additional "stand-by" pumping systems that may be necessary to address any safety concerns.*

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[2] As you are aware, Seabrook Station's CWIS was originally designed to provide cooling for two reactors. Since only one reactor was built, EPA believes that the capacity of Seabrook's CWIS may be as much as twice that which is necessary to cool the plant.

e. *Any other technology that you deem worthy of consideration for reducing Seabrook Station's entrainment and/or impingement mortality of aquatic organisms.*

USEPA comment: *For each of the technologies evaluated; please provide;*

a. *A detailed explanation of the process changes required to operate and maintain such technologies.*

b. *An estimate of the most stringent thermal discharges limits that Seabrook Station would be able to comply with utilizing the technology in question.*

c. *An estimate of the most stringent cooling water withdrawal flow limits that the facility would be able to comply with utilizing the technology in question.*

d. *An estimate of the most stringent cooling water intake velocity limits that the facility would be able to comply with utilizing the technology in question.*

e. *An estimate of the extent to which (1) impingement, (2) impingement mortality, and (3) entrainment would be reduced at Seabrook Station by utilizing the particular technology.*

f. *To the extent that you believe any of these technologies would be infeasible for implementation at Seabrook Station, provide a detailed explanation for your conclusion in this regard.*

g. *An estimate of the cost for installing and operating each of these technologies.*

h. *Please describe in detail the non-water quality environmental impacts (including energy, noise, air pollution, public safety), if any, that you have determined will occur from the use of each technology.*

FPL response: The following subsections address each of the technologies that the USEPA requested (items a through e above) and the additional technical information (items a through h above).

3.2.3.1 Mechanical Draft/Natural Draft Cooling Towers

3.2.3.1.1 Considerations for the Application of Mechanical or Natural Draft Cooling Towers

Retrofit, closed-cycle mechanical draft cooling towers were evaluated at the site as a means to significantly reduce cooling water intake flows while meeting the plant's heat rejection load requirements. A copy of the complete report evaluating closed-cycle mechanical draft cooling towers for the Seabrook Station is provided in Appendix F.

A preliminary study in January 2008, screened the Seabrook site for possible locations of multi-cell mechanical draft cooling towers and determined that two separate areas (locally known as Snoopy's Head and the 18-Acre Laydown Area) provided enough physical space within the site property lines to accommodate the number of tower cells needed to provide the amount of cooling necessary for the plant's heat rejection load needs. The preliminary study also determined that two, 15- cell strings of towers would be needed at Snoopy's Head and a single string of 24 cells would be required at the 18-Acre Laydown Area, for a total of 54 cells. These two chosen sites were also determined to be free of major underground or above-ground infrastructure facilities.

The evaluation applies to the Unit 1 circulating water system (CWS), which uses the majority of the cooling water at the site. The service water system, which uses significantly less water for non-condenser-related cooling purposes, would continue to operate independently in a once-through cooling mode, using the same 21,000 gpm as it currently does. With the inclusion of the service water flows, cooling tower blowdown (23,155 gpm at 1.5 cycles of concentration), cooling tower evaporation (11,600 gpm) and drift (45 gpm), the cooling water intake flow would be 55,800 gpm. Based on the current maximum once through flow rate of 473,000 gpm ((452,000 gpm for once through cooling and 21,000 gpm for service water flow needs), the closed-cycle cooling system would provide a cooling water flow reduction of 88%.

Due to the size and locations of the potential mechanical draft cooling towers, a very significant level of complex construction activity would be required to install the systems. A lot of the work activity would be in Unit 1's turbine building area to tie the new piping systems for the cooling towers into the condensers. Routing the new piping and associated systems into the turbine building which is already very congested with various infrastructure systems would require an intense effort to complete. In addition, this is a high security area which would further complicate work activities. It is estimated that the entire process including engineering, procurement and construction would require 165 weeks to complete. This schedule length assumes that all permitting and equipment procurement would proceed without any significant delays. Since this is a nuclear facility, in addition to federal, state and local permitting entities, the Nuclear Regulatory Commission would also need to be involved for review and approval of the plant design changes proposed.

3.2.3.1.2 Process Changes for Operation and Maintenance

The installation of closed-cycle mechanical draft cooling towers at Seabrook would increase operation and maintenance costs. Use of the cooling tower systems would result in higher temperature water being supplied to the steam condensers. This would cause a rise in the Unit 1 low-pressure turbine backpressure from the normal value of 1.7" Hga to 3.8" Hga. This increase in turbine backpressure would result in an annual average reduction of 29.7 MW in capacity. In addition, additional or increased-capacity pumps would be required to move the condenser discharge water up to the top of the towers requiring an annual average power need of 11.3 MW. 54 new tower fans for inducing the mechanical draft heat exchange process would be needed requiring an average annual power need of 10.5 MW

The total surface area of the thin film media fill for the cooling towers would require continual observation to ensure levels of biofilm buildup on the film is controlled and doesn't become a source of film plugging. Continuous application of biocide treatments to the water entering the towers would be required to control biofilm build-up.

3.2.3.1.3 Thermal Discharge Limits

It is estimated that the temperature of the cooling water discharge, primarily from the cooling tower blowdown water, would decrease from an average of 69.4 to 110.4°F for the current once-through system to an average range of 34 to 78 °F with a design maximum of 83 °F. Due to the potential 88% reduction in discharge flows associated with the closed-cycle system compared to the current once-through system, the net result would be a reduction in thermal loading at the discharge point.

3.2.3.1.4 Cooling Water Withdrawal Flow Limits

The installation of a closed-cycle mechanical draft cooling tower system would reduce intake water withdrawal rates by 88%.

3.2.3.1.5 Intake Velocity Limits

With the installation of a closed-cycle mechanical draft cooling tower system, the intake velocity at the velocity cap intake structures would decrease from a current maximum of 0.84 feet per second (fps) to less than 0.1 fps, due to the 88% reduction in intake flow levels.

3.2.3.1.6 Impingement, Impingement Mortality and Entrainment Reduction

Although no modifications to the velocity cap intake structures would occur under this option, it is expected that the reduction of intake velocities to less than 0.1 fps with the installation of a closed-cycle cooling system would reduce impingement, impingement mortality and entrainment. Due to the reduction in flow volume by 88%, it is expected that the reduction in entrainment would be reduced by 88%. Similarly, due to a comparable 88% reduction in intake velocities, it is expected that impingement would also be reduced in a linear fashion by 88%.

3.2.3.1.7 Feasibility

Closed-cycle mechanical draft cooling tower systems have been successfully retrofitted at many fossil-fueled steam-cycle plants. Salt water-based cooling towers are also currently in use in the petrochemical industry outside of The United States. There are some fossil fuel-based facilities in The United States that use brackish water, not straight salt water in closed cycle cooling systems. However, there currently are no known nuclear generating facilities in the United States that utilize salt-water based mechanical draft cooling water systems. The complex and prohibitively costly (see cost discussion in Section 3.2.3.1.8) permitting, engineering, procurement and construction effort that would be required to install this type of system at a nuclear facility over at least a three year period of time would present a high level of risk. Also, as discussed in Section 3.2.3.1.9, particulate emissions from the proposed cooling towers would exceed all particulate matter PSD thresholds in New Hampshire air quality regulations even if the most advanced particulate emission methods were to be employed. Based on the high levels of risk, uncertainty and the prohibitive cost of this option, it is not considered a suitable alternative at Seabrook.

3.2.3.1.8 Cost

A detailed opinion of cost for this option was developed as part of the closed-cycle mechanical draft cooling tower report prepared for this option. The detailed cost estimate is provided in Appendix B of the report which is located in Appendix F of this document. It is estimated that the cost to install a closed- cycle mechanical draft cooling tower system at Seabrook would be approximately $217 million. In addition, the annual cost due to reduced capacity of the turbine due to higher backpressures and additional power needed to run the new systems would amount to $31.4 million.

3.2.3.1.9 Non-Water Quality Environmental Impacts

The main non-water quality environmental impacts associated with the potential installation of a closed-cycle mechanical draft cooling tower system at Seabrook involve drift, particulate matter emissions, plume abatement and noise. Due to the potential siting of the cooling tower cell arrays within 700 feet of currently occupied residential or commercial properties, the potential for fogging and icing effects from plumes generated by the cooling towers, even though plume abatement controls would be installed on the towers, could be a local problem. Drift eliminators (baffles) would be installed in the towers to minimize drift but the potential deposition of drift as salt or ice may be locally problematic. Atmospheric particulate matter emissions are particles of salt that were in the evaporative droplets of water from the cooling towers that remain airborne after the water evaporates. It is estimated that particulate matter emissions of 1,463 tons/year (tpy) would be discharged from the potential 30 tower cells on Snoopy's Head and 2,344 tpy from the potential 18-Acre Laydown Area site. The New Hampshire regulations require that new installations limit particulate emissions to 100 tpy. Even with the installation of the best available technology, particulate emission rates at Seabrook for potential closed-cycle cooling towers would exceed these limits. Noise levels associated with the potential tower cells would range from 55 decibels (dB) to 75 dB, depending on proximity to the various sides of the tower cell arrays. Because the tower cells would be in operation most of the time, the continuous noise associated with their operation may be an issue to nearby residential and commercial properties.

In addition, approximately 51.5 mw of replacement generation would be required due to reduced electrical output and efficiency due to increased turbine back pressure as well as the additional electrical loads for the operation of pumps and fans associated with the tower cells. If this lost capacity, which equates to approximately 416,000 mwh of annual generation, were replaced by a fossil fueled generating unit, additional environmental impacts would result. These impacts could include the increased emissions associated with the replacement generation. The following three tables provide an estimate of the expected increase a coal-burning plant (Table 3-2), an oil burning plant (Table 3-3) and a natural gas burning plant (Table 3-4) that annually produce approximately the same amount of generation (416,000 mwh) that would be needed to replace the lost power at the Seabrook Station.

Table 3-2: Emissions from Coal Burning Plant

Pollutant	Amount (metric tons)
SO_X	6514
NO_X	1374
CO_2	572230

Table 3-3: Emissions from Oil Burning Plant

Pollutant	Amount (metric tons)
SO_X	2241
NO_X	495
CO_2	398807

Table 3-4: Emissions from Gas Burning Plant

Pollutant	Amount (metric tons)
SO_X	140
NO_X	285
CO_2	335680

The assumptions made for the above tables are the following:

- The oil burning plant used for comparison is the Oswego Harbor Power Plant in New York State. The plant had an annual generating capacity in 2002 of 415,194 MWh.
- The coal burning plant used for comparison was the Blount Street Plant in Wisconsin. The plant had an annual generating capacity in 2002 of 438,398 MWh.
- The gas burning plant used for comparison was the Linden Plant in New Jersey. The plant had an annual generating capacity in 2002 of 435,762 MWh.

Based on the implementation of a cooling tower retrofit, the acquisition of additional generating capacity whether from coal, gas, or oil would result in increased levels of CO_2, SO_X, and NO_X. The additional CO_2 emissions would be equal to putting an additional 2,205 cars onto the road annually (based on a coal burning plant). New coal-burning power plants have seen recent delays and cancellations due to regulatory uncertainty regarding climate change policies and strained project budgets based on escalating costs within the industry. A $1 billion power plant in 2000 would now cost $2.31 billion due to increases in costs of cement, steel, and specialized labor (CERA 2008). The cost per kilowatt of capacity for construction of new power plants now can range between $2,000 and $3,000 (NY Times, 2007). Based on a cost of $3,000 per kilowatt, the construction of a new 50 mw power plant would cost roughly $150 million.

There is also unease over the growing world-wide demand for electricity because of the uncertainty surrounding the decreasing supply and increasing costs of various fuel types. The Energy Information Administration (EIA) forecasts that electricity demand will increase 40 percent by 2030 (EIA 2007) Both oil and natural gas have been experiencing escalating per unit costs and growing concern about their future availability. The EIA has projected that between 2007 and 2030 there will be an incremental increase in generation capacity of coal generated electricity totaling 64 percent. Between 1999 and 2006 the price of coal rose 43 percent, and as other countries begin to increase their need for electricity, it is expected that the price of coal will continue to rise (EIA 2008). By 2030, the average delivered price in the *Annual Energy Outlook* reference case is projected to be over $35 per ton, with each ton of coal able to supply about 2,000 kWh of electricity (EIA 2008).

3.2.3.2 CWIS Screening System/Barrier Technology

<u>FPL response:</u>

3.2.3.2.1 Considerations for the Application of Wedgewire Screens

The one new screening technology evaluated for the reduction of impingement mortality and entrainment at Seabrook is wedgewire screens. The proposed screens would have to be installed at the location of the offshore intakes and the velocity caps would have to be modified to accommodate the installation of the screens (Figure 3-4). To meet the through screen velocity requirement of 0.5 fps, it would be necessary to install 9 wedgewire screens, three on each velocity cap. With ¼" slot openings, each screen would have to be 84-inch diameter and 28-feet long.

In addition to the installation of the screens at the offshore intakes, it would also be necessary to install an air burst system for cleaning of the screens. The airburst system would consist of a compressor with an air accumulator and a separate air line to each screen. Air would be supplied to the center of each screen in a sequential manner to remove debris which may accumulate on the outer surface of the screens.

The frequency of cleaning the debris from the screens with the air burst system would depend on the rate at which the debris accumulates.

As noted above the cylindrical wedgewire screens would have to be installed at the offshore location. Several potential concepts for the installation of the screens exist, however, the conceptual design presented in Figure 3-2 was selected and used for this analysis.

For effective operation and reduction of impingement mortality and entrainment, three conditions should exist when designing a cylindrical wedgewire screen installation. The slot size should be small enough to physically prevent the entrance of the organisms being protected; there should be enough screening surface to provide a low through slot velocity (typically less than 0.5 fps); and there should be sufficient ambient current to assist organisms in bypassing the screens and to move debris dislodged from the screen surface to an area away from the screen (USEPA, 2004). At Seabrook, not all of these criteria can be met. While enough screens can be installed to maintain a low through slot velocity and some ambient currents do exist, a slot size small enough to effectively prevent the entrainment of eggs and larvae can not be used due to the possibility of significant biofouling. There are ambient currents present at the location of the intakes, however, the current is not always parallel to the longitudinal axis of the screens because the screens must be mounted in several different directions and the currents are a combination of longshore and tidal currents.

The concept presented in Figure 3-4 maintains the existing velocity cap in place and modifies the cap for installation of the screens. The existing vertical bars that were installed to keep large debris from entering the intakes and then later modified to prevent seals from entering the intakes would be removed. The velocity caps could then be reinforced and modified as shown for the installation of the screens. Although prefabrication of components would be utilized wherever possible, much of the work would have to be performed by divers. The water depth at the intakes is approximately 60 feet. While these modifications are being made and the screens are being installed, the intakes and the circulating water system would have to be removed from service, therefore, requiring the generating unit to be shut down. It is estimated that the required length of time that the intake would be out of service would be 70 days.

Possibly the most challenging aspect of installing wedgewire screens at the Seabrook offshore intakes is the supply of compressed air to the screens for cleaning purposes. Because only one screen can be cleaned at a time, it is necessary to run 9 individual 8-inch air lines from the on-shore compressor, air receiver tank and actuated air valves to the screens. It is anticipated that the installation of these lines would require directional drilling from the plant to the shoreline and trenching from the shoreline to the location of the screens.

Other than the modifications at the offshore intakes and the installation of the air burst system, the remainder of the cooling water systems should remain unchanged. Some additional head loss will occur through the screens; however, the head loss that occurs across clean screens would not have a significant effect on the operation of the circulating water pumps.

For the installation of this proposed intake technology federal, state and local construction permits would be required. However, because this work is taking place at a nuclear generating station, qualified station nuclear licensing personnel will need to conduct normal plant design change reviews required by the U.S. Nuclear Regulatory Commission regulations. A proposed change/modification at a nuclear plant requires a "50.59" review (10 CFR 50.59) or screening. This review can become significant if "safety-related" systems are involved in the review. Since the cooling water intake at the station is the "normal" means of obtaining cooling water for both the stations circulating water system (non-safety related) and service water system (safety related) this could complicate the licensee's 50.59 review. Based upon the existence of alternative cooling for the service water system by a cooling tower system serviced by municipal water supply at Seabrook, it would be expected that this concern should be minimized. The possibility of an extended, NRC-related, review process by the station still needs to be considered.

3.2.3.2.2 Process Changes for Operation and Maintenance

Wedgewire screens have been installed on an offshore intake in the United States and operated successfully; however, that installation is in a fresh water lake. There are not any domestic offshore ocean installations to draw experience from. Seabrook would be the first installation of its type in the U.S. There is a shoreline marine installation of wedgewire screens in the Boston Harbor.

The installation of wedgewire screens at Seabrook would create operational concerns. With the installation of wedgewire screens, the openings at the intakes would be reduced from approximately 6-inches to 1/4-inch. For effective reduction of entrainment the screen slot size should be reduced to 1 mm or less, however, such a small slot size is not practical at Seabrook because of the anticipated biofouling problems. The Boston Harbor installation of wedgewire screens has experienced heavy biofouling on the screens. It has been reported that during the summer months the screens have to be manually cleaned once a month. This is not as serious an issue at the Boston Harbor site since the screens are located at the shoreline and can be lifted out of the water and pressure washed. At Seabrook the screens would have to be cleaned by divers at the current velocity cap locations, which is much more costly and time consuming. In addition to the fouling organisms which grow on the screens, there is the potential at the Seabrook intake of fouling with kelp which is dislodged from the ocean bottom during strong storms. This type of fouling has the potential to quickly cover the screens causing a rapid loss of cooling water and the air burst system may not be effective in removing the kelp from the screens.

3.2.3.2.3 Thermal Discharge Limits

The installation of wedgewire screens would not have any effects on the current thermal discharge limits at Seabrook.

3.2.3.2.4 Cooling Water Withdrawal Flow Limits

The installation of wedgewire screens would not have any effects on the current cooling water withdrawal flow limits at Seabrook.

3.2.3.2.5 Intake Velocity Limits

With the installation of wedgewire screens the through slot velocity could be maintained at 0.5 fps or less with clean screens. All other velocities within the CWIS would remain unchanged.

3.2.3.2.6 Impingement, Impingement Mortality, and Entrainment Reduction

Wedgewire screens with a through slot velocity of less than 0.5 fps would essentially eliminate impingement and therefore, impingement mortality (EPA, 2004). Due to the fact that screens with 0.5 to 1.0 mm slot size are not practical at Seabrook due to the biofouling potential, physical exclusion cannot be relied upon to reduce entrainment. Some entrainment reduction may occur from hydrodynamic exclusion due to the low through slot velocity and rapid dissipation of the velocity field, which is a characteristic of wedgewire screens (USEPA, 2004). However, the current velocity caps also have a low inlet velocity (approximately 0.8 fps) and may provide a similar hydrodynamic exclusion, although no documented testing results of velocity caps for the reduction of the entrainment of eggs and larvae is available for comparison purposes. Without site specific testing of the wedgewire screens at the Seabrook intake location, there is no data available to make a projection of entrainment reduction.

3.2.3.2.7 Feasibility

As determined from the technical evaluation of this potential option, the installation of wedgewire screens at Seabrook present many permitting, engineering and construction challenges in addition to operational risks. These issues have been reviewed above and due to these challenges and risks, it is our opinion that wedgewire screens are not a suitable intake technology at Seabrook. Although the engineering, permitting and installation would be difficult and costly, with several issues that have the potential to prevent installation, the significant increase in the operational risk of failure and potential maintenance efforts support a decision to eliminate this option from further consideration.

3.2.3.2.8 Cost

Although it is recommended that this option be eliminated from further consideration, to satisfy the requirements of the EPA's December 2006 letter, an opinion of cost was developed. It is estimated that the cost to install wedgewire screens at Seabrook, including the airburst system, would be approximately $26 million. This does not include the cost of lost generation, due to the extended outage required for the installation of the screens.

3.2.3.2.9 Non-Water Quality Environmental Impacts

The installation of wedgewire screens would not have any non-water quality environmental impacts if installed at Seabrook.

3.2.3.3 Use of Grey Water for Cooling

FPL response: As requested, the potential of using the discharge of treated wastewater (grey water) from several water pollution control plants (WPCP) in the area of the Seabrook Station was investigated. In the vicinity of Seabrook are the Portsmouth, Hampton and Seabrook WPCPs. The Seabrook WPCP is the closest to Seabrook and is 2.2 miles to the south. Portsmouth WPCP is the furthest from Seabrook and is located 15 miles to the north (Figure 3-5).

The available flow from any of these plants is very small in comparison to the Seabrook cooling water flow. For the Portsmouth and Hampton WPCPs, the maximum discharge flows are 4.8 and 3.9 MGD respectively (Tetra Tech, et al. 2007). The design flow for the Seabrook WPCP is not available; however, the average daily flow is 0.88 MGD (Tetra Tech, et al. 2007). If it is estimated that the average daily flow for the Portsmouth and Hampton WPCPs is approximately 50 percent of the design flow, the total water available from all three WPCP's would be approximately 5 to 6 MGD. This is less than one percent of the 682 MGD cooling water flow required for the Seabrook Station.

The permitting, engineering and construction of the necessary pipelines to transport the discharge water from the WPCPs to Seabrook would be very difficult. The Portsmouth WPCP is located on an island in the Piscataqua River and there are salt water marshes and wetlands between all three WPCPs and Seabrook. These conditions would increase the cost and time for permitting, design and construction of the water transport piping and may create a situation where the installation of the line is not feasible. Without considering the potential problems that could be encountered with the acquisition of right-of-ways, construction in wetlands and salt marsh areas, remote power requirements, and ongoing maintenance, the estimated cost to construct the necessary pipelines and pumping stations would be in excess of $12 million.

With less than a one percent decrease in the amount of cooling water drawn into the Seabrook CWIS, the reduction in impingement mortality and entrainment with the use of grey water from the three WPCPs would be essentially imperceptible. For these reasons, the use of grey water from the WPCPs was not considered a suitable option for reducing impingement mortality and entrainment and was not considered further.

3.2.3.4 Reduction of Cooling Water Flow

3.2.3.4.1 Considerations for the Application of Flow Reduction Measures

There are several potential methods for reducing cooling water intake flow at Seabrook. Intake flow can be reduced by recirculating a portion of the cooling water discharge back to the intake, periodically reducing the number of circulating pumps operating from three to two pumps, and installing variable frequency drives on the circulating water pump motors to reduce the pump speed, which will reduce the pump flow. The amount of flow reduction is limited by several operational and environmental issues that are discussed below.

Seabrook currently reduces cooling water intake flow by recirculating water from the cooling water discharge structure back to the cooling water intake structure. Because the circulating water pumps and service water pumps operate at a flow that is essentially constant, the amount of water drawn in through the offshore intakes is reduced with greater recirculation flow. Although it is assumed here that the circulating water pumps operate at a constant flow, the flow is somewhat affected by the tide, the level of condenser fouling, intake screen debris loading, and other factors which may alter the head loss through the circulating water system. To continue with the current recirculation practice or to further optimize the level of recirculation to maximize intake flow reduction is an operational measure and does not require equipment or system modifications.

The design of the circulating water system at Seabrook allows for the recirculation of heated discharge water back to the intake transition structure. This is accomplished by partially opening the butterfly valve in the backwash conduit to the intake transition structure. Although recirculation provides the benefit of reducing cooling water intake flow, it is performed to increase inlet water temperature when condenser backpressure begins to drop below the optimum level. Using the recirculation of heated discharge water to adjust the inlet water temperature allows the station to maintain the optimum condenser pressure and, therefore, maximize turbine efficiency.

To estimate the amount of recirculation, it is first necessary to determine the cooling water intake flow without recirculation. This was accomplished by compiling the flow information for only those months when the unit operated 100 percent of the available hours and the capacity factor was approximately 100 percent. Under these operating conditions, all three circulating water pumps and two service water pumps would be operating continuously. The data that represents cooling water intake flow for full load operation for each month is presented in Table 3-5. During the month of September, when inlet water temperatures have been the warmest, it becomes difficult to maintain the design condenser pressure, therefore, all cooling water is drawn through the offshore intakes and no water is recirculated. Therefore, the flow of 682 mgd that occurs in September is representative of the cooling water intake flow without recirculation. The difference between the full load intake flow in September and the full load intake flow during the other months of the year is the estimated recirculation flow (Table 3-5). The estimated recirculation flow is an average flow during full load operation

As expected, the amount of recirculation is essentially zero during the summer months and is at a maximum during the months of January, February, and March when the intake water temperatures are the coldest.

Seabrook has previously studied the option of reducing the number of operating circulating water pumps from three to two for at least a part of the year. As determined in a previous study performed by Normandeau Associates, when operating with only two circulating water pumps it was estimated that the cooling water intake flow would be reduced to 525 mgd (364,600 gpm). As with recirculation, operation with only two pumps can only be implemented during the non-summer months. It was estimated that reductions in cooling water flow from two pump operation would only be achieved from November through April. The estimated flow reduction from baseline flow and current intake flow without recirculation is presented in Table 3-6. These reductions can only be achieved by exceeding the current permit temperature differential limit of 39 °F between the cooling water intake and discharge temperatures.

As with recirculation, operation with a reduced number of pumps is an operational measure that does not require intake or system modifications. This operational change does create some additional operational risk since the loss of a single pump during two pump operation will have a greater impact on the system than the loss of single pump during three pump operation. Due to the long intake tunnel an analysis of the system reaction in the event of a pump trip would be required if this operational measure were to be further considered. In addition, the loss of a single pump during two pump operation will create a greater discharge temperature excursion.

Cooling water intake flow through the use of variable frequency drives (VFDs) on the circulating water pump motors is an operational measure that will require a significant capital investment for the procurement and installation of the VFDs. It is estimated that that the cost to retrofit the three circulating water pumps at Seabrook with VFDs will be $7.7 million. With the addition of VFDs for all three circulating water pump motors, it has been estimated that the minimum flow achievable would be 250,000 gpm (360 mgd). If only two pumps were equipped with VFDs, the estimated minimum flow would be 350,000 gpm (504 mgd). The minimum flow with only one VFD would be approximately 400,000 gpm (576 mgd). The use of three VFDs provides the greatest potential flow reductions and also creates a preferred operating mode as compared to the options with only one or two VFDs. With three variable speed pumps, each pump will operate at approximately the same reduced flow if the operating speeds of all pumps remain equal. With only one or two VFDs, as speed is reduced on the variable speed pumps the flow of the constant speed pump will increase and the flow of the variable speed pumps will decrease. This will continue with further reduction in pump speeds until the variable speed pumps reach a point of unstable operation. For these reasons, the evaluation of VFDs will be continued with the three VFD option only.

Each VFD enclosure would be in excess of 20 feet long, therefore it is anticipated that the VFDs would be installed outside the turbine building and provided in outdoor enclosures. A preliminary review of product availability has indicated that VFDs may not be readily available for 13.2 kV motors, as those used at Seabrook. VFDs for 3,400 hp, 6.6 kV motors are available, therefore, a rewind of each of the circulating pump motors may be required. If a rewind of each motor is required, it may be necessary to purchase a spare pump motor which can be used in place of the motor being rewound to avoid an extended unit outage while the motor rewind is being completed. Each VFD would be provided with a bypass to allow operation of the circulating water pump in the event of a VFD failure.

The reductions in cooling water intake flow that can be achieved with VFDs are presented in Table 3-7. As with the other flow reduction options, the maximum flow reduction occurs during the winter months and the reductions can only be achieved if the permitted temperature differential can be exceeded. Table 3-8 provides the potential flow reduction that can be achieved without exceeding the current temperature differential limits.

3.2.3.4.2 Process Changes Required for Operation and Maintenance

To effectively operate the cooling water system and maximize reductions of cooling water intake flow using any of the operational measures discussed above, it will be necessary to have the process controlled by turbine backpressure and cooling water temperature differential or by providing operators with the necessary information to control the system manually. With any of the flow reduction measures presented, the potential for temperature excursions and excursions from desired turbine backpressure increase.

3.2.3.4.3 Thermal Discharge Limits

The reduction in cooling water flow produces an increase in the differential between the cooling water inlet and discharge temperatures. Whether intake flow is reduced through the use of VFDs, recirculation or reduced number of pumps operated, the temperature differential will increase. The flow reductions currently achieved through recirculation are done while operating within the currently permitted cooling water temperature differential limits and the near-field jet mixing region thermal limits. To achieve the reductions noted for two pump operation and VFDs cooling water temperature differential limits will be exceeded. To operate under either of these two scenarios the maximum monthly average temperature differential would have to be increased from 39 °F to approximately 45 °F. The two pump operation and VFD scenarios will both cause the near-field plume volume to decrease and the temperature to increase, however, it is anticipated that the current permit thermal limits can be maintained.

To operate within the current permit limit for maximum monthly average cooling water temperature differential, the minimum cooling water intake flow with use of VFDs would have to be limited to approximately 590 mgd. Because operation with two circulating water pumps in operation does not provide a means of increasing flow without bringing the third pump back into service, operation with two circulating water pumps will always exceed the maximum monthly average temperature differential of 39 °F or the daily average temperature differential limit of 41 °F unless operation with two pumps was only done intermittently.

3.2.3.4.4 Cooling Water Withdrawal Flow Limits

Under the current operating mode of utilizing the recirculation of cooling water discharge, the minimum average daily flow from 2002 – 2006 operating data occurs in March and is 575 mgd. For operation with two circulating water pumps, the cooling water intake flow is reduced to 525 mgd. The minimum cooling water intake flow with the use of three VFDs can be reduced to approximately 520 mgd when inlet water temperatures drop below 37 °F, while still maintaining the desired condenser pressure of 1.7" Hga.

3.2.3.4.5 Intake Velocity Limits

Under all of the potential flow reduction options the velocity entering the velocity caps would not exceed the current maximum calculated velocity of 0.84 fps at the current maximum average daily flow.

3.2.3.4.6 Impingement, Impingement Mortality, and Entrainment Reduction

Operation under any for the potential flow reduction options, the minimum velocity entering the velocity caps would be approximately 0.6 fps. Although velocity is one of the factors affecting impingement rates, it is only one of many factors and it would be difficult, if not impossible, to accurately quantify the impingement reduction that would be achieved by reducing the velocity by 0 to 25 percent throughout the year. From past observations of impingement at Seabrook, changes in environmental conditions appear to have the greatest effect on impingement rates. However, one commonly used method of projecting impingement reduction is to assume that impingement reduction is directly proportional to the reduction in the volume of water withdrawn. At Seabrook, it is believed that the proportional relationship between flow and impingement would not provide an accurate projection of impingement reduction. Under storm conditions, when the highest impingement events typically occur, it is believed that the slight reduction in flow and intake velocity would not have a significant impact on the impingement rates.

For the entrainment of eggs and larvae, the reduction is typically proportional to the reduction in cooling water intake flow. However, maximum flow reduction is typically achieved from December through March, which are usually the low entrainment months. During times of high entrainment the ability to reduce flow is limited due to the higher water temperatures. Due to these seasonal patterns of flow reduction capability and entrainment, the annual entrainment reduction is usually less than the annual reduction in flow. Using the proportional relationship between flow and entrainment, it is projected that the current operation practice of recirculating a portion of the cooling water discharge back to the intake reduces entrainment by 38 percent when compared to the baseline entrainment calculated in the PIC (Appendix A). Seasonal operation with two circulating water pumps would not provide any further reduction in entrainment from current operation even though there could be a slight reduction in annual flow. This lack of further entrainment reduction is due to the projected increase in flow during June, which is the highest entrainment month. The use of three VFDs could result in a 4 percent incremental reduction in entrainment. The reduction projected for the VFD scenario can only be achieved if the current NPDES Permit limit on maximum daily and monthly average cooling water temperature differential is increased. If this permitted maximum temperature differential is not increased, the projected entrainment reduction from the addition of VFDs is reduced to 3 percent.

3.2.3.4.7 Feasibility

The recirculation scenario has been proven to provide the flow reduction benefits with continued reliable operation. Operation with two circulating water pumps must be further studied, if it is a recommended option, to determine the impact of the sudden failure of one of the pumps. The use of VFDs are feasible, however, the addition of another piece of equipment does decrease the reliability of the system.

3.2.3.4.8 Cost

The continued use of recirculation would not require any capital expenditures. The same is true for operation with two circulating water pumps, however, some additional engineering costs would be required to further study this option. For the addition of VFDs, the estimated capital cost is $7.7 million.

3.2.3.4.9 Non-Water Quality Environmental Impacts

The use of any of the potential operational measures described above would not have any non-water quality environmental impacts if utilized at Seabrook.

3.2.3.5 Other Technologies

FPL response: No other technologies have been found that would have application at Seabrook.

3.2.4 Fisheries Data Collected During Each Entrainment and Impingement Sampling Event at Seabrook Station during 2002 – 2007

USEPA comment: *Please provide all fisheries data collected during entrainment and impingement sampling conducted from 2002 to 2007, including all data collected by Seabrook Station. Specifically, USEPA requests the following for each sampling event that was conducted:*

- *Number of eggs of each fish species collected*
- *Number of larvae of each fish species collected*
- *Number of fish (juvenile and adult) of each species collected*
- *Duration of the sampling event (in hours)*
- *The location and method of sampling*
- *The ambient water temperature (s) measured during the sampling event*

FPL response: A database is provided on the enclosed CD which contains sampling data for each entrainment sampling event for the years 2002 through 2006 in accordance with Item 6 of the EPA letter of July 31, 2007. This database includes the year and date of sampling, the diel period of sampling, and the density of each taxon captured along with the volume of water sampled and the water temperature. Specific definitions of variables follow:

Files EE and EL (egg and larval entrainment)

Variable	Definition
YEAR	Year of sampling
DATE	Date of sample collection
DIEL	Diel period of sampling; Prior to April 2002: 1 = 2400-0600 2 = 0600-1200 3 = 1200-1800 4 = 1800-2400 April 2002 and later: 1 = 0415-1015 2 = 1015-1615 3 = 1615-2215 4= 2215-0415
SAMPD	Sample Period A six digit (YYMMWS) unique number representing the date and sequence of sampling. YY= year of sampling MM= month of sampling W = week of sampling 1 = dates 1-8 2 = dates 9-15 3 = dates 16-23 4 = dates 24-end of month S = sequence of sampling within a week 1 = first sample within a week 2 = second sample within a week
SCODE	A unique numeric code for each taxon
NAME	The common name of the taxon
DENSITY	The number of organisms /1000 m^3
FVOL	The volume of water sampled in m^3

Variable	**Definition**
TEMP	The inlet water temperature in °F

Files IMP (impingement)

YEAR	The year of sampling
START DATE	The start date of the sample
START TIME	The start time of the sample
END DATE	The end date of the sample
END TIME	The end time of the sample
DURATION	The duration of the sample in decimal hours (HH.00)
TEMP	The inlet water temperature in °F
SCODE	A unique numeric code for each taxon
NAME	The common name of the taxon

3.2.5 Information Based on the Data Collected Under Item 3.2.4

<u>USEPA comment:</u> *Provide the following, based on the data described above in Section 3.2.4 above.*

a. *Provide Estimated Average Number of Eggs Entrained per Calendar Month for Each Species and the Estimated Annual Total Number of Eggs Entrained for Each Species of Fish based on Seabrook Station's Typical Recent Withdrawal Rate for Each Calendar Month.*

b. *Provide Estimated Average Number of Larvae Entrained per Calendar Month for Each Species and the Estimated Annual Total Number of Larvae Entrained for Each Species of Fish based on Seabrook Station's Typical Recent Withdrawal Rate for Each Calendar Month.*

c. *Provide Estimated Average Number of Fish (Juveniles and Adults) of Each Species Impinged per Calendar Month for Each Species and the Estimated Annual Total Number of Each Species of Fish Impinged based on Seabrook Station's Typical Recent Withdrawal Rate for Each Calendar Month.*

d. *Provide Estimated Average Number of "Adult Equivalent" Fish of Each Species Lost to Entrainment and Impingement per Calendar Month and an Annual Adult Equivalent Total for Each Species of Fish, Based on Seabrook Station's Typical Recent Withdrawal Rate and Operations for Each Calendar Month*

e. *Provide Assumptions, Methods, and Calculations for Each of the Above Estimates of Entrainment and Impingement Effects.*

FPL response: The database created in Section 3.2.4 was used to estimate entrainment of fish eggs and larvae, and impingement of fish under typical operating conditions. Entrainment and impingement rates (number of organisms/ unit of cooling water flow) were multiplied by actual average monthly cooling water flows for the years 2002 through 2006 were used to estimate entrainment and impingement under typical operating conditions.

3.2.5.1 *Entrainment of Eggs*

FPL response: Table 3-9 presents monthly and annual estimates of fish egg entrainment under typical operating conditions. An estimated 1,103 million eggs were entrained annually under typical operating conditions. Of these eggs, an estimated 641 million (58%) were cunner/yellowtail flounder eggs. These two species are grouped together because in the early stages of egg development they cannot be distinguished. It is important to attempt to estimate the contribution of each fish to this mixed group because cunner is an extremely abundant relatively low monetary value forage species while yellowtail flounder is a high vale commercial species. Based on the abundance of cunner and yellowtail flounder larvae, and assuming equal hatching rates for these fishes, more than 99% of this mixed group was cunner eggs. Entrainment of cunner/yellowtail flounder eggs was highest in June, which is consistent with the peak in cunner spawning (Collette and Klein-MacPhee 2002).

Atlantic mackerel eggs ranked second in annual entrainment abundance (12%) at an estimated 134 million eggs. Peak entrainment occurred in June which is consistent with the published Atlantic mackerel spawning season (Collette and Klein-MacPhee 2002). Atlantic mackerel spawning stock biomass has been increasing since 1978, reached a recent high in 2005, and is not considered to be overfished (Mayo et al. 2006).

Silver hake eggs ranked third in entrainment abundance at an estimated 128 million (12%). Silver hake have an extended spawning season, but eggs are most abundant from May to November (Collette and Klein-MacPhee 2002) which is consistent with the monthly occurrence of silver hake eggs in entrainment samples. The silver hake spawning stock biomass indexes has declined substantially since 1977 and as of 2005 was at its lowest level (Mayo et al. 2006). Despite current low stock levels, the stock is not considered overfished.

The remaining taxa each contributed less than 10% to the total entrainment estimate. Of these remaining taxa, cunner (46 million; 4%) hake/fourbeard rockling (46 million 4%), and windowpane (26 million; 2%) were the most numerous. Based on the abundance of larvae and assuming equal hatching rates for hakes and fourbeard rockling, approximately 99% of the combined hake/fourbeard group was fourbeard rockling.

On a monthly basis, total egg entrainment was highest in June (618 million; 56%) and July (327 million; 30%) primarily due to entrainment of cunner/yellow flounder, Atlantic mackerel, and silver hake eggs.

3.2.5.2 Entrainment of Larvae

<u>FPL response</u>: An estimated 448 million larvae were entrained annually under typical operating conditions (Table 3-10). The most abundant larvae entrained were cunner (175 million; 39%), fourbeard rockling (53 million; 12%), and rock gunnel (52 million; 12%). The remaining taxa each contributed less than 10% to the annual total.

Entrainment of cunner larvae was greatest in July and August when 94% of the annual total for this species was entrained. The peak in entrainment of cunner larvae was about one month after the peak in entrainment of cunner/yellowtail flounder eggs and is consistent with the published larval stage duration for cunner.

Fourbeard rockling (53 million; 12%) ranked second in entrainment abundance. The fourbeard rockling is a small non-commercial member of the cod family that is common in much of the Gulf of Maine (Collette and Klein-MacPhee 2002). Highest entrainment occurred in August when 68% of the annual total occurred.

The third most abundant larval species entrained was rock gunnel (52 million; 12%). Rock gunnel are small inshore fish often found around rocks, structures or in tide pools (Collette and Klein-MacPhee 2002). They have no commercial value but are a prey item for piscivorous fishes such as Atlantic cod and are often found in the stomachs of seabirds. Highest entrainment of rock gunnel larvae occurred in March when 73% of the annual total was entrained.

3.2.5.3 Number of Fish Impinged

FPL response: An estimated 29,876 fish were entrained annually under typical operating conditions (Table 3-11). The most abundant fish impinged were Atlantic silverside (5,260; 18%), rock gunnel (3,602; 12%), and winter flounder (2,963; 10%). All other species each contributed less than 10% to the estimated total.

Atlantic silverside is a small inshore fish that spawns in estuaries (Collete and Klein-MacPhee 2002). It is not a commercial fish but is a prey species for many other fishes. Impingement of Atlantic silverside was highest in the fall and winter months, presumably as a result of a movement offshore past the intakes as they leave nearshore areas in response to colder water temperatures (Conover and Murawski 1982).

Rock gunnel ranked second in impingement abundance. Impingement occurred in every month, but was highest in April when 43% of the annual total was impinged. Based on the lengths of rock gunnel impinged, the majority of the fish appear to be ages 1 through 3.

Winter flounder ranked third in impingement abundance at an estimated 2,963 fish. Impingement of winter flounder occurred in every month except July and August with the majority (61%) impinged in December, possibly a result of seasonal movements. These were primarily ages 0 and 1 fish any may have been moving out of the estuary in response to decreasing water temperatures.

3.2.5.4 Number of Adult Equivalent Fish Impinged or Entrained

FPL response: An estimated 1,103 million fish eggs and 448 million fish larvae were lost to entrainment at Seabrook Station while an estimated 29,876 juvenile and adult fish were lost to impingement under typical operating conditions (Tables 3-9, 3-10, 3-11). These losses can appear to be very large until the natural mortality of early life stages of fish is accounted for. Adult Equivalency (AE) modeling is a procedure where mortality rates for each life stage are applied to numerical estimates of entrainment and impingement losses of early life stages to estimate the equivalent number of fish that would have been lost if these early life stages had survived to adulthood. In this analysis adulthood is defined as that age at which at least 50% of the female fish are estimated to be mature. The AE procedure was first developed by Horst (1975) and further advanced by Goodyear (1978) and others. Computationally the model is relatively simple and can be represented as:

$$N_a = S_i N_i$$

where, N_a = number of adult fish,

S_i = the probability of survival from an early life stage to adulthood, and

N_i = number of fish lost to entrainment or impingement.

The difficulty in this model is in estimating S_i. Goodyear (1978) and references within develop this model further, but the underlying assumption is that the probability of one fish egg surviving to adulthood (S) is the reciprocal of the lifetime fecundity, also known as the lifetime egg production (F_a). Because two fish eggs (one male, one female) must survive to adulthood for a female fish to be replaced, the total probability across all lifestages of each egg surviving to become a mature female is:

$$S = 2/F_a$$

where, F_a = the lifetime fecundity (egg production)

and the probability of life stage i surviving to adulthood is:

$$S_i = 2/S_eF_a$$

where, S_e = the probability of an egg surviving to life stage i.

Saila et al. (1997) lists four assumptions for AE estimates to be valid:

1. the stock is in equilibrium, meaning that it is not significantly increasing or decreasing,
2. there is a stable population age distribution,
3. there is a constant male:female ratio, and
4. there are no density dependent compensatory mechanisms meaning that a reduction in the abundance of a life stage is compensated by an increase in survival of that life stages of later life stages.

Survival rates for the life stages of the fish entrained and impinged at Seabrook Station came from various sources. Empirically derived survival rates for American sand lance, Atlantic cod, Atlantic herring, Atlantic mackerel, cunner, red and white hakes, pollock, Acadian redfish, silver hake, windowpane, winter flounder, witch flounder, yellowtail founder, seasnail spp., lumpfish, longhorn and sculpin, etc. were derived from larval length data collected as part of the Seabrook Station environmental monitoring program using the method described in Goodyear (1978) and Saila et al. (1997). Sources for mortality rates for other fish are described in the footnotes to the life tables in Appendix G (see enclosed CD) and included among others EPA (2004) and Barnthouse (2005). Adult fish that were impinged were added directly to estimates of equivalent adults derived from impingement of juveniles.

An important factor in the life tables is to ensure that they are balanced, meaning that the ratio of lifetime egg production to the probability of survival from egg to maturity is approximately 1 (Barnthouse 2005). If this ratio is substantially greater than 1, the population is growing. If it is less than 1, the population is decreasing. Both these cases violate the basic assumption of adult equivalent modeling that the population is in equilibrium. Where the lifetime egg production of the species was obtainable from the literature, mortality rates, usually of the juvenile stage, were adjusted so that the ratio approximated 1.

3.2.5.4.1 Equivalent Adults Resulting from Egg Entrainment

<u>FPL response</u>: The entrainment of 1,103 million fish eggs under typical operating conditions (Table 3-9) represented the loss of an estimated 106,000 equivalent adults (Table 3-12). Cunner eggs (104,000 adults; 98%) made the largest contribution to the equivalent adult estimate with the majority of the estimate occurring in June and July. This analysis assumes that 99% of the eggs in the mixed cunner/yellowtail flounder group were cunner eggs (see section 3.2.4.1). The greatest equivalent adult estimate occurred in June and July due to the large numbers of cunner eggs entrained in those months (Table 3-9). All other egg taxa each contributed less than 1% to the equivalent adult total.

3.2.5.4.2 Equivalent Adults Resulting from Larval Entrainment

<u>FPL response</u>: The entrainment of 448 million fish larvae (Table 3-10) under typical operating conditions represented the loss of an estimated 388,000 equivalent adults (Table 3-13). Although fewer larvae than eggs were entrained, the equivalent adult estimate for larvae was greater than for eggs because the survival rate to adulthood is higher for larvae than for eggs. As with fish eggs, cunner larvae made the greatest contribution to the equivalent adult estimate (139,000 adults; 36%). Substantial contributions were also made by Atlantic seasnail (95,000 adults; 25%) grubby (68,000 adults; 17%). The Atlantic seasnail is a small, non-commercial, benthic fish that uses a ventral sucker to attach to rocks, seaweed and other structure. They do not have pelagic eggs, therefore the eggs have not appeared in entrainment samples. If unidentified snailfish (*Liparis* sp. 1,459) and the closely related Gulf snailfish (9,494) are combined with Atlantic seasnail, an estimated 106,000 adult *Liparis* spp. were lost due to entrainment of the larvae of these species. The grubby is a small non-

commercial member of the sculpin family that is common in the Gulf of Maine (Collette and Klein-MacPhee 2002). If all the unidentified sculpins are considered to be grubby and are combined with shorthorn and longhorn sculpins, an estimated 81,000 adults were lost due to the entrainment of sculpin larvae.

Larval entrainment of most commercially and recreationally important fishes (Atlantic cod, Atlantic mackerel, Atlantic menhaden, cusk, fourspot flounder, goosefish, haddock, red and white hakes, pollock, redfish, silver hake, summer flounder, tautog, windowpane, and yellowtail flounder) were represented by the loss of fewer than 100 equivalent adults of each species. Exceptions were American plaice (233 adults), Atlantic herring (412 adults), rainbow smelt (7,647 adults), and winter flounder (1,861 adults). The equivalent adult estimates for larvae of these species were higher than the other species due to the higher larval entrainment estimates for these species (Table 3-10). The entrainment of the ecologically important forage fish American sand lance was represented by an estimated 30,000 equivalent adults.

3.2.5.4.3 Equivalent Adults Resulting from Impingement of Juvenile and Adults

<u>FPL response:</u> The impingement of 29,876 fish under typical operating conditions is represented by the loss of an estimated 17,000 equivalent adults annually (Table 3-14). The estimated number of equivalent adults roughly paralleled the estimated number of fish impinged because many of the fish impinged were adults or near reproductive age. The most numerous equivalent adults impinged were Atlantic silverside (4,800 equivalent adults), rock gunnel (2,700 equivalent adults), winter flounder (1,100 equivalent adults), rainbow smelt (1,100 equivalent adults), and windowpane (1,000 equivalent adults). These were also the five most abundant fish impinged.

Atlantic silverside had the highest estimate of equivalent adults. These fish were probably impinged as they moved past the intakes in the fall and early winter as they leave nearshore areas in response to colder water temperatures (Conover and Murawski 1982). The reduction between estimated number impinged (5,260) and estimated number of equivalent adults (4,841) was relatively small (8%) because most of the Atlantic silverside impinged were adults.

Rock gunnel ranked second in estimated number of equivalent adults. These structure oriented fish are impinged year-round and have been observed by divers to be living in close association with the intake structure. There was a 25% reduction due to natural mortality in the estimated number of rock gunnel impinged (3,602), and estimated equivalent adults (2,665).

Winter flounder is an important commercial fish that ranked third in number impinged (2,963) and in equivalent adults (1,140). Almost 70% of the equivalent adult loss occurred in December as large numbers of age 1 fish were impinged. Natural and fishing mortality resulted in a 62% reduction between the estimated number of winter flounder impinged and the number of equivalent adults. The winter flounder stock in the Gulf of Maine is not overfished, spawning stock biomass is relatively high, and fishing mortality is at a record low (Mayo et al. 2006).

Rainbow smelt ranked fifth in impingement (2,026) and fourth in estimated equivalent adults (1,122). The egg, larval and early juvenile stages of rainbow smelt occur in the estuary and therefore these lifestages are not normally subject to entrainment or impingement at the offshore intakes. The majority of the rainbow smelt were impinged as age 1 and age 2 fish in December. Rainbow smelt are mature at age 2 and impingement of these fish at ages close to maturity resulted in a relatively small reduction (44%) between impingement and equivalent adults. To put the equivalent adult loss in perspective, and estimated average of 163,000 rainbow smelt were taken by recreational anglers in the Great Bay, NH, fishery each year between 1994 and 2005 (New Hampshire Fish and Game Department [NHFG], 2007).

Windowpane are a commercial fish that ranked fourth in impingement (2,106) and fifth in equivalent adults (1,012). Losses of windowpane equivalent adults were greatest in December when most age 1 fish were impinged. This fish matures by age 3 and there was a 52% reduction between estimated impingement and number of equivalent adults. This fish is not considered to be overfished and the spawning stock biomass has declined since 1998 (Mayo et al. 2006).

Table 3-15 presents a summary of estimates of equivalent adults lost to egg entrainment, larval entrainment and juvenile and adult impingement. Fish listed are the five highest equivalent adult estimates for each of egg and larval entrainment and impingement. In addition several selected commercially important fishes and lobster are included. Fish are categorized as prey species, commercial species or recreational species. In reality these categories overlap to a large degree as many commercial species are also recreationally important, and many commercial and recreational species are also prey species when young.

For most species, entrainment of eggs and larvae made a greater contribution to the total equivalent adult estimate than impingement. This generalization even held true for several species whose eggs are not subject to entrainment because either they are demersal and adhesive, or do not occur in the vicinity of the intake such as Atlantic herring, American sand lance, grubby, northern pipefish, and rainbow smelt.

Annual equivalent adult losses for most commercial fish were generally less than 500 with the exception of silver hake (729), windowpane (1,046) and winter flounder (3,188). Egg entrainment made the biggest contribution to the total equivalent adult estimate for silver hake, while impingement made the greatest contribution for windowpane. Larval entrainment and impingement made similar contributions to the total equivalent adult estimate for winter flounder.

3.2.5.5 Assumptions, Methods, Calculations

FPL response: See Sections 3.2.5 and 3.2.5.4 for a discussion of assumptions, methods and calculations regarding the estimates of entrainment and impingement effects.

3.2.6 Other Information Requested

3.2.6.1 Response to USEPA's December 6, 2006 Letter

USEPA comment: Provide the Additional Information Requested in the USEPA's December 6, 2006 Letter to FPL

FPL response: The additional information requested in the USEPA's December 6, 2006 letter is provided in section 2 (above). Revisions to any sections of the PIC made in response to the December 6th letter are provided in the Revised PIC document (Appendix A).

3.2.6.2 Description of Existing/Proposed Technologies and Operational Measures that Reflect BTA for Minimizing Adverse Environmental Impacts at Seabrook Station

USEPA comment: Provide a Description of the Combination of Existing and Proposed Technologies and operational Measures at Seabrook Station for which Seabrook Station believes the Location, Design, Capacity and Construction Reflect the Best technology Available for Minimizing Adverse Environmental impacts

FPL response:

Several types of technologies and operational measures have been evaluated in this CWIS ID. When comparing the potential IM&E reductions of these various technologies to the known IM&E reductions associated with the existing off-shore intakes at the Seabrook Station, the overall conclusion is that none of the technologies evaluated would provide environmental effectiveness, cost effectiveness, and operational reliability in reducing IM&E at Seabrook. Under the site specific conditions at Seabrook Station, none of the technologies or additional operational measures evaluated would be able to provide a significant decrease in the current levels of IM&E achieved by the existing intake without the creation of other environmental impacts and high levels of operational risk and uncertainty. The application of some of the potential technologies would be experimental in nature since they have not been applied to the specific conditions that exist at the Seabrook station. Based on the site-specific considerations and the uncertainty of the technologies and operational measures considered, it is concluded that the current configuration of the Seabrook Station intake, which is located at an off-shore location of low biological activity and employs the use of velocity caps, along with the current use of recirculation as a reliable operational measure to reduce intake flow, is the best technology available (BTA) for minimizing adverse environmental impacts.

4. Information Described in 40 CFR § 122.21 (r) (2) and 40 CFR § 122.21 (r) (3)

USEPA comment: *In their July 31, 2007 response letter, under the "Schedule for Information Collection and Submission", item 3 (page 3), the USEPA requested that copies of the Source Water Physical Data section and the Cooling Water Intake Structure Data section from the PIC be provided.*

The Source Water Physical Data section has been revised, based on USEPA comments, and is provided in Section 4.1 of the Revised PIC document (Appendix A). The Cooling Water Intake Structure Data section has been revised and is provided in Section 4.2 of the Revised PIC document (Appendix A).

4.1 Source Water Physical Data (40 CFR § 122.21 (r) (2))

FPL response: This section (Section 3.2) of the PIC has been revised to include an expanded discussion of the source water physical data for the Seabrook Station. This includes discussions regarding water temperature, salinity, dissolved oxygen and local bathymetry. This revised section of the PIC is provided in the Revised PIC document (Appendix A).

4.2 Cooling Water Intake Structure Data (40 CFR § 122.21 (r) (3))

FPL response: This section (Section 3.3) of the PIC has been updated to reflect additional data collected in 2005 and 2006. This revised section of the PIC is provided in the Revised PIC document (Appendix A).

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Table 3-1. Seabrook Station Cooling Water System Pumps.

Type	Identification Number	Capacity GPM	Related HP	RPM
Circulating Water Pump	P-39A	130,000	3,400	400
Circulating Water Pump	P-39B	130,000	3,400	400
Circulating Water Pump	P-39C	130,000	3,400	400
Service Water Pump	P41A	10,500	600	800
Service Water Pump	P41B	10,500	600	800
Service Water Pump	P41C	10,500	600	800
Service Water Pump	P41D	10,500	600	800
Screen Wash Pump	P40	600	75	3,550
Screen Wash Pump	P178	600	75	3,550
Circulating Water Lube Water Pump	P-136A	110	10	3,550
Circulating Water Lube Water Pump	P-136B	110	10	3,550
Chlorination System Metering Pump	P380A	4	1	280
Chlorination System Metering Pump	P380B	4	1	280
Anti-Scalant Injection Pump	P-439	0.02	0.2	60
Cooling Tower Pump	P110A	13,000	800	1,185
Cooling Tower Pump	P110B	13,000	800	1,185

Table 3-5. Flow Reduction from Recirculation

Month	Baseline Flow (MGD)	Average Full Load Intake Flow Without Recirculation (2002-2006) (MGD)	Average Full Load Intake Flow With Recirculation (2002-2006) (MGD)	Reduction from Baseline	Reduction from Full Load Intake Flow Without Recirculation
January	744	682	586	21%	14%
February	744	682	584	22%	14%
March	744	682	575	23%	16%
April	744	682	604	19%	11%
May	744	682	643	14%	6%
June	744	682	669	10%	2%
July	744	682	676	9%	1%
August	744	682	678	9%	1%
September	744	682	682	8%	0%
October	744	682	668	10%	2%
November	744	682	667	10%	2%
December	744	682	631	15%	7%

Table 3-6. Flow Reduction from Operation with Two Circulating Water Pumps

Month	Baseline Flow MGD)	Average Full Load Intake Flow Without Recirculation (2002-2006) (MGD)	Average Full Load Intake Flow With Recirculation (2002-2006) (MGD)	Projected Flow with Operation on Two CW Pumps (MGD)	Reduction from Baseline	Reduction from Full Load Intake Flow Without Recirculation	Reduction from Full Load Intake Flow With Recirculation
January	744	682	586	525	29%	23%	10%
February	744	682	584	525	29%	23%	10%
March	744	682	575	525	29%	23%	9%
April	744	682	604	559	25%	18%	7%
May	744	682	643	682	8%	0%	0%
June	744	682	669	682	8%	0%	0%
July	744	682	676	682	8%	0%	0%
August	744	682	678	682	8%	0%	0%
September	744	682	682	682	8%	0%	0%
October	744	682	668	682	8%	0%	0%
November	744	682	667	666	10%	2%	0%
December	744	682	631	525	29%	23%	17%

Table 3-7. Flow Reduction from Operation with VFDs on Three Circulating Water Pumps (Exceeds Permitted ΔT Limits)

Month	Baseline Flow MGD)	Average Full Load Intake Flow Without Recirculation (2002-2006) (MGD)	Average Full Load Intake Flow With Recirculation (2002-2006) (MGD)	Projected Flow with VFDs on Three CW Pumps (MGD)	Reduction from Baseline	Reduction from Full Load Intake Flow Without Recirculation	Reduction from Full Load Intake Flow With Recirculation
January	744	682	586	536	28%	21%	9%
February	744	682	584	521	30%	24%	11%
March	744	682	575	526	29%	23%	9%
April	744	682	604	547	26%	20%	9%
May	744	682	643	594	20%	13%	8%
June	744	682	669	628	16%	8%	6%
July	744	682	676	666	10%	2%	1%
August	744	682	678	682	8%	0%	0%
September	744	682	682	682	8%	0%	0%
October	744	682	668	682	8%	0%	0%
November	744	682	667	627	16%	8%	6%
December	744	682	631	574	23%	16%	9%

Table 3-8. Flow Reduction from Operation with VFDs on Three Circulating Water Pumps (Within Permitted ΔT Limits)

Month	Baseline Flow MGD)	Average Full Load Intake Flow Without Recirculation (2002-2006) (MGD)	Average Full Load Intake Flow With Recirculation (2002-2006) (MGD)	Projected Flow with VFDs on Three CW Pumps (MGD)	Reduction from Baseline	Reduction from Full Load Intake Flow Without Recirculation	Reduction from Full Load Intake Flow With Recirculation
January	744	682	586	590	21%	13%	0%
February	744	682	584	590	21%	13%	0%
March	744	682	575	590	21%	13%	0%
April	744	682	604	590	21%	13%	2%
May	744	682	643	594	20%	13%	8%
June	744	682	669	628	16%	8%	6%
July	744	682	676	666	10%	2%	1%
August	744	682	678	682	8%	0%	0%
September	744	682	682	682	8%	0%	0%
October	744	682	668	687	8%	0%	0%
November	744	682	667	627	16%	8%	6%
December	744	682	631	590	21%	13%	6%

Table 3-9. Mean Monthly and Annual Estimated Numbers of Fish Eggs (in millions) Entrained by the Cooling Water System at Seabrook Station During 2002-2006.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
American plaice	<0.01	0	0.05	1.51	12.53	5.57	2.45	0.02	0	0	0	0	22.14
American sand lance	0	0	0	0	0	0	0	0	0	<0.01	<0.01	0	0.01
Atlantic cod	1.05	<0.01	0.02	0.02	0.09	0.18	0.63	0	0	0.11	2.92	2.34	7.36
Atlantic cod/haddock	0.08	0.20	0.34	0	0	0	0	0	0	0	0	0	0.61
Atlantic cod/witch flounder	0	0	0	0.68	5.25	12.11	5.06	0.39	0.12	<0.01	0	0	23.61
Atlantic mackerel	0	0	0	0.72	14.72	114.31	3.52	0.28	0	0	0	0	133.56
Atlantic menhaden	0	0	0	0	0	0	0	0	0	0	0	<0.01	0.005
Butterfish	0	0	0	0	0	0	0.01	0.04	0.02	0	0	0	0.07
Cunner	0	0	0	0	0	3.93	42.43	0.05	<0.01	<0.01	0	0	46.41
Cunner/Yellowtail flounder	0	0	0	10.28	3.98	425.07	195.81	5.60	0.11	0.06	<0.01	0	640.91
Cusk	0	0	0	0	0.02	0.13	0.19	0.04	0	0	0	0	0.38
Fourbeard rockling	0	0	0	0.04	0.84	2.80	1.19	0.41	0.12	0.06	<0.01	0	5.47
Fourspot flounder	0	0	0	0	0	0	0	0	0.07	0	0	0	0.07
Goosefish	<0.01	<0.01	<0.01	0	0	0.01	0	0	0	0	0	0	0.03
Hake[a]	0	<001	0.02	1.60	0.01	3.04	3.57	8.85	2.58	0.29	0.01	0.01	20.00
Hake/Fourbeard rockling	0	0	0	2.62	10.46	17.22	9.21	4.92	1.32	0.51	0.03	0	46.30
Lumpfish	0	0	0	0	<0.01	0	0	0	0	0	<0.01	<0.01	0.005
Northern searobin	0	0	0	0	0	0	0	0	<0.01	0	0	0	0.005
Pollock	0.26	0.09	<0.01	<0.01	0	0	0	0	0	<0.01	0.13	1.02	1.52
Silver hake	0	0	0.26	25.12	0.13	20.25	58.69	18.93	2.57	1.90	0.04	0	127.89
Tautog	0	0	0	0	0	0	0.42	0.40	0	0	0	0	0.82
Unidentified	<0.01	0	0	<0.01	<0.01	0.01	0.01	0.02	0.08	0.01	0.03	<0.01	0.18
Unidentified sculpin	<0.01	0.01	0	0	0	0	0	0	0	0	0	0	0.02
Unidentified searobin	0	0	0	0	0	0	0	0.12	0	0	0	0	0.12
Windowpane	<0.01	0	0	0.09	1.81	13.80	4.08	3.51	2.20	0.04	<0.01	<0.01	25.55
Winter flounder	<0.01	0	0	<0.01	0.05	0	0	0	0	0	0	0	0.06
Witch flounder	0	0	0	0	0	0	0.03	0	0	0	0	0	0.03
Yellowtail flounder	0.03	0.05	0.06	0	0	0	0	0	0	0	<0.01	0	0.15
TOTAL	**1.45**	**0.38**	**0.76**	**42.70**	**49.90**	**618.43**	**327.30**	**43.58**	**9.20**	**3.00**	**3.20**	**3.38**	**1103.29**

[a] Hake = red, white, and spotted hake

Table 3-10. **Mean Monthly and Annual Estimated Numbers of Fish Larvae (in millions) Entrained by the Cooling Water System at Seabrook Station During 2002-2006.**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Alligatorfish	0	0	0	0.03	0.02	0	0	0	0	0	0	0	0.05
American eel	0	<0.01	0	0	0	0	0	0	0	0	0	0	<0.01
American plaice	0	0	0.03	0.02	0.14	0.92	3.68	0.19	0.01	0	0	0	4.99
American sand lance	3.73	16.9	12.18	3.55	0.86	0.09	0	0	0	0	0	0.08	37.40
Atlantic cod	0.11	<0.01	0	<0.01	0.01	0.11	4.03	3.52	0.05	0	0.02	0.04	7.90
Atlantic herring	0.76	0.11	0.37	0.26	0.02	0.02	0	<0.01	0	0.65	6.59	2.86	11.65
Atlantic mackerel	0	0	0	0	0	0.11	4.11	0	0	0	0	0	4.23
Atlantic menhaden	0	0	0	<0.01	0	0	0.01	<0.01	0.01	0	<0.01	0	0.04
Atlantic seasnail	<0.01	0	0.04	4.29	15.27	16.29	2.74	0.17	0	0	0	0	38.81
Atlantic silverside	0	0	0	0	0	0	0	0	0	0	0	0.01	0.01
Cunner	0	0	0	6.13	<0.01	0.27	98.8	65.52	4.47	0.02	0	<0.01	175.22
Cusk	0	0	0	0	0	<0.01	0.67	0.15	0	0	0	0	0.82
Fourbeard rockling	0	0	0	0.53	0.04	0.31	13.57	36.16	2.13	0.04	0.01	0	52.80
Fourspot flounder	0	0	0	0	0	0	0	0	<0.01	0	0	0	<0.01
Gadidae	0	0	0	0	0	0	0	0	0	0	0	<0.01	<0.01
Goosefish	0	0.01	0	0	0	0	0	0	0	0	0	0	0.01
Grubby	<0.01	0.42	11.95	5.61	2.50	0.09	0	0	0	0	0	<0.01	20.59
Gulf snailfish	0.26	0.65	1.54	0.36	0.57	0.04	0.03	0.42	0	0	0	0.02	3.87
Haddock	0	<0.01	0	0	0	0	<0.01	0	0	0	0	0	0.01
Hake[a]	0	0	0	0	0	0	0.14	0.05	0.10	0.01	0	0	0.30
Herring family	0	0	0	0	0.06	0.04	0	0	0	0	<0.01	0	0.11
Liparis sp.	0.01	0.03	0.01	0.01	0.04	0.47	0.02	0	0	0	0	0	0.59
Longhorn sculpin	0.07	1.09	0.72	0.07	0.02	0	0	0	0	0	0	0	1.97
Lumpfish	0	0	<0.01	0.02	0.06	0.07	0.03	0.06	<0.01	0	0	0	0.26
Moustache sculpin	<0.01	0	0	0	0	0	0	0	0	0	0	0	<0.01
Northern pipefish	<0.01	0	0	0	0	0.01	<0.01	0	0.02	<0.01	<0.01	0	0.05
Northern searobin	0	0	0	0	0	0	<0.01	0	0	0	0	0	<0.01
Ocean pout	0	0	0	0	0	0	0	0	0	0	0	<0.01	<0.01
Pollock	0.08	0	<0.01	0.02	0	0	0.05	0	0	0	0	0.16	0.3
Radiated shanny	0	0	<0.01	0.02	1.26	2.37	1.99	1.34	0.07	<0.01	0	0.01	7.07
Rainbow smelt	<0.01	0	0	0	0.71	0.26	0	<0.01	0	<0.01	0	<0.01	0.99
Redfish spp.	0	0	0	0	0	0	<0.01	0	0	0	0	0	<0.01
Rock gunnel	0.49	8.35	37.99	4.72	0.80	<0.01	0	0	0	0	0	<0.01	52.36
Sea raven	0	<0.01	0.05	<0.01	<0.01	0	0	0	0	0	0	0	0.06
Shorthorn sculpin	<0.01	0.80	2.56	0.17	0.05	0	<0.01	0	0	0	0	0	3.58
Silver hake	0	0	0	0	0	0	0.81	0.42	0.11	0	0	0	1.34

Table 3-10. Mean Monthly and Annual Estimated Numbers of Fish Larvae (in millions) Entrained by the Cooling Water System at Seabrook Station During 2002-2006.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Snakeblenny	0	0	<0.01	0	0	0	0	0	0	0	0	0	<0.01
Spotted hake	0	0	0	0	0	0	0	0	0	<0.01	0	0	<0.01
Summer flounder	0	0	0	0	0	0	0	0	0	0	<0.01	0	<0.01
Tautog	0	0	0	0	0	0	0	0	0.03	0	0	0	0.03
Unidentified	0.18	0.15	0.31	0.60	0.25	0.22	0.67	0.08	0.06	<0.01	0.02	0.02	2.57
Unidentified sculpin	0.01	0.24	0.64	0.32	0.08	0	0	0	0	0	0	<0.01	1.29
Windowpane	0	0	0	0.04	0	0.01	0.53	0.96	0.09	0.03	<0.01	<0.01	1.67
Winter flounder	<0.01	0	0	0.13	2.66	9.77	1.67	0.03	0	0	0	0	14.26
Witch flounder	0	0	0	0	0	0.01	0.58	0.16	0.09	0	0	0	0.85
Wrymouth	0	0	0	<0.01	0	0	0	0	0	0	0	0	<0.01
Yellowtail flounder	0	0	0	<0.01	0.03	<0.01	0.16	<0.01	0	<0.01	0	0	0.21
TOTAL	**5.74**	**28.76**	**68.41**	**26.94**	**25.47**	**31.52**	**134.31**	**109.25**	**7.27**	**0.77**	**6.66**	**3.23**	**448.33**

[a] Hake = red, white, and spotted hake

Table 3-11. Mean Monthly and Annual Estimated Numbers of Fish Impinged by the Cooling Water System at Seabrook Station During 2002-2006.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Acadian redfish	0	0	0.6	0	0	0	0	0	0	0	0	0	1
Alewife	7.0	0	1.6	1.4	26.2	0	0.2	2.2	27.6	21.4	22.4	2.8	113
American eel	0	0	0	0	0	0	0	0.6	0	0.6	0	0.6	2
American lobster	1.6	0	0	0	3	0	0	0.6	0.8	8.4	6.0	4.4	25
American plaice	0.6	0	0	0	0	0	0	0	0	0	0	0	1
American sand lance	206.2	47.4	52.0	40.4	17.8	0	0	0	0	15.0	16.6	714.2	1110
American shad	0.6	0	0	0	0	0	0	0.6	0.8	1.4	1.4	1.4	6
Atlantic cod	40.2	8	6.2	4.6	10.6	52.2	12.0	10.6	11.2	70	54.2	585.0	865
Atlantic hagfish	0	0	0	1.4	0	0	0	0	0	0	0	0	1
Atlantic herring	0.6	7.2	11.0	13.4	15.8	17.8	0.8	0	0	28.2	32.2	24.4	151
Atlantic mackerel	0	0	0	0	0	0.8	0	0	0	0	0.8	0	2
Atlantic menhaden	22.2	1.8	0	0.8	0.8	0	0	53.8	16.6	1495	152.8	276	2020
Atlantic moonfish	0	0	0	0	0	0	0	0	0	10	0	0	10
Atlantic silverside	405.8	49.2	22.0	3.8	2.8	0	0	3.6	17.4	397.6	150.2	4207.4	5260
Atlantic wolffish	0	0	0	0	0	0	0.8	0	0	0	0	0	1
Black sea bass	0	0	0	0	0	0.8	0	0.6	0	2.8	2.4	0.8	7
Blackspotted stickleback	0	0	0	0	0.6	0	0	0	0	0	0	23.8	24
Blueback herring	2.2	0	5.0	13.2	17.2	1.4	0.8	14.2	1.8	52.6	120.8	5.4	235
Bluefish	0	0	0	0	0	0	0	0	1.4	0	0	0	1
Butterfish	0	0	0	0	0	2.6	1.4	2.8	247.8	3.8	3	0	261
Cunner	3.2	1.8	5.6	32.4	201.6	117.4	56.0	18.4	49.0	81.4	29.0	14.2	610
Fourbeard rockling	0	0	0	0	0	0	0	0	0	0.6	1.4	0	2
Fourspine stickleback	0	0	0	0	0	0	0	0	0	0.6	0	0	1
Fourspot flounder	0	0	0	0	2.8	0	0	0	0	3.4	0	1.4	8
Goosefish	1	0.6	0	0	0.8	0.8	0	0	0	0	4.0	0	7
Gray triggerfish	0	0	0	0	0	0	0	0	0.6	0.2	0	0	1
Grubby	81.4	141.6	178.4	180	24.8	9.4	4.2	0.6	1.2	20.8	83.8	284.6	1011
Haddock	0	0	0	0	0	0.6	0	0	0.8	0.6	0	0	2
Hake sp.[a]	30.4	2	1.2	9	2.2	12.8	2.0	0.6	2.8	9.8	295.6	37.8	406
Longhorn sculpin	9.2	0.2	2.2	6.8	45.0	7.6	0.8	0	0	16.4	12.2	8.0	108
Lookdown	0	0	0	0	0	0	0	0	0	0.4	0	0	0

Table 3-11. Mean Monthly and Annual Estimated Numbers of Fish Impinged by the Cooling Water System at Seabrook Station During 2002-2006.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Lumpfish	38.2	3.8	2.6	8.0	4.4	2.2	1.4	0.8	0	7.6	8.6	74.2	152
Mummichog	0	0.8	0	0	0	0	0	0	0	0	0	0	1
Northern pipefish	1.8	7.0	175.4	580.2	124.2	0.8	0	6.4	129.4	374.2	200.6	15.4	1615
Northern puffer	0	0	0	0	0	0	0	0	0	3	0	0	3
Northern searobin	0	0.6	0	110.2	0	0	0	0	0	0.8	0.4	3.4	115
Ocean pout	0.6	0	1.6	0	1.2	0	0	0	0	0.6	0	1.2	5
Planehead filefish	0	0	0	0	0	0	0	0	0	0.6	0	0	1
Pollock	0	2	1.2	1.4	7.4	21.4	26.6	36.8	39.0	122.2	14.8	45.0	318
Radiated shanny	0.6	7.4	12.8	9.2	3.0	0.8	0	0	0	0	0	20.8	55
Rainbow smelt	237.2	25.0	93.2	34.8	15	2.2	0	11.2	15.8	521.4	305.4	765	2026
Red hake	21.2	1.4	12.4	20.4	93.2	3.2	4.8	1.6	87.4	154.6	56.6	59.6	516
Rock gunnel	31.4	49.4	512.8	1561.2	111.0	53.4	90.2	50.4	159.8	280.6	70.2	631.8	3602
Scup	0	0	0	0	0	0	0	0	0	3.4	5.6	0.4	9
Sea lamprey	0	0	0.6	0	0	0	0	0	0	0	0	0	1
Sea raven	6.8	5	6.6	13.4	18.8	19.0	10.0	6.6	10.6	39.6	11.6	26.2	174
Shorthorn sculpin	159.6	463.2	710.6	135.4	24.0	14.0	9.6	2.8	0.4	33.2	29.0	906.2	2488
Silver hake	0	0	0	2.8	50.6	3.8	0	0	1.2	44.2	235.2	11.8	350
Skate sp.	10.8	2.8	0.2	0.8	21.8	10.0	0	0	0	41.2	24.6	29.2	141
Snailfish sp.	10	48.6	114.0	66.0	0	0	0	0	5.4	68.8	36.6	55.4	405
Spiny dogfish	0	0	0	0	0	0	0	0	3.0	3.6	0	0	7
Striped bass	0.6	0	0	0	0.2	0	0	0	0	0	2.8	0	4
Striped searobin	0	0.6	0	0	0	0	0	0	0	0	0	0	1
Summer flounder	0	0	0	0	0	0	0	0	0.8	0	0	0	1
Tautog	0	0	0	0.6	1.4	0	0	0	0	0	0	0	2
Threespine stickleback	35.6	26.4	30	16.2	2.8	0	0	0	0	14.4	3.8	302.6	432
Whiptail conger	0	0	0	0	0	0	0	0	0	1.2	0	0	1
White hake	2	0	1.4	6.4	9.8	0.8	3.2	0	1.6	20.6	1.4	6	53
White perch	0.6	0	0	0	0	0	0	0	0	0	0	40.2	41
Windowpane	142.2	44.2	18.2	13.8	112.2	9.8	0	0	50.6	388.0	434.8	892.8	2107
Winter flounder	375.8	233.2	106.4	108.2	123.8	4.4	0	0	0.6	86	119.2	1805	2963
Wrymouth	12.4	2.6	2.6	0.8	3.0	0	0	0	0	0.6	3.6	9.4	35
Yellowtail flounder	1.4	0.6	0	0	0	0	0	0	0	0	0.4	0.6	3
TOTAL	**1901.0**	**1184.4**	**2088.4**	**2997.0**	**1099.8**	**370.0**	**224.8**	**225.8**	**885.4**	**4451.4**	**2554.0**	**11894.4**	**29876**

a Hake sp = red and white hake

Table 3-12. Mean Monthly and Annual Estimated Numbers of Equivalent Adults Entrained as Fish Eggs by the Cooling Water System at Seabrook Station 2002-2006.

Common Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
American plaice	<1	0	<1	17	138	61	27	<1	0	0	0	0	243
American sand lance	0	0	0	0	0	0	0	0	0	<1	1	0	2
Atlantic cod	3	<1	<1	2	12	28	13	<1	<1	<1	7	6	73
Atlantic mackerel	0	0	0	2	45	349	11	<1	0	0	0	0	408
Atlantic menhaden	0	0	0	0	0	0	0	0	0	0	0	<1	<1
Butterfish	0	0	0	0	0	0	<1	<1	<1	0	0	0	1
Cunner	0	0	0	1,549	600	64,650	35,908	851	16	11	<1	0	103,585
Cusk	0	0	0	0	<1	<1	<1	<1	0	0	0	0	<1
Fourbeard rockling	0	0	0	22	94	167	87	44	12	5	<1	0	432
Fourspot flounder	0	0	0	0	0	0	0	0	<1	0	0	0	<1
Goosefish	<1	<1	<1	0	0	<1	0	0	0	0	0	0	<1
Haddock	<1	<1	<1	0	0	0	0	0	0	0	0	0	<1
Hake[a]	0	<1	<1	10	<1	19	22	53	16	2	<1	<1	122
Lumpfish	0	0	0	0	1	0	0	0	0	0	1	1	4
Northern searobin	0	0	0	0	0	0	0	0	22	0	0	0	22
Pollock	2	<1	<1	<1	0	0	0	0	0	<1	1	8	12
Silver hake	0	0	1	125	<1	101	292	94	13	9	<1	0	637
Tautog	0	0	0	0	0	0	<1	<1	0	0	0	0	<1
Unidentified	<1	0	0	<1	<1	<1	<1	<1	1	<1	<1	<1	2
Unidentified sculpin	<1	3	0	0	0	0	0	0	0	0	0	0	3
Windowpane	<1	0	0	<1	2	14	4	3	2	<1	<1	<1	25
Winter flounder	<1	0	0	<1	<1	0	0	0	0	0	0	0	<1
Witch flounder	0	0	0	<1	4	8	4	<1	<1	<1	0	0	16
Yellowtail flounder	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	0	<1
TOTAL	**6**	**4**	**3**	**1,727**	**897**	**65,397**	**36,368**	**1,050**	**83**	**28**	**12**	**15**	**105,588**

[a] Hake = red, white, and spotted hake

Table 3-13 Mean Monthly and Annual Estimated Numbers of Equivalent Adults Entrained as Fish Larvae by the Cooling Water System at Seabrook Station During 2002-2006.

Common name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Alligatorfish	0	0	0	1	<1	0	0	0	0	0	0	0	2
American eel	0	<1	0	0	0	0	0	0	0	0	0	0	<1
American plaice	0	0	1	<1	7	43	172	9	<1	0	0	0	233
American sand lance	3,004	13,598	9,797	2,859	694	70	0	0	0	0	0	63	30,085
Atlantic cod	1	<1	0	<1	<1	1	40	35	<1	0	<1	<1	78
Atlantic herring	27	4	13	9	<1	<1	0	<1	0	23	233	101	412
Atlantic mackerel	0	0	0	0	0	2	59	0	0	0	0	0	61
Atlantic menhaden	0	0	0	<1	0	0	3	1	2	0	1	0	9
Atlantic seasnail	9	0	105	10,529	37,510	40,003	6,738	427	0	0	0	0	95,320
Atlantic silverside	0	0	0	0	0	0	0	0	0	0	0	40	40
Cunner	0	0	0	4,850	4	217	78,138	51,815	3,536	17	0	2	138,580
Cusk	0	0	0	0	0	<1	2	<1	0	0	0	0	3
Fourbeard rockling	0	0	0	22	2	13	551	1,469	87	1	<1	0	2,145
Fourspot flounder	0	0	0	0	0	0	0	0	<1	0	0	0	<1
Gadidae	0	0	0	0	0	0	0	0	0	0	0	<1	<1
Goosefish	0	1	0	0	0	0	0	0	0	0	0	0	1
Grubby	21	1,366	39,323	18,464	8,220	307	0	0	0	0	0	20	67,720
Gulf snailfish	633	1,585	3,781	882	1,390	90	63	1,032	0	0	0	39	9,494
Haddock	0	<1	0	0	0	0	<1	0	0	0	0	0	<1
Hake[a]	0	0	0	0	0	0	5	2	3	<1	0	0	10
Herring family	0	0	0	0	2	2	0	0	0	0	<1	0	4
Liparis sp.	31	81	32	31	94	1,150	41	0	0	0	0	0	1,459
Longhorn sculpin	131	2,027	1,335	134	30	0	0	0	0	0	0	0	3,657
Lumpfish	0	0	41	71	278	320	130	258	29	0	0	0	1,127
Moustache sculpin	12	0	0	0	0	0	0	0	0	0	0	0	12
Northern pipefish	1,398	0	0	0	0	5,212	736	0	6,332	3,218	1,297	0	18,192
Northern searobin	0	0	0	0	0	0	43	0	0	0	0	0	43
Ocean pout	0	0	0	0	0	0	0	0	0	0	0	<1	<1
Pollock	2	0	<1	<1	0	0	1	0	0	0	0	4	9
Radiated shanny	0	0	<1	<1	9	18	15	10	<1	<1	0	<1	53
Rainbow smelt	48	0	0	0	5,501	2,015	0	28	0	29	0	27	7,647

Table 3-13 Mean Monthly and Annual Estimated Numbers of Equivalent Adults Entrained as Fish Larvae by the Cooling Water System at Seabrook Station During 2002-2006.

Common name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Redfish sp.	0	0	0	0	0	0	<1	0	0	0	0	0	<1
Rock gunnel	8	137	623	77	13	<1	0	0	0	0	0	<1	859
Sea raven	0	5	87	6	7	0	0	0	0	0	0	0	104
Shorthorn sculpin	6	1,479	4,742	311	100	0	3	0	0	0	0	0	6,641
Silver hake	0	0	0	0	0	0	19	10	3	0	0	0	32
Snakeblenny	0	0	<1	0	0	0	0	0	0	0	0	0	<1
Spotted hake	0	0	0	0	0	0	0	0	0	<1	0	0	<1
Summer flounder	0	0	0	0	0	0	0	0	0	0	<1	0	<1
Tautog	0	0	0	0	0	0	0	0	<1	0	0	0	<1
Unidentified	9	8	15	30	12	11	33	4	3	<1	<1	<1	127
Unidentified sculpin	25	439	1,190	587	156	0	0	0	0	0	0	5	2,402
Windowpane	0	0	0	<1	0	<1	3	5	<1	<1	<1	<1	8
Winter flounder	<1	0	0	18	347	1,275	217	4	0	0	0	0	1,861
Witch flounder	0	0	0	0	0	<1	22	6	4	0	0	0	32
Wrymouth	0	0	0	<1	0	0	0	0	0	0	0	0	<1
Yellowtail flounder	0	0	0	<1	<1	<1	<1	<1	0	<1	0	0	<1
TOTAL	**5,364**	**20,729**	**61,085**	**38,881**	**54,377**	**50,748**	**87,035**	**55,117**	**10,002**	**3,290**	**1,533**	**304**	**388,465**

[a] Hake = red, white, and spotted hake

Table 3-14. Monthly and Annual Estimated Numbers of Equivalent Adults Resulting from Juvenile and Adult Fish an Lobsters Impinged by the Cooling Water System at Seabrook Station During 2002-2006.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Acadian redfish	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Alewife	0.012	0.000	0.003	0.883	17.213	0.000	0.000	0.004	2.302	0.035	0.037	0.198	20.686
American eel	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	1.000
American lobster	0.199	0.000	0.000	0.000	0.325	0.000	0.000	0.600	0.123	2.724	1.223	0.674	5.868
American plaice	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
American sand lance	206.200	47.400	52.000	40.400	17.800	0.000	0.000	0.000	0.000	15.000	16.600	714.200	1109.600
American shad	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.002	0.002	0.002	0.010
Atlantic cod	0.000	0.000	1.550	3.266	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5.850	10.666
Atlantic hagfish	0.000	0.000	0.000	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.000
Atlantic herring	0.000	0.000	7.920	7.906	0.632	0.000	0.000	0.000	0.000	0.000	0.000	0.000	16.458
Atlantic mackerel	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	1.000	0.000	2.000
Atlantic menhaden	1.497	0.121	0.000	0.054	0.000	0.000	0.000	3.627	1.086	111.711	10.903	18.608	147.607
Atlantic moonfish	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001
Atlantic silverside	54.566	6.616	2.958	0.511	0.377	0.000	0.000	3.600	17.400	397.600	150.200	4207.400	4841.227
Atlantic wolffish	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	1.000
Black sea bass	0.000	0.000	0.000	0.000	0.000	0.800	0.000	0.600	0.000	1.400	0.000	0.000	2.800
Blueback herring	0.004	0.000	0.008	0.022	11.035	0.883	0.504	0.023	1.135	0.087	21.470	0.179	35.349
Bluefish	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.013
Butterfish	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.002	0.207	0.003	0.003	0.000	0.219
Cunner	2.885	1.092	3.240	21.318	149.821	97.554	48.074	16.384	44.507	60.272	20.644	12.166	477.959
Fourbeard rockling	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.600	1.064	0.000	1.664
Fourspot flounder	0.000	0.000	0.000	0.000	2.100	0.000	0.000	0.000	0.000	0.850	0.000	1.400	4.350
Goosefish	0.632	0.600	0.000	0.000	0.397	0.800	0.000	0.000	0.000	0.000	1.793	0.000	4.222
Gray triggerfish	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.002
Grubby	29.370	109.009	138.146	139.315	19.196	7.807	3.251	0.600	1.200	16.287	64.891	219.740	748.811
Haddock	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.487	0.000	0.000	0.490
Hake sp.[a]	0.000	0.000	0.000	0.000	2.104	0.000	0.000	0.000	0.000	1.850	0.000	0.000	3.954
Longhorn sculpin	4.532	0.200	2.200	5.728	37.177	6.379	0.376	0.000	0.000	13.741	11.263	6.566	88.162
Lookdown	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001
Lumpfish	6.363	0.653	0.279	1.336	0.596	0.697	0.363	0.162	0.000	0.832	1.311	10.841	23.432
Mummichog	0.000	0.800	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.800

Table 3-14. Monthly and Annual Estimated Numbers of Equivalent Adults Resulting from Juvenile and Adult Fish an Lobsters Impinged by the Cooling Water System at Seabrook Station During 2002-2006.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Northern pipefish	1.800	7.000	175.400	580.200	124.200	0.800	0.000	6.400	129.400	372.597	199.741	15.400	1612.937
Northern puffer	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.000	0.000	0.000	3.000
Northern searobin	0.000	0.225	0.000	85.092	0.000	0.000	0.000	0.000	0.000	0.300	0.400	2.696	88.714
Ocean pout	0.600	0.000	0.801	0.000	0.904	0.000	0.000	0.000	0.000	0.600	0.000	0.600	3.504
Planehead filefish	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001
Pollock	0.000	1.801	1.080	1.260	2.158	17.456	18.547	16.630	4.134	51.087	3.226	3.964	121.346
Radiated shanny	0.600	7.400	7.477	6.772	2.838	0.800	0.000	0.000	0.000	0.000	0.000	19.892	45.779
Rainbow smelt	50.574	4.450	60.467	17.629	9.220	1.183	0.000	6.024	8.908	316.594	172.737	475.114	1122.903
Rock gunnel	14.901	18.039	369.993	1248.960	99.900	45.390	88.396	48.384	158.202	269.801	42.928	260.953	2665.848
Scup	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.156	0.256	0.018	0.430
Sea lamprey	0.000	0.000	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.600
Sea raven	5.472	4.024	5.517	8.781	12.673	17.480	6.619	4.899	8.888	19.010	8.146	13.920	115.428
Shorthorn sculpin	35.438	104.427	209.090	39.095	10.202	4.333	11.029	2.768	7.632	51.554	13.924	35.714	525.206
Silver hake	0.000	0.000	0.000	0.170	3.068	0.230	0.000	0.000	0.000	9.028	43.194	4.659	60.350
Skate sp.	3.120	0.280	0.000	0.000	2.616	0.700	0.000	0.000	0.000	9.888	4.182	18.396	39.182
Snailfish sp.	7.200	35.964	94.620	63.360	0.000	0.000	0.000	0.000	2.322	26.832	22.326	48.198	300.822
Spiny dogfish	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4.000	4.000	8.000
Striped bass	0.005	0.000	0.000	0.000	0.081	0.000	0.000	0.000	0.000	0.000	0.022	0.000	0.107
Striped searobin	0.000	0.600	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.600
Summer flounder	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.800	0.000	0.000	0.000	0.800
Tautog	0.000	0.000	0.000	0.600	0.140	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.740
Sticklebacks	35.600	26.400	30.000	16.200	3.400	0.000	0.000	0.000	0.000	15.600	3.800	326.400	457.400
Whiptail conger	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001
White perch	0.045	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2.985	3.030
Windowpane	11.427	3.212	3.218	5.027	94.643	6.818	0.000	0.000	35.454	208.718	237.425	406.778	1012.721
Winter flounder	158.431	92.845	44.613	43.748	63.900	2.622	0.000	0.000	0.012	37.050	61.619	635.956	1140.797
Wrymouth	1.603	0.583	0.859	0.264	0.420	0.000	0.000	0.000	0.000	0.039	0.188	0.452	4.409
Yellowtail flounder	0.472	0.202	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.360	0.540	1.575
TOTAL	**633.549**	**473.944**	**1212.041**	**2339.898**	**689.135**	**213.736**	**178.162**	**110.709**	**423.715**	**2015.357**	**1120.880**	**7475.461**	**16886.59**

[a] Hake sp. = red and white hake

Table 3-15. **Estimated Annual Number of Equivalent Adults of Selected Species Lost to Entrainment and Impingement at Seabrook Station.**

	Egg Entrainment	Larval Entrainment	Juvenile and Adult Impingement	Total	Type[a]
Species					
American eel	0	0	1	1	C/P
American lobster	0	0	6	6	C
American plaice	243	233	<1	476	C
Atlantic cod	73	78	11	162	C/R
Atlantic herring	0	412	16	428	C/P
Atlantic mackerel	408	61	2	471	C/R
American sand lance	0	30,085	1,110	31,195	P
Atlantic silverside	0	40	4,841	4,881	P
Cunner	103,585	138,580	478	242,643	P
Fourbeard rockling	432	2,145	2	2,579	P
Grubby	0	67,720	749	68,469	P
Haddock	<1	<1	<1	1	C/R
Hake spp.	122	10	4	136	C
Northern pipefish	0	18,192	1,612	19,804	P
Pollock	12	9	121	142	C/P
Rainbow smelt	0	7,647	1,122	8,769	R
Rock gunnel	0	859	2,666	3,525	P
Silver hake	637	32	60	729	C
Snailfish spp.	0	95,320	300	95,620	P
Windowpane	25	8	1,013	1,046	C
Winter flounder	<1	1,861	1,327	3,188	C/R
Witch flounder	16	32	0	48	C
Yellowtail flounder	<1	<1	2	2	C

[a] Type:
C= commercial species
R= recreational species
P = prey species

G:\Div10\JLC\2008\048811022 Figure 3-1.doc

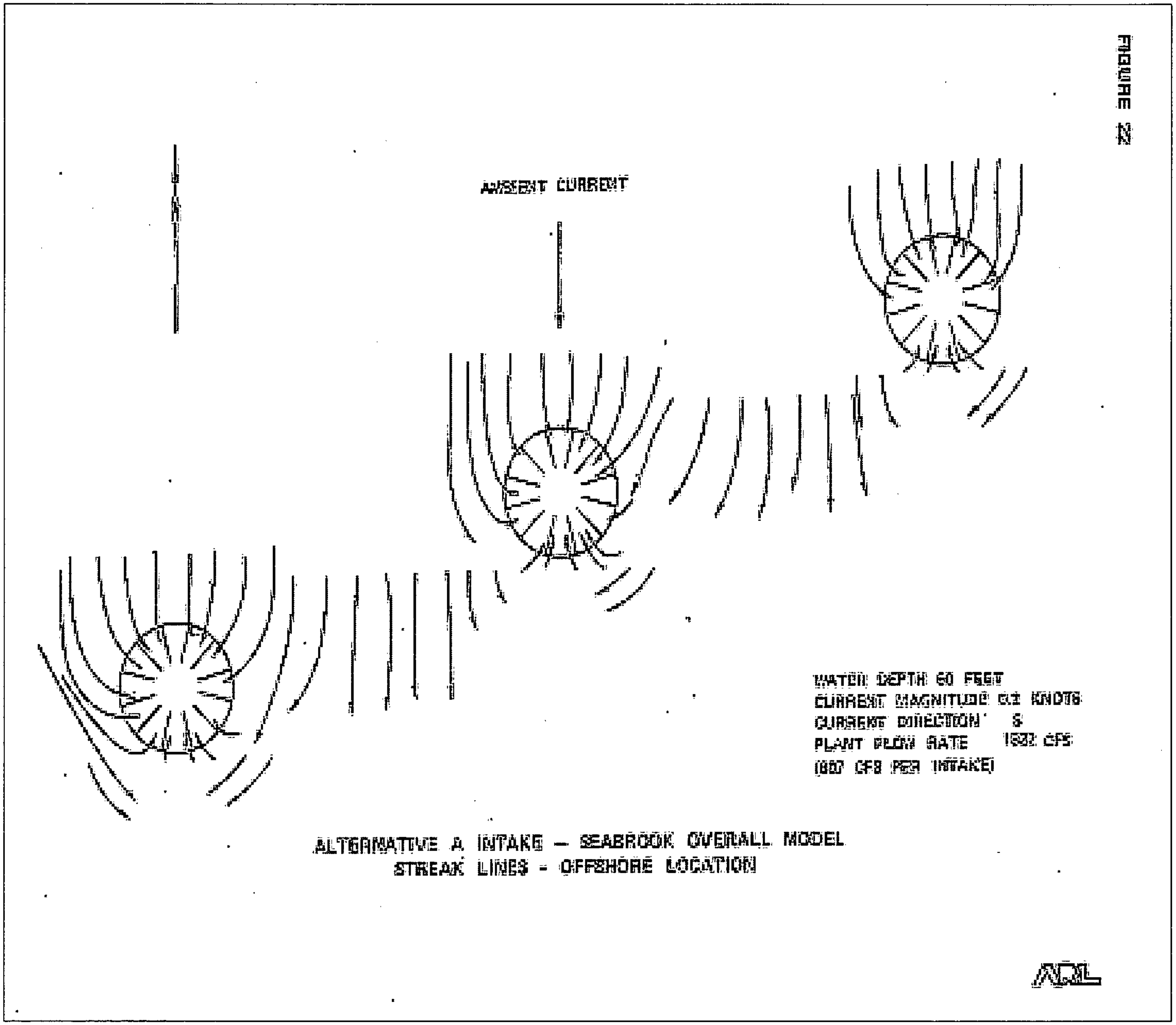


Figure 3-1
Seabrook Intake HZ Streak Line as Determined from Physical Modeling
Ambient Current: 0.2 Knots South

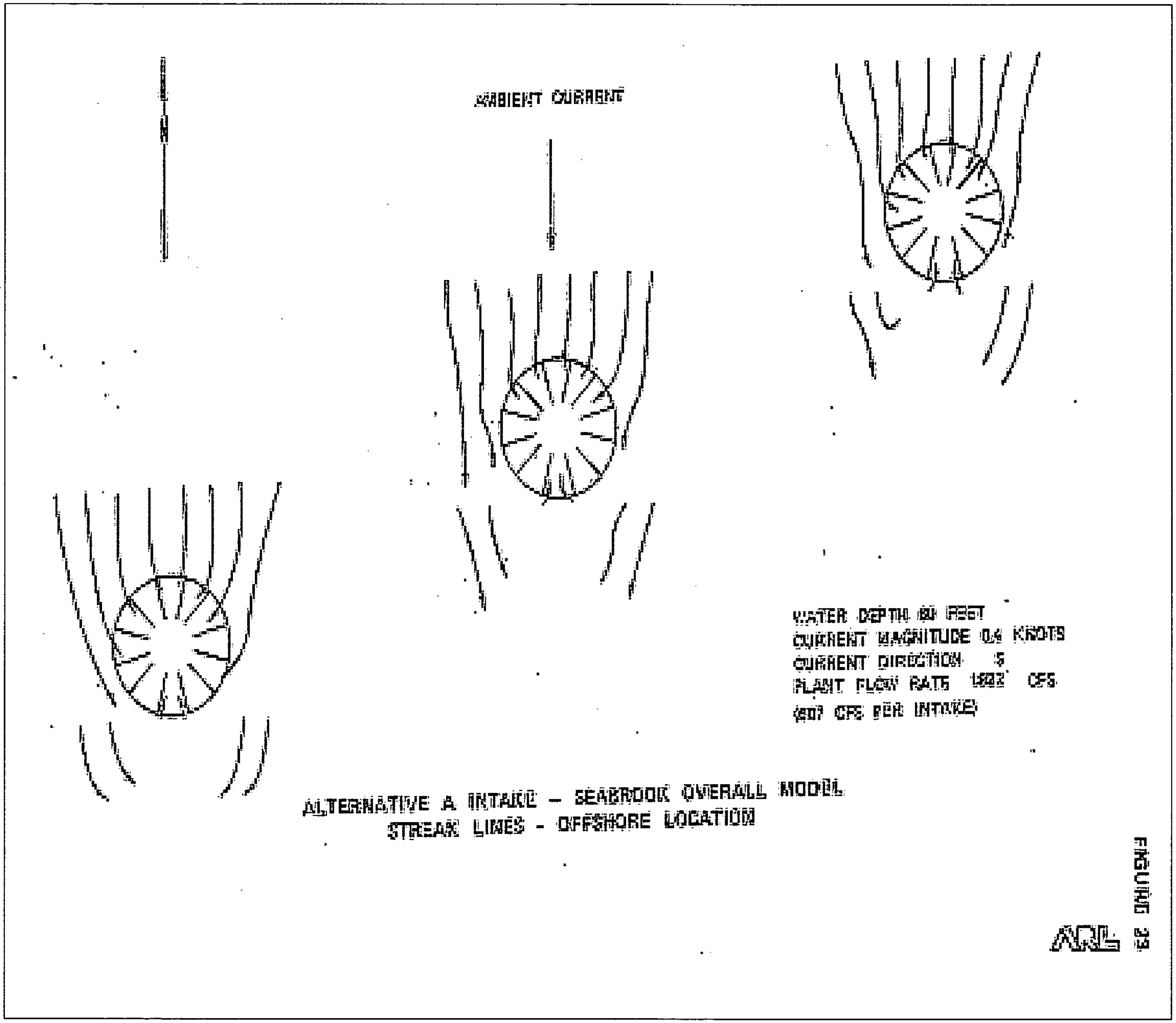
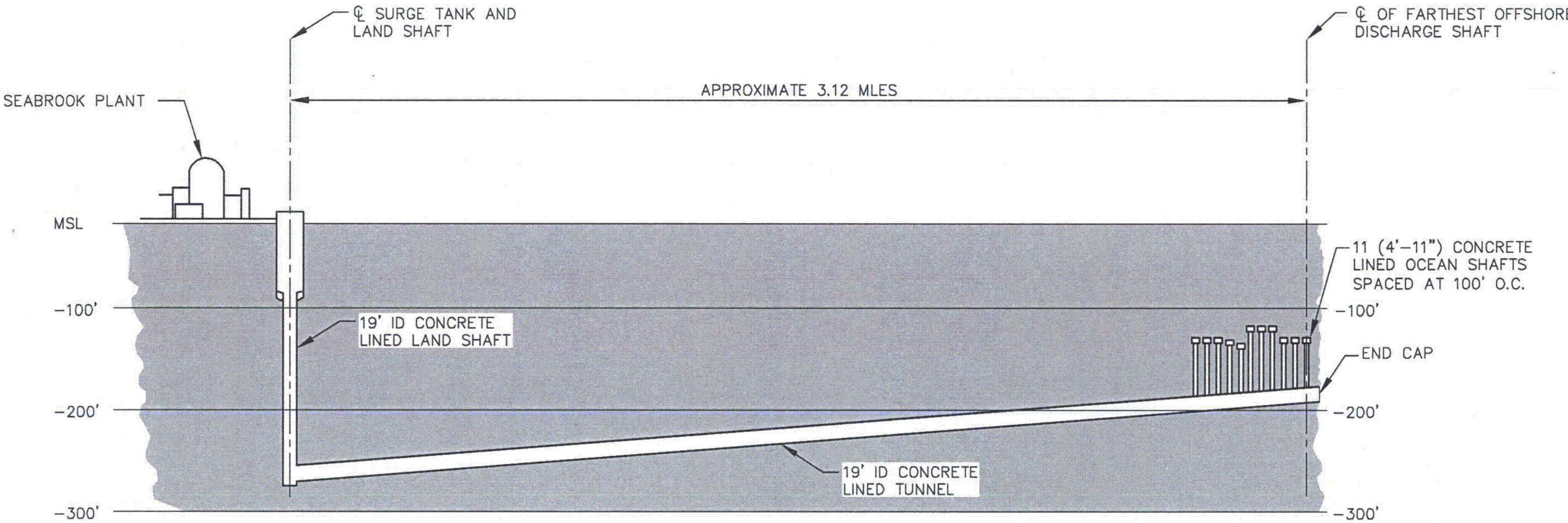


Figure 3-2
Seabrook Intake HZI Streak Line as Determined from Physical Modeling
Ambient Current: 0.4 Knots South

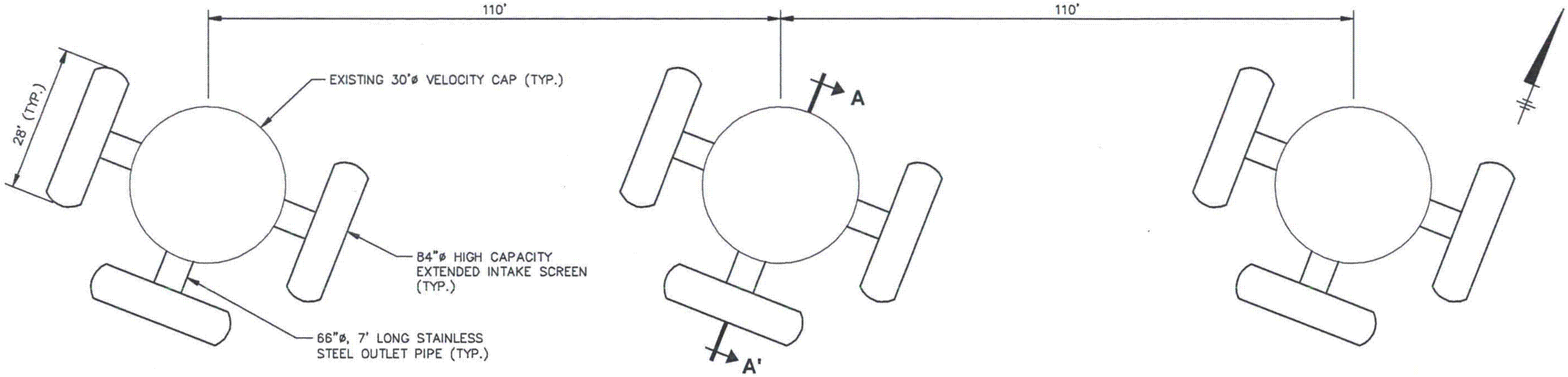


FPL ENERGY SEABROOK, LLC
SEABROOK STATION
CWIS INFORMATION DOCUMENT

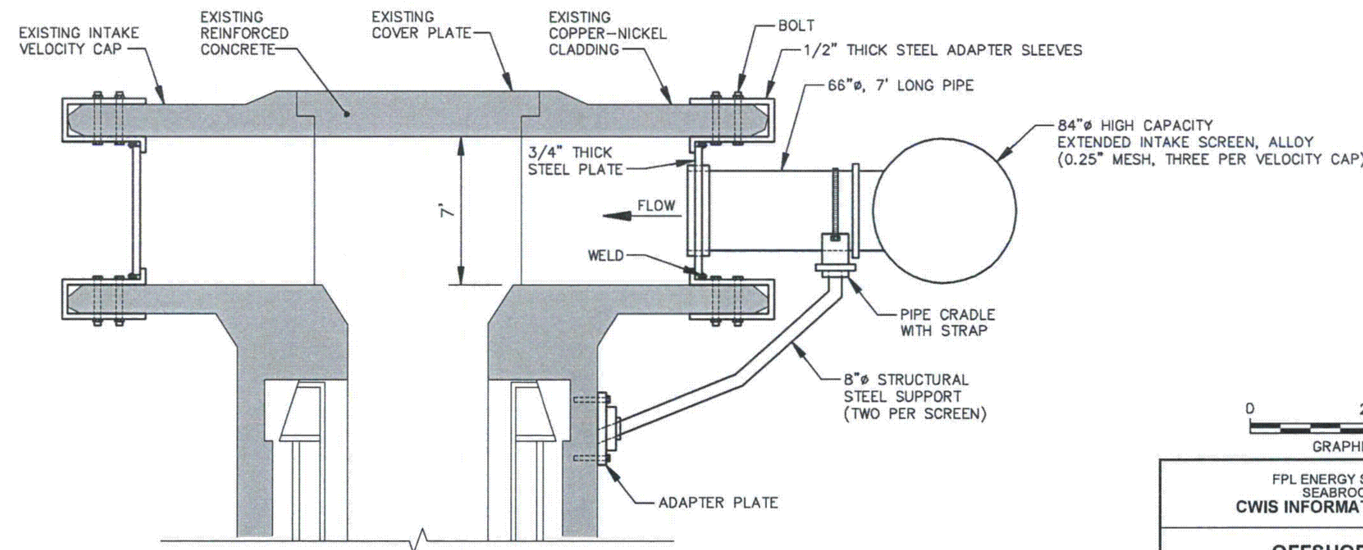
PROFILE OF DISCHARGE TUNNEL AND SHAFTS

ARCADIS

FIGURE
3-3



PLAN



TYPICAL WEDGE-WIRE SCREEN CONNECTION
SECTION A-A'

NOT TO SCALE

0 20' 40'
GRAPHIC SCALE

FPL ENERGY SEABROOK, LLC
SEABROOK STATION
CWIS INFORMATION DOCUMENT

OFFSHORE INTAKE:
COARSE MESH WEDGE-WIRE SCREENS

ARCADIS

FIGURE
3-4

CITY: SYR DIV/GROUP: 85 DB: KLS LD: BGP PIC: (Opt) PM: (Reqd) TM: (Opt) LYR: (Opt)ON=*;OFF=*REF*
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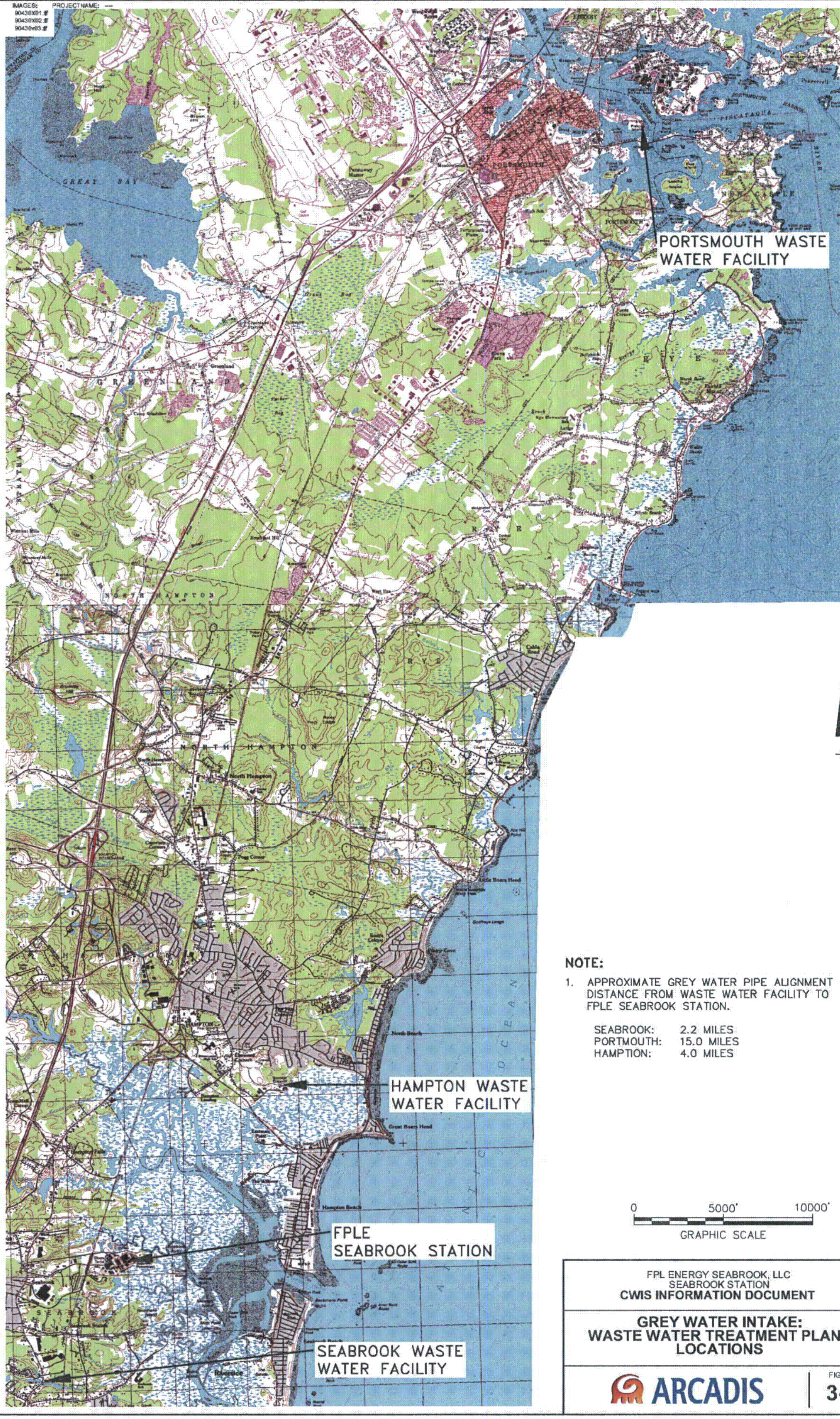


NOTE:

1. APPROXIMATE GREY WATER PIPE ALIGNMENT DISTANCE FROM WASTE WATER FACILITY TO FPLE SEABROOK STATION.

SEABROOK:	2.2 MILES
PORTMOUTH:	15.0 MILES
HAMPTION:	4.0 MILES

0 5000' 10000'
GRAPHIC SCALE

FPL ENERGY SEABROOK, LLC
SEABROOK STATION
CWIS INFORMATION DOCUMENT

GREY WATER INTAKE: WASTE WATER TREATMENT PLANT LOCATIONS

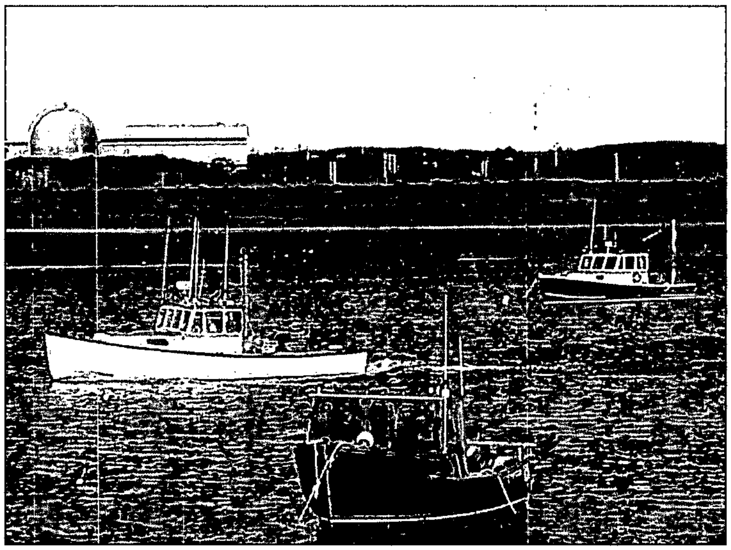
ARCADIS

FIGURE
3-5

Appendix A

Revised PIC

SEABROOK NUCLEAR POWER STATION
EPA 316(b) PHASE II RULE PROJECT
REVISED PROPOSAL FOR INFORMATION COLLECTION



JUNE 2008

SEABROOK NUCLEAR POWER STATION
EPA 316(b) PHASE II RULE PROJECT
REVISED PROPOSAL FOR INFORMATION COLLECTION

Prepared for
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June 2008

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1.0 INTRODUCTION

Submittal of a Proposal for Information Collection (PIC) is the first step in compliance with the Phase II rule of Section 316(b) of the Clean Water Act (CWA). This PIC for the FPL Energy Seabrook Nuclear Power Station (Seabrook Station) is submitted to EPA Region I to allow review and comment on Seabrook Station's plan to collect information to support the Comprehensive Demonstration Study (CDS). The CDS is the document that will demonstrate the means of compliance by Seabrook Station with the Phase II rule. The PIC also provides descriptive information on the Cooling Water System (CWS) and the source waterbody for cooling water for Seabrook Station.

This document is intended to document Seabrook Station's compliance with Section 125.95(b)(1) of the Phase II rule. It includes:

- a brief overview of Section 316(b) Phase II regulatory requirements (Section 2.0),
- a description of Seabrook Station and the cooling water system, including the descriptions required in Sections 122.21(r)(2), (3), and (5) of the Phase II rule are presented in Section 3.0.
- a description of existing and potential technology, operational and restoration measures that can be used to demonstrate compliance (Section 4.0),
- a description of historical studies that were used to characterize impingement mortality and entrainment (Section 5.0),
- a description of historical consultations with environmental regulatory agencies, and future impingement and entrainment sampling plans (Section 6.0), and
- a summary of the current environmental monitoring program.

2.0 SECTION 316(B) COMPLIANCE REQUIREMENTS

The final Section 316(b) Phase II rule (40 CFR Parts 9, 122, 123, 124, and 125) implements section 316(b) of the Clean Water Act for existing power production facilities that employ a cooling water intake structure and are designed to withdraw 50 MGD or greater from the waters of the United States for cooling purposes. According to Part 125.91, this rule is applicable to Seabrook Station because:

- Seabrook Station's primary activity is to generate electric power,
- Seabrook Station is a point source that uses a cooling water intake structure,
- the cooling water intake withdraws cooling water from waters of the United States and at least 25% is used exclusively for cooling purposes, and
- the cooling water intake structures have a total design flow 50 MGD or more.

The Phase II rule in Part 125.94(a) presents five alternatives for compliance:

Alternative 1—Demonstrate facility has reduced flow commensurate with closed-cycle recirculating system or demonstrate facility has reduced design intake velocity to less than 0.5 foot per second (fps).

Alternative 2—Demonstrate that existing design and construction technologies, operational measures, and/or restoration measures meet the performance standards.

Alternative 3—Demonstrate facility has selected design and construction technologies, operational measures, and/or restoration measures that will, in combination with any existing design and construction technologies, operational measures, and/or restoration measures, meet the performance standards.

Alternative 4—Demonstrate facility has installed and properly operates and maintains an approved technology (cylindrical wedgewire screens for intakes in freshwater rivers and streams).

Alternative 5—Demonstrate a site-specific determination of BTA is appropriate.

Four of these compliance alternatives require that the station meet the established performance standards and the fifth option allows for a site-specific determination of BTA. These compliance options can potentially be achieved through the implementation of a technological, operational, and/or restoration measures.

3.0 SEABROOK NUCLEAR POWER STATION

3.1 STATION DESCRIPTION

Seabrook Station, a 1,221 MW nuclear power plant located in Seabrook, NH, started commercial operation in August 1990. Cooling water enters the once-through cooling water system through three offshore intake structures equipped with 30 foot diameter velocity caps and nominal 5-inch vertical bar racks. The intakes are located in about 60 feet of water, approximately 7,000 feet offshore in the western Gulf of Maine, an embayment of the North Atlantic Ocean. Each intake rises a total of approximately 18 feet off the bottom and water enters the intakes through 7-foot tall intake bays (Figure 3-1). Water is withdrawn primarily from the middle of the water column and travels down vertical risers to a 19-foot diameter intake tunnel 17,000 feet long that delivers cooling water to traveling screens located in the screenhouse at the plant. Average cooling water flow is 599.5 million gallons per day (MGD) and the maximum design flow is 684 MGD.

The design locations of the intakes were moved several times for environmental concerns during the permitting process. Early proposed intake designs (Ebasco Services Inc. 1969) included:

- an intake pipe withdrawing from the ocean at a depth of 18 feet to a canal dredged across the saltmarsh to the plant,
- an intake pipe withdrawing from the ocean at a depth of 18 feet running directly to the plant, and
- an intake pipe withdrawing water from Hampton Harbor to a canal dredged across the saltmarsh to the plant.

The intake designs that withdrew cooling water from either Hampton Harbor or from the ocean at a depth of 18 feet were eliminated from consideration for environmental reasons. The March 1973 Construction Permit Application to the Nuclear Regulatory Commission included a proposed intake location 3,000 feet offshore in 30 feet of water. The cooling water would be conveyed to the power plant through an intake tunnel bored through the bedrock. In September 1975, the Regional Administrator of the Environmental Protection Agency issued a ruling adding 4,000 feet to the intake

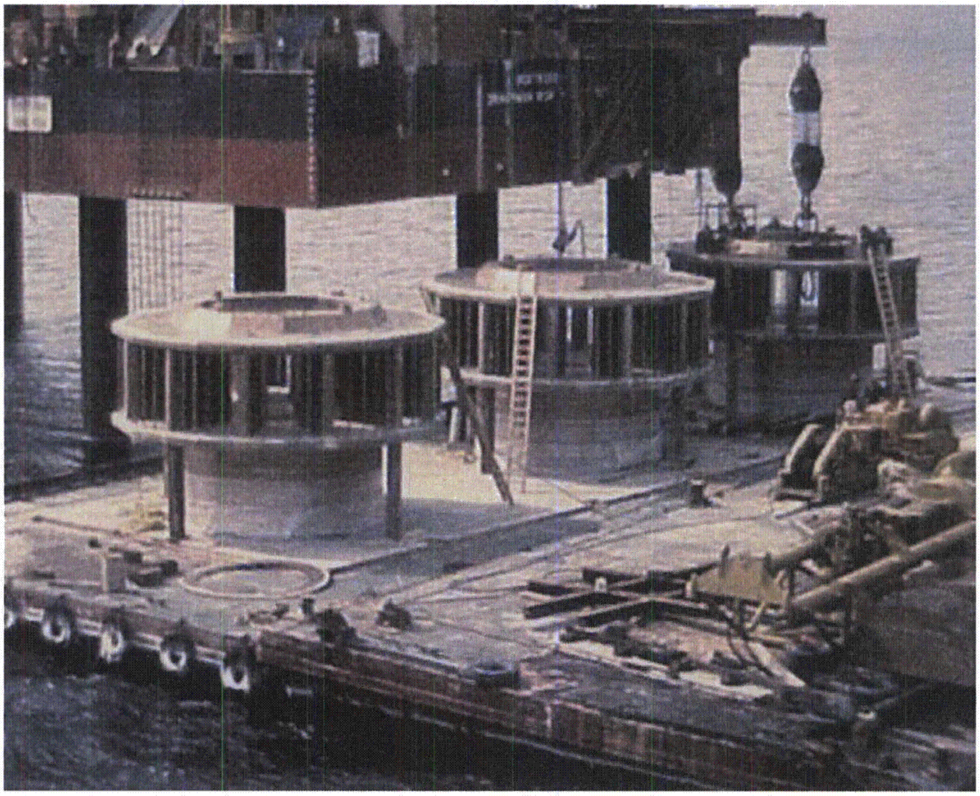


Figure 3-1. Seabrook Nuclear Power Station intake structures on construction barge prior to installation (top) and intake tunnel (bottom).

tunnel for environmental reasons moving the intake location to 60 feet of water. After a series of reversals, reaffirmations, and appeals to the U.S. First Circuit Court of Appeals, an intake tunnel with an intake location 7,000 feet offshore in 60 feet of water was approved and constructed.

3.2. SEABROOK STATION SOURCE WATER PHYSICAL DATA (40CFR 122.21(R)(2))

The following water body description complies with the EPA Clean Water Act 316 (b) Phase II Rule. Although the Rule was remanded in 2006, requirements for source water description outlined below provide input for the regulator to exercise Best Professional Judgment (BPJ) in evaluating the appropriate technology for potential reductions in impingement mortality and entrainment at Seabrook Station.

Specifically, the rule requires the following:

1. A narrative description and scaled drawings of the physical configuration of all source water bodies used by Seabrook Station, including areal dimensions, depths, salinity and temperature regimes.
2. An identification and characterization of the source water body's hydrological and geomorphologic features
3. Location maps

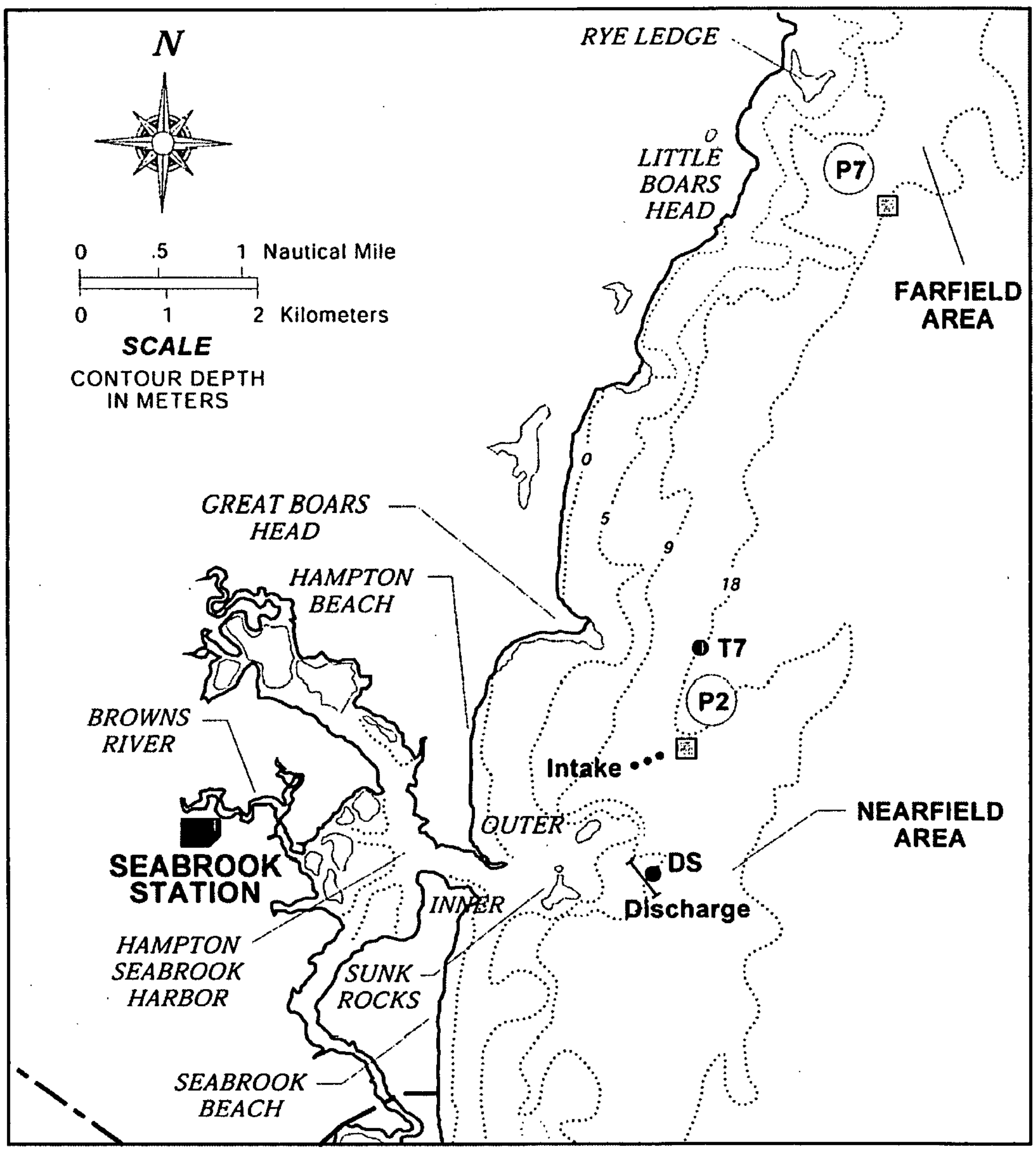
3.2.1 Source Water Body

The source water body for the Seabrook Station is the Western Gulf of Maine. There is an extensive source of data (e.g., bathymetry, ocean currents, water temperature, etc.) available for the Gulf of Maine from the Gulf of Maine Ocean Data Partnership (www.gomodp.org) which began compiling data in 2001. The founding members of the Partnership include government agencies, intergovernmental organizations, and nongovernmental organizations, including academic, research, and other nonprofit entities. Each participant is engaged in the collection of physical, biological, chemical or geologic data on the Gulf of Maine.

The GoMODP data base will be used to provide information to describe the general bathymetry and ocean currents near the intakes of the Seabrook Station. However, Seabrook Station has established an extensive water quality (water temperature, salinity and dissolved oxygen) data base from two sampling stations, one located in the nearfield area (Station P2) of the Seabrook Station cooling water intake structure in 57 feet MLW, and the other located in the farfield area (Station P7) approximately 4 miles north of the Seabrook cooling water intake in 60 feet MLW(Figure 3-2). Water quality data from the nearfield and farfield are examined for the period Seabrook Station was operational (1991-2007) to provide the environmental setting.

Water quality methods are provided in more detail in the attached document "Seabrook Station Environmental Studies Quality Program and Standard Operating Procedures, Revision 10." Temperature, dissolved oxygen, and salinity measurements began in 1979 at the Nearfield Station P2 and in 1982 at the Farfield Station P7 (Figure 3-2). Sampling at Stations P2 and P7 has continued to the present.

From 1991 to 1994, temperature and salinity profiles were taken in two-meter increments four times per month, January through December with a Beckman™ Thermistor Salinometer (through



LEGEND


= water quality stations

● = continuous temperature monitoring stations

Figure 3-2. Seabrook Station water quality sampling stations.

March 1989) or a YSI™ (Model 33) S-C-T In 1995 and 1996, temperature profiles continued to be collected using a YSI Model 33 S-C-T Meter. Salinity samples were collected at near surface (-1 m) and near-bottom (1 m above bottom) depths, placed in wax-sealed glass bottles and analyzed in the lab using a YSI Model 34 S-C-T Meter. Beginning in 1997, temperature and salinity were recorded *in situ* using a YSI 600XL Water Quality Monitor with the same sampling schedule as in previous years. Data were downloaded weekly.

From 1979 to 1996, duplicate dissolved oxygen samples were collected at near-surface (-1 m) and near-bottom (1 m above bottom) depths. Samples were fixed in the field with manganese sulfate and alkaline iodide-azide, and analyzed by titration within eight hours of collection using EPA Methods for Chemical Analyses of Water and Wastes (USEPA 1979) and Standard Methods (APHA 1989). Beginning in 1997, dissolved oxygen profiles were recorded *in situ* using a YSI 600XL Water Quality Monitor at the same depths as previous measurements.

Water quality was evaluated to determine seasonal patterns and to detect trends among years, means and confidence limits (Sokal and Rohlf 1981) were calculated and tabulated for operational years (1991-2007). Monthly means and their 95% confidence limits period were compared graphically to the monthly means for the operational period to provide a visual estimate of their magnitude and seasonality. Annual means and their 95% confidence limits were presented to show any long-term trends.

All analyses used untransformed weekly data. Only near-surface and near-bottom measurements were used from Stations P2 and P7. Monthly means for each depth were computed by averaging all weekly collections within a month. Annual means and their 95% confidence limits were computed from the 12 monthly means. Preoperational and operational period means and their confidence limits were computed from the annual means.

3.2.1.1 Water Temperature

Heating of the surface water in the spring and summer can cause thermal stratification, which can affect the vertical distribution of pelagic organisms and nutrient cycling. Monthly surface temperature at Station P2 peaked in August and was lowest in February. Monthly mean bottom temperatures were highest in September and lowest in February. Differences between monthly mean surface and bottom temperatures at P2 were most pronounced between May and October, indicating that the nearshore water column was stratified during these months (Figure 3-3).

During the period that Seabrook Station was in operation, there were no significant differences in surface or bottom water temperatures between the nearfield and farfield stations (NAI 2007). Mean water surface water temperature was 9.7 °C in the nearfield area and 9.6 °C in the farfield area (Table 3-1). Bottom water temperatures averaged 7.7 °C in the nearfield area and 7.6 °C in the farfield area. The time series of annual means for surface and bottom temperatures at both stations P2 and P7 indicate that there were no obvious trends in water temperatures across years (Figure 3-4). Quantitative comparisons of mean water temperature from the nearfield and farfield arras, and from both before and after the plant started operation indicate that there has been no evidence of an impact on water temperature due to the operation of Seabrook Station (NAI 2007).

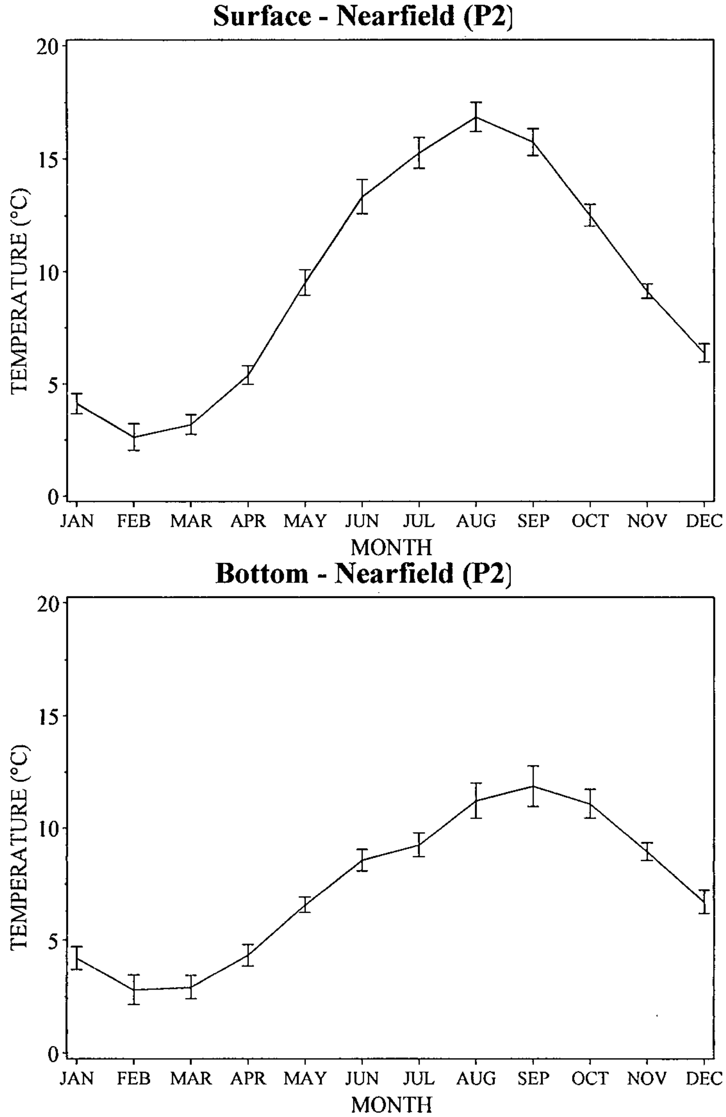


Figure 3-3. Surface and bottom temperature (°C) at nearfield station P2, monthly means and 95% confidence intervals from 1991-2007.

Table 3-1. **Annual Means and Upper and Lower Confidence Limits and Minima and Maxima of Water Quality Parameters Measured During Plankton Cruises at Stations P2 and P7 during Operational Years 1991-2007.**

		LCL	Mean	UCL	MIN	MAX
Temperature (°C)						
Surface	**P2**	9.3	9.5	9.7	0.0	20.4
	P7	9.1	9.3	9.6	0.2	20.9
Bottom	**P2**	7.1	7.4	7.7	0.1	17.7
	P7	6.9	7.3	7.6	0.2	18.5
Salinity (PSU)						
Surface	**P2**	30.9	31.2	31.5	25.5	34.2
	P7	30.8	31.2	31.5	25.2	34.4
Bottom	**P2**	31.6	31.8	32.1	26.9	34.2
	P7	31.6	31.9	32.1	26.2	34.7
Dissolved Oxygen (mg/l)						
Surface	**P2**	9.6	9.7	9.9	4.2	13.9
	P7	9.6	9.7	9.9	5.2	14.7
Bottom	**P2**	8.8	9.2	9.2	2.6	12.6
	P7	8.7	9.0	9.2	3.4	12.2

Operational years: P2 and P7 = 1991–2007
LCL = Lower 95% confidence limit
Mean of annual means
UCL = Upper 95% confidence limit

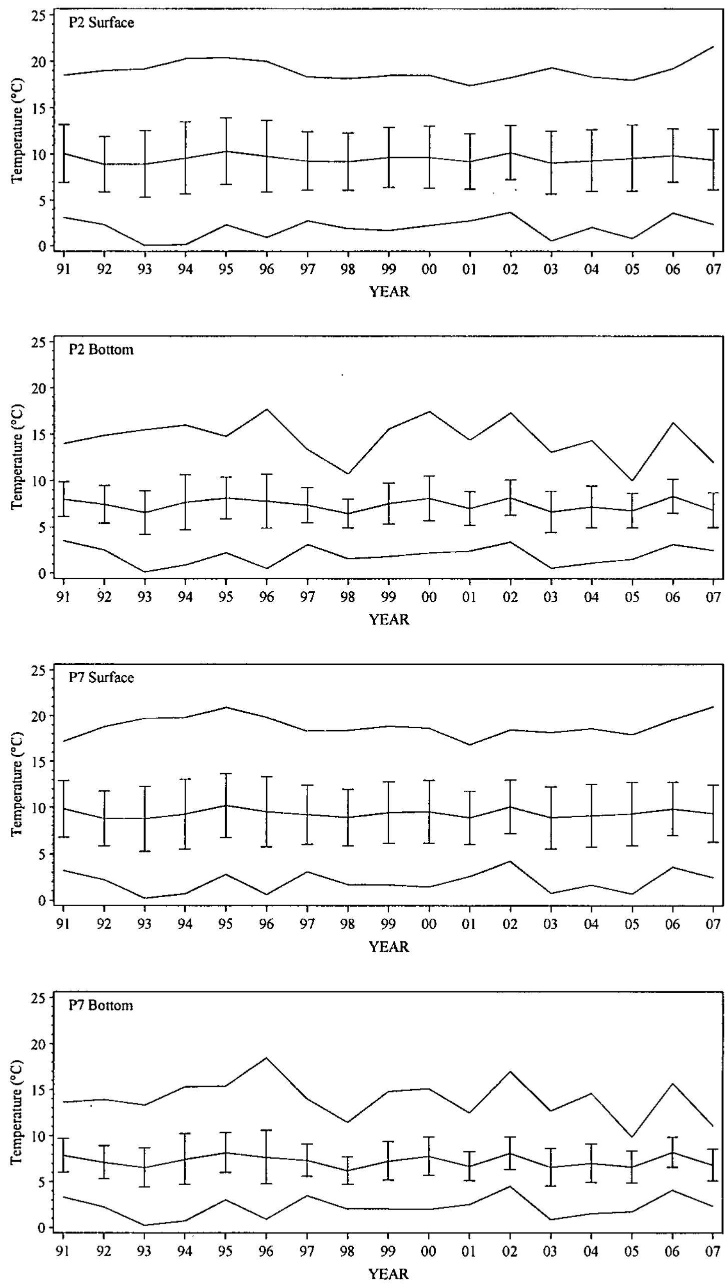


Figure 3-4. Time series of annual means and 95% confidence intervals and minima and maxima of surface and bottom water temperatures (°C) at nearfield station P2 and farfield station P7 from 1991-2007.

3.2.1.2 Salinity

Mean monthly salinities at the surface and bottom at Station P2 were similar (Figure 3-5). Salinity was generally lowest in April through June and highest in December and January. Annual mean surface salinity was identical (31.2 PSU) at the nearfield Station P2 and farfield Station P7 (Table 3-1). Similarly annual mean bottom salinity was almost identical at Station P2 (31.8 PSU) and Station P7 (31.9 PSU). Annual mean salinity and upper and lower 95% confidence intervals over the 1991-2007 operational period indicated no substantial differences in salinities between surface and bottom depths at either the nearfield (P2) or farfield (P7) areas (Table 3-1).

Long-term patterns in annual surface and bottom salinity from 1991 through 2007 indicated that similar conditions and trends occurred at both stations and at both depths (Figure 3-6). Salinity was lowest at both stations and depths in 2005 due to higher than normal freshwater runoff. Quantitative comparisons of mean salinity from the nearfield and farfield areas, and from both before and after the plant started operation indicate that there has been no evidence of an impact on salinity due to the operation of Seabrook Station (NAI 2007).

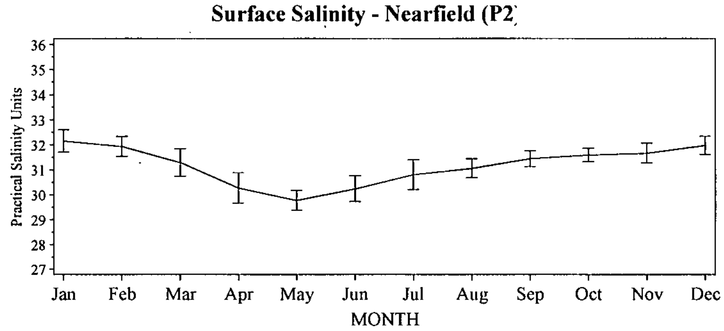
3.2.1.3 Dissolved Oxygen

Several factors affect dissolved oxygen in nearshore waters, including temperature, which affects the solubility of oxygen, and the mixing of water masses. Photosynthetic organisms produce oxygen through photosynthesis, and respiration by all organisms consumes oxygen. Low dissolved oxygen levels are known to have adverse effects on many marine organisms.

Dissolved oxygen (DO) concentrations at Station P2 followed a regular seasonal pattern with higher dissolved oxygen at both the surface and bottom occurring in the colder months of February through April (Figure 3-7). Lower water temperature, phytoplankton blooms and reduced abundance of consumers can increase DO concentrations in the winter and spring. Lowest DO concentration occurred in August through October, primarily due to higher water temperatures and increased respiration (Figure 3-7). Mean surface DO concentration (9.2 mg/l) was identical between the nearfield (P2) and farfield (P7) stations (Table 3-1). Mean bottom DO concentration was similar between the nearfield (9.2 mg/l) and farfield areas (9.0 mg/l). A time series plot of mean DO concentration and 95% confidence intervals indicated generally similar concentrations and 95% confidence intervals of DO among years except for 2006 where mean DO concentration appeared to be lowest at both the nearfield and farfield areas (Figure 3-8). Quantitative comparisons of mean DO concentrations from the nearfield and farfield areas, and from both before and after the plant started operation indicated that there has been no evidence of an impact on DO due to the operation of Seabrook Station (NAI 2007).

3.2.2 Bathymetry

The intakes for Seabrook Station are located in about 60 ft MLW and the general bottom topography is relatively flat with a gradual slope to deeper water several miles offshore. Approximately 20 miles offshore of the Seabrook intakes running from Gloucester Point in the southeast for about 40 miles in a northwesterly direction is an underwater structure known as Jeffreys Ledge. This ledge generally varies in depth from 50-100 ft. Inshore of Jeffreys Ledge and offshore of the intakes is Scantum Basin where water depths can be as great as 300-400 ft (Figure 3-9). The Isle of Shoals, a series of small rock islands are located about 10 miles to the northwest of the intakes (Figure 3-9).



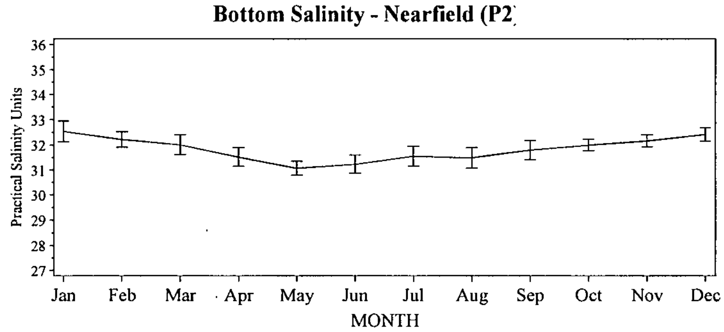


Figure 3-5. Surface and bottom salinity (PSU) at nearfield station P2, monthly means and 95% confidence intervals from 1991-2007.

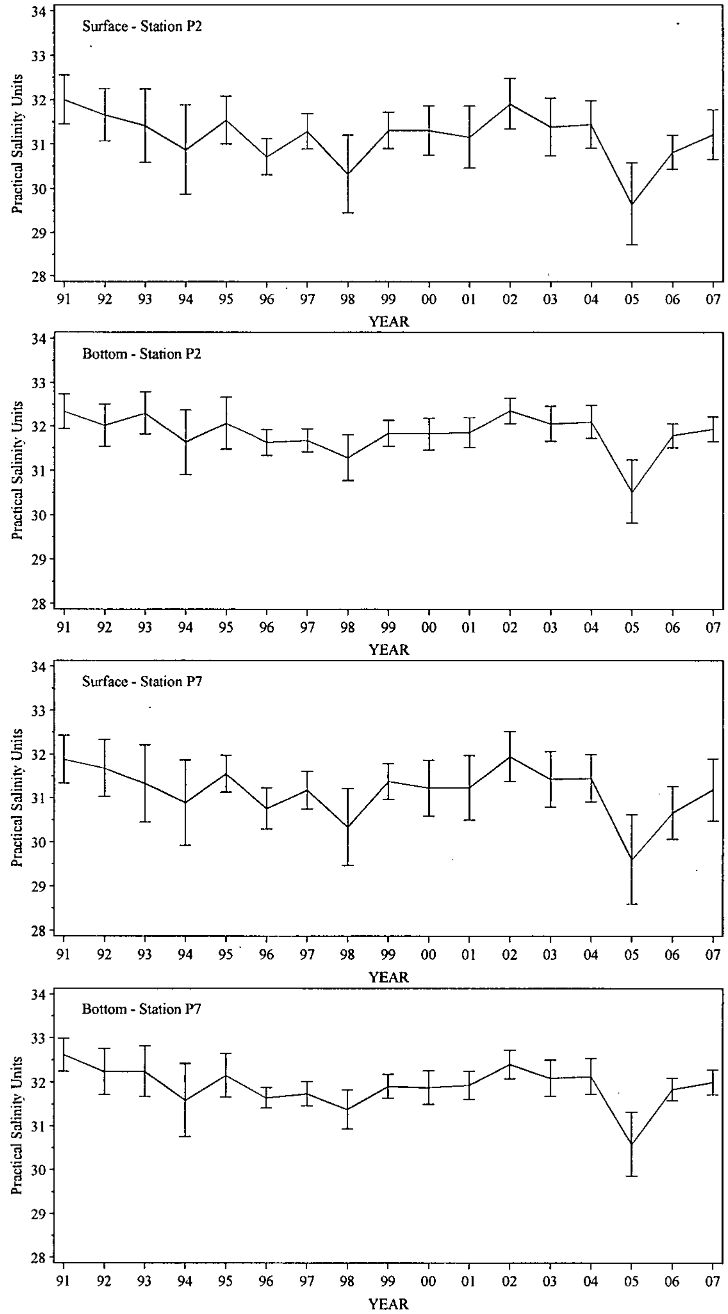


Figure 3-6. Time series of annual means and 95% confidence intervals of surface and bottom salinity (PSU) at nearfield station P2 and farfield station P7 from 1991-2007.

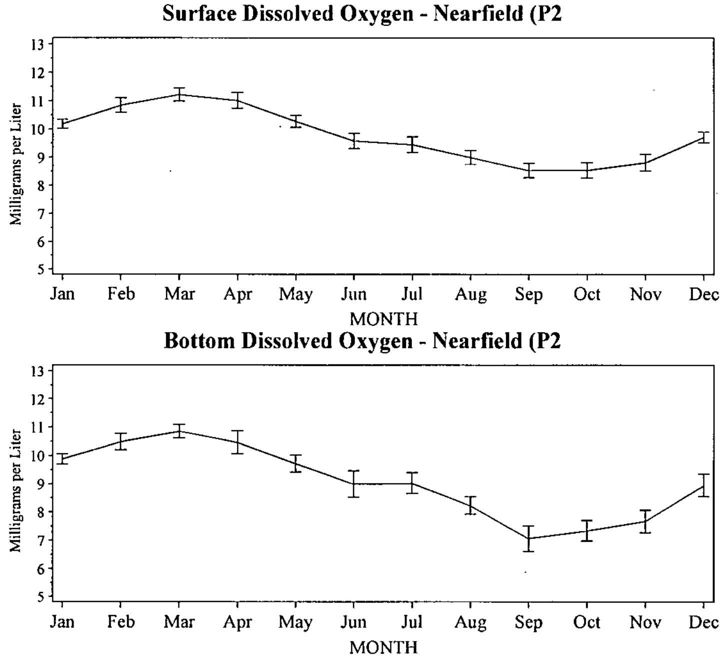


Figure 3-7. Surface and bottom dissolved oxygen (mg/l) at nearfield station P2; monthly means and 95% confidence intervals during 1991-2007.

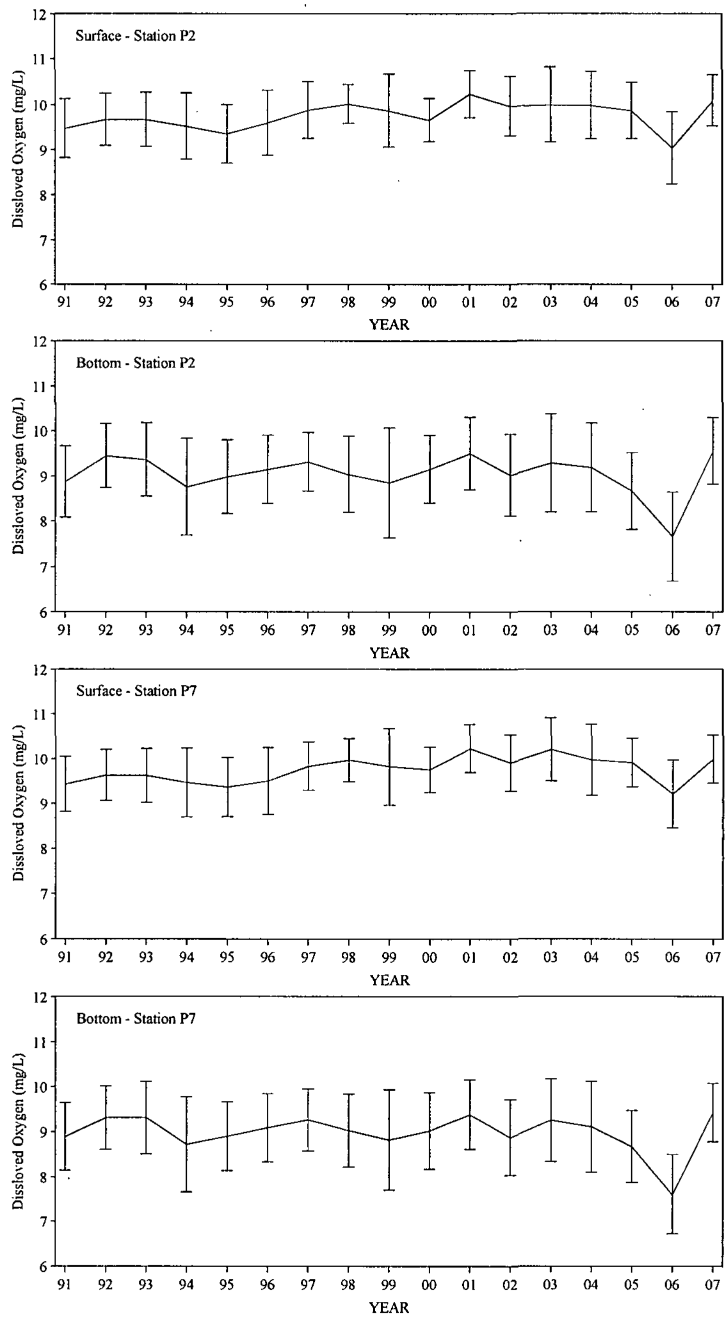


Figure 3-8. Time series of annual means and 95% confidence intervals of surface and bottom dissolved oxygen (mg/L) at nearfield station (P2) and farfield station (P7) from 1991-2007.

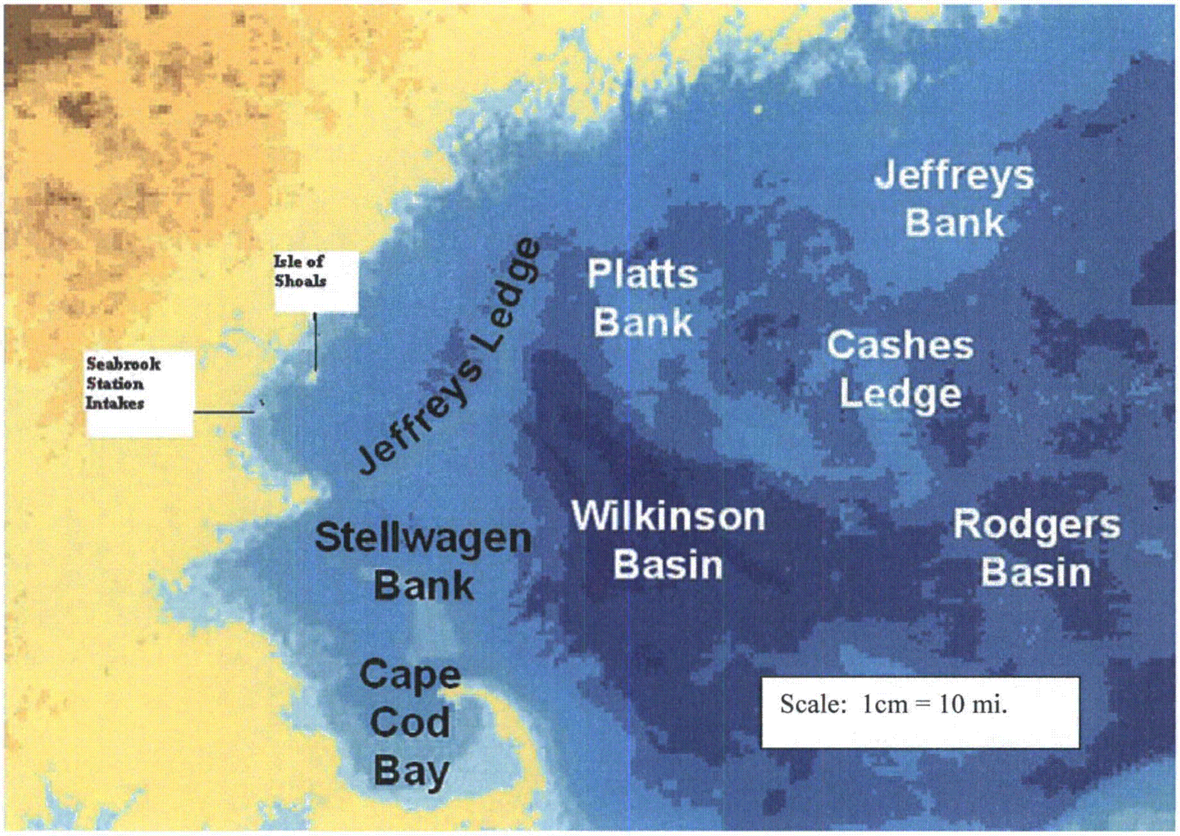


Figure 3-9. Bathymetry of the western Gulf of Maine near Seabrook Station. (From Gulf of Maine Data Partnership).

The bottom topography and fish habitat in the vicinity the Seabrook Intakes is a generally uniform sandy bottom. There are no major outcroppings of bedrock or relief in the vicinity of the intakes that could provide exceptional fish habitat. Potential rocky areas or steep sloping bottom contours that could provide varied habitat such as Jeffreys Ledge or the Isle of Shoals are miles beyond the zone of influence of the intakes.

The three intake velocity caps are located in approximately the same depth of 60 ft MLW. The substrate in the areas of the intake structures consists of several feet of sand overlying bedrock. This sand substrate extends for several hundred feet around each of the intake structures. Observations by Normandeau Associates divers who routinely clean the structures of fouling organisms (bivalves, barnacles, etc.) report that the sand substrate around the base of each structure has remained undisturbed (i.e., sand has not migrated up sides of the structures) because they see original small construction debris (e.g., concrete remnants) left over from the construction of the intakes in the late 1980s (Erik Fel'Dotto, Personal Communication, 2007).

The intake structures are described in Section 3.3.1 and consist of three velocity caps arrayed in a straight line, approximately 100 ft apart and located approximately one mile offshore. Fish impingement patterns indicate that the bulk of impinged fish are primarily demersal fish such as flounder and rock gunnel. These species tend to be impinged during and after storm events when surface wave action potentially brings fish off the bottom to the height of the intake manifold (i.e., about 10 ft off the sandy bottom). Diver observations during cleaning of the intake structure indicates that when there is a greater than 5 ft swell and long periodicity between waves, these conditions tend to create turbulence at the 60 ft depth of the structure, occasionally hampering cleaning efforts by the divers (Erik Fel'Dotto, Personal Communication, 2007).

3.2.3 Water Circulation and Hydraulic Zone of Influence

The currents in the vicinity of the intakes in coastal New Hampshire are divided into tidal and non-tidal types (NAI 1978). Regular tidal currents are predominant and have a reversing northward flowing flood component and a southward flowing ebb component. About 42% of all flows were reversing tidal currents. Weak tidal currents occur at the slack tides and these account for 12% of all flows. Tidal amplitude ranges from about 9 to 12 ft.

Non-tidal flows make up the remaining current type, about 46% of all flows. There is a net movement of water along the shoreline from northwest to southeast as part of the Gulf of Maine counter-clockwise gyre (Figure 3-10: GoMODP, 2007). Although the net flow is to the southeast, both north and south currents are present (NAI 1978). Flows to the south are more frequent during the winter and spring. Conversely, flows to the north are more frequent in the summer and fall. The net current flow near the intake structure (after accounting for inshore-offshore tidal currents) is approximately 0.1 m/s. However, as indicated from diver observations during storm events, it is apparent that there is also a significant groundswell or, water turbulence at the depth of the intake structures, caused by surface wave action.

The horizontal flow patterns for the intake structures were determined using a physical model under a two operating unit scenario for Seabrook Station and a cooling water flow of 1,177.6 MGD (March and Nyquist 1976). Only one unit was built at Seabrook Station, therefore the modeled flow is about twice the average actual flow. Nevertheless, the modeling exercise provides a conservative upper bound of estimates of the withdrawal zone and flow patterns. At zero ambient current, which would correspond to slack tide, the intakes withdraw from the entire water column. At an ambient current of 0.2 kt, the intakes withdraw from the lower 35 ft (depths of 60-25 ft depth). At an ambient current of 0.4 kt the intakes withdraw from the lower 25 feet (depths of 60-35 ft).

The hydraulic zone of influence (HZI) of the intakes was also estimated under a variety of ambient current conditions using a physical model and plan-view streak lines. As with the horizontal flow patterns, the model assumed two units were built, and therefore provides a very conservative estimate of the HZI. The HZI was estimated for 0.1 m/s and 0.2 m/s South, and 0.1 m/s and 0.2 m/s SW ambient currents. At a velocity of 0.1 m/S the HZI was limited to one intake diameter (30 ft) to either side of the periphery of the intake. At the higher ambient currents of 0.2 m/s the HZI was limited to about ½ intake diameter (15 ft) to either side of the intake. As these models were constructed with the flow from two units, the actual HZI for the one unit that was built could be roughly half the estimated HZI for two units.

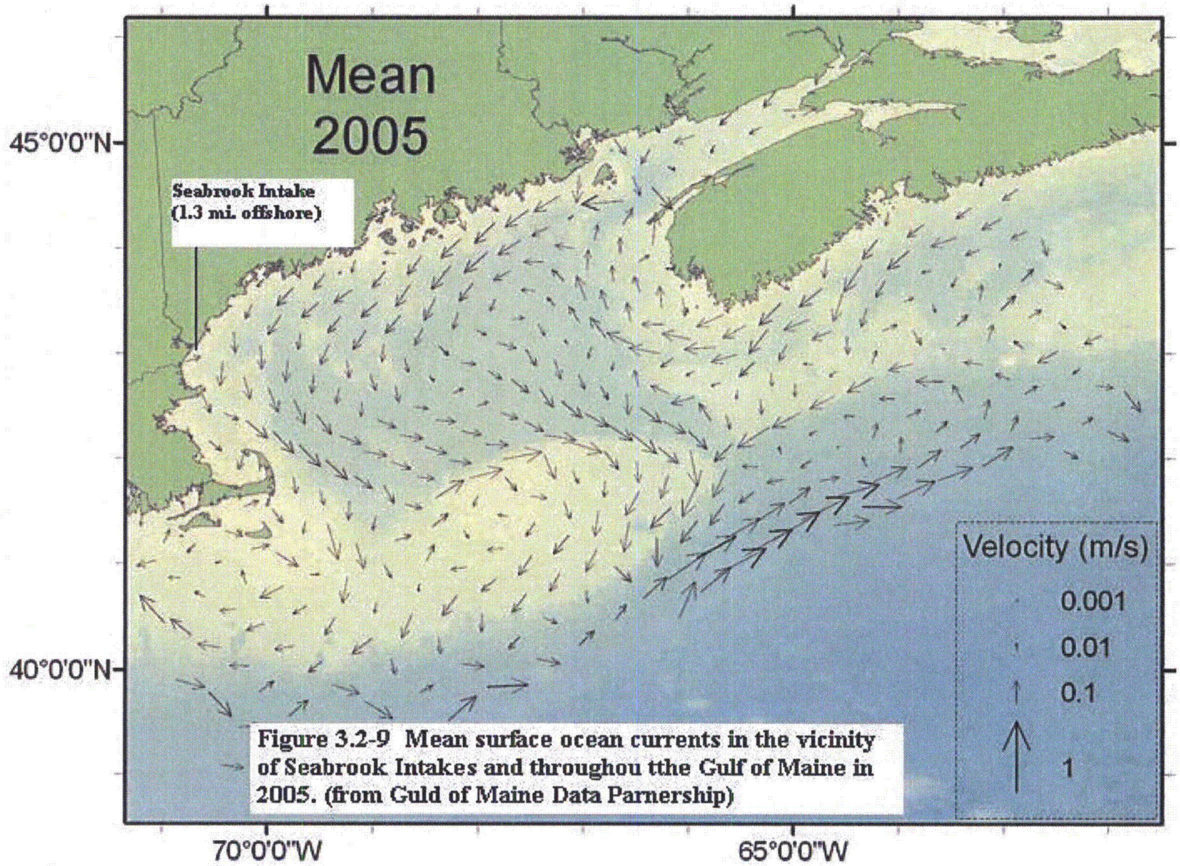


Figure 3-10. Mean surface ocean currents in the vicinity of Seabrook Intakes and throughout the Gulf of Maine in 2005. (From Gulf of Maine Data Parnership).

3.2.4 Location Maps

Seabrook Station is located in southeastern New Hampshire in the town of Seabrook (Figure 3-11). The Station was built primarily on upland on the edge of the Hampton-Seabrook saltmarsh complex near the tidal portion of the Browns River (Figure 3-12). The Station is located about 2 miles from the open water at Seabrook Beach. Nearby large population centers include Portsmouth, NH, Portland, ME, Manchester, NH, and Boston MA.

3.3 Cooling Water Intake Structure

Seabrook Station's CWIS consists of three submerged offshore intake structures, an intake tunnel, a structure to transition the flow from the tunnel to the on-shore intake structure, traveling intake screens, and three circulating water and four service water pumps. The following sections will provide a more thorough discussion of the CWIS and include the information required under 40 CFR 122.21(r)(3).

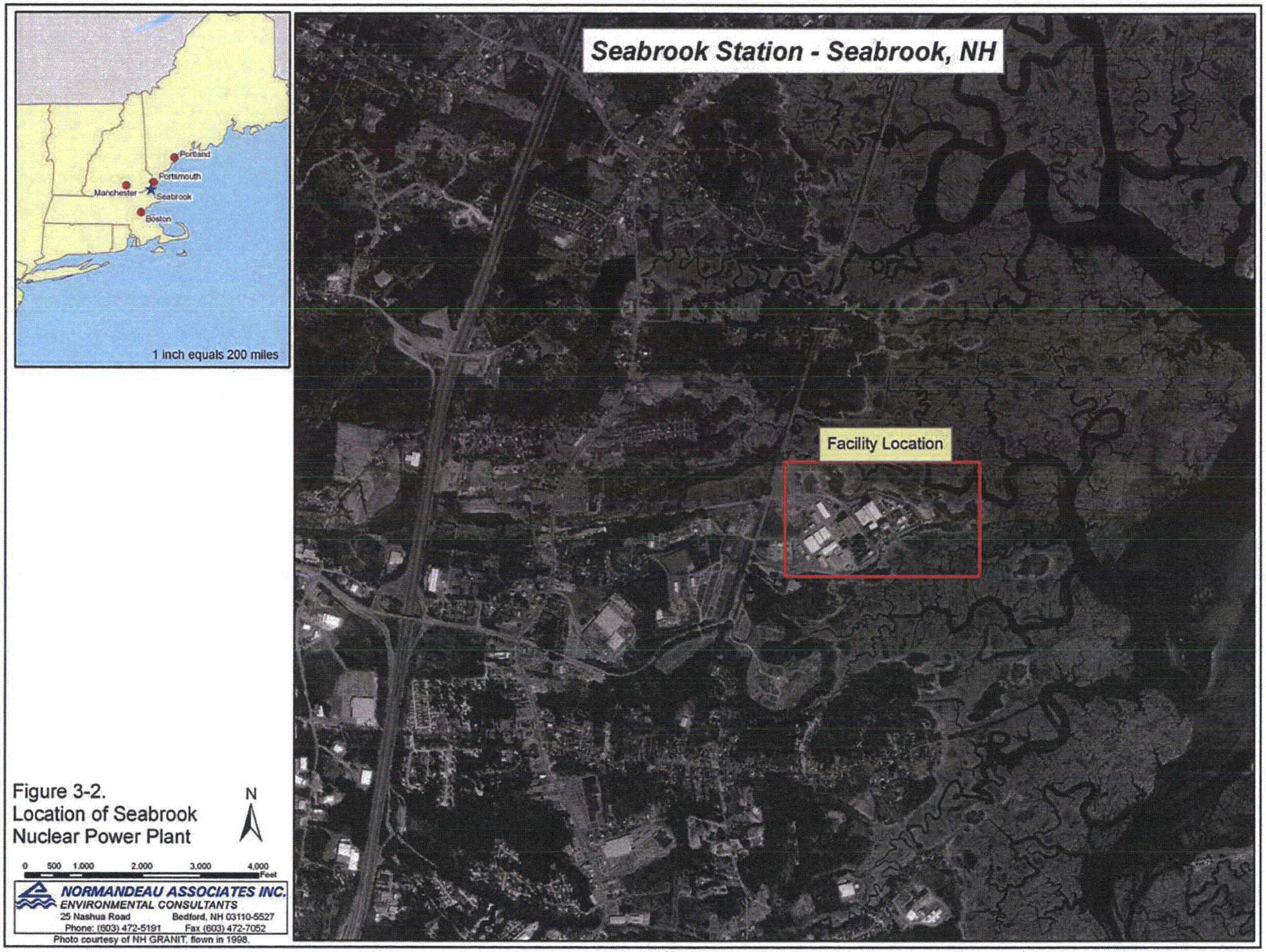


Figure 3-11. Location of Seabrook Nuclear Power Station.

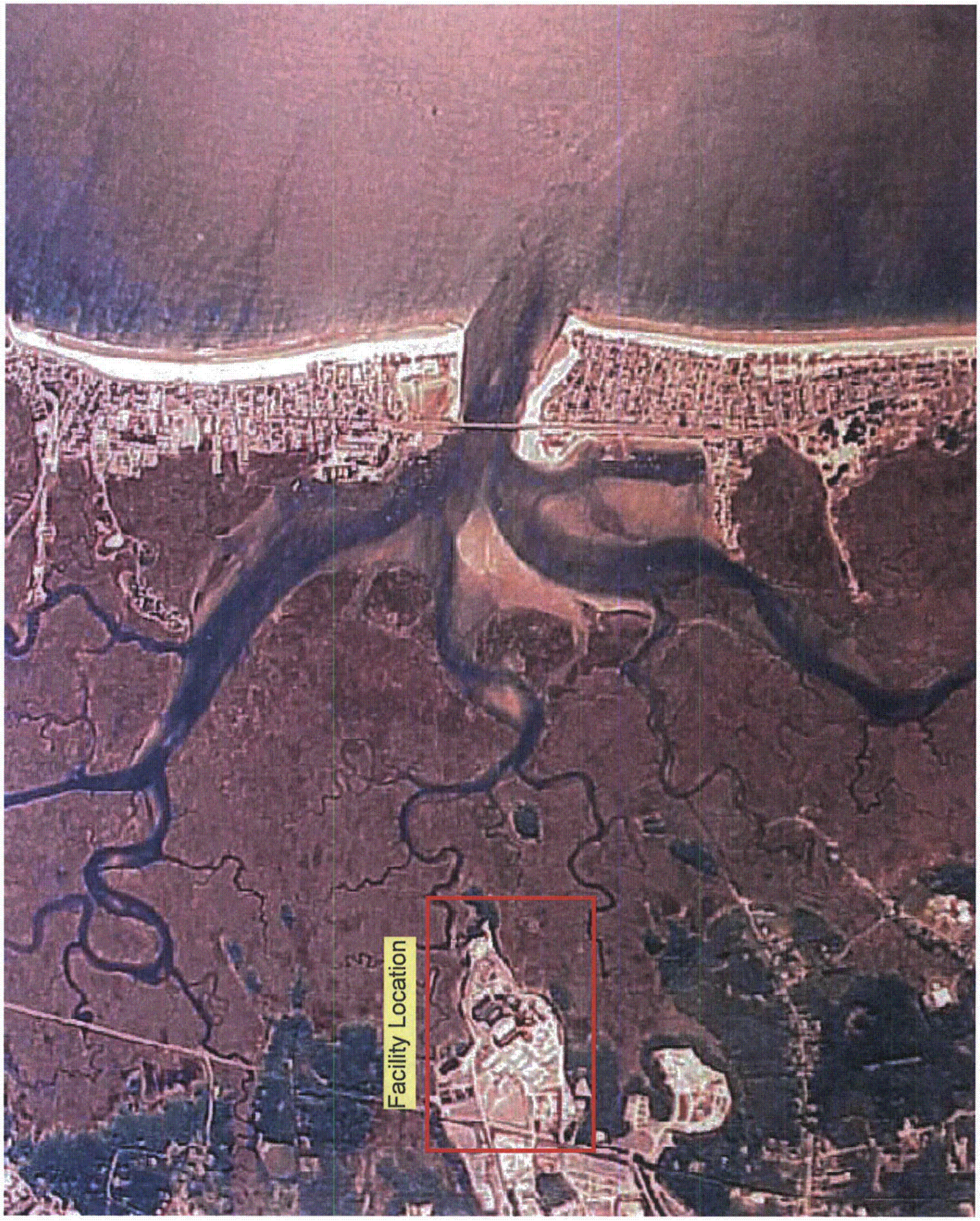


Figure 3-12. Location of Seabrook Nuclear Power Station in relation to the Hampton-Seabrook estuary.

3.3.1 Cooling Water Intake Structure Description

As defined in the 316(b) regulations, §125.93, the "cooling water intake structure extends from the point at which water is withdrawn from the surface water source up to, and including, the intake pumps".

Seabrook Station makes use of a once-through circulating water system with an offshore cooling water intake for both the condenser cooling water and the plant service water. There are three offshore submerged intake structures which are located approximately 1.3 miles offshore and draw water from the western Gulf of Maine. The three intake structures are approximately 110 feet apart and each has a 9'-10" inside diameter (ID) vertical intake shaft. Each intake shaft connects to the intake tunnel at approximately 160 feet below mean sea level (MSL). The 19-foot ID intake tunnel then conveys the water approximately 3.22 miles to an inland termination point which consists of a 19-foot ID vertical shaft and the transition structure. From the transition structure the water is distributed to the circulating water (CW) and the service water (SW) pumphouses.

As an alternate source of cooling water for the service water system, cooling towers were installed to provide shutdown cooling in the event the intake and/or discharge tunnels are blocked due to a seismic event. There are two cooling trains provided from the cooling tower to provide water to both trains of the service water system.

Each offshore intake structure consists of a 30-foot diameter prefabricated reinforced concrete velocity cap with copper-nickel cladding that draws the water in horizontally and directs it to the vertical intake shaft (Figure 3-13). Each velocity cap is located in about 60 feet of water at MSL, and extends approximately 18 feet above the ocean floor with the top of the structures approximately 42 feet below MSL. The opening around the periphery of the velocity cap where cooling water enters is approximately 7-feet high. The original design included vertical trash bars placed in the opening around the periphery that were spaced with 17-inch openings between bars. In August of 1999, modifications were made which reduced the openings between bars to 5 inches. This modification was made to prevent the entrance of seals into the intake structure.

The vertical intake shafts extend from the submerged intake structures to the intake tunnel which is approximately 160 feet below MSL at this location. Each vertical intake shaft is concrete lined, has a finished inside diameter of 9'-10", and has six 2-inch risers for the injection of sodium hypochlorite into the cooling water intake system from the intake tunnel chlorination system.

The concrete lined intake tunnel has an inside diameter of 19 feet The tunnel slopes downward from a depth of 160 feet below MSL at the location of the submerged intake structures to a depth of 240 feet below MSL at the location of the intake transition structure (Figure 3-14). Approximately 1.89 miles of the 3.22 mile long tunnel are inland.

The vertical shaft at the plant end of the intake tunnel is also concrete lined and has an inside diameter of 19 feet. The vertical shaft terminates at a ground-level transition structure, which is a large surge chamber open to the atmosphere (Figure 3-15). At the transition structure are four 102-inch diameter valved connections for circulating water supply, two 42-inch diameter valved connection for service water supply, two 120-inch valved connections for the return of heated circulating water, and one 38-inch diameter valved connection for the return of heat treated service water. Two of the circulating water connections, one of the service water connections, and one of the

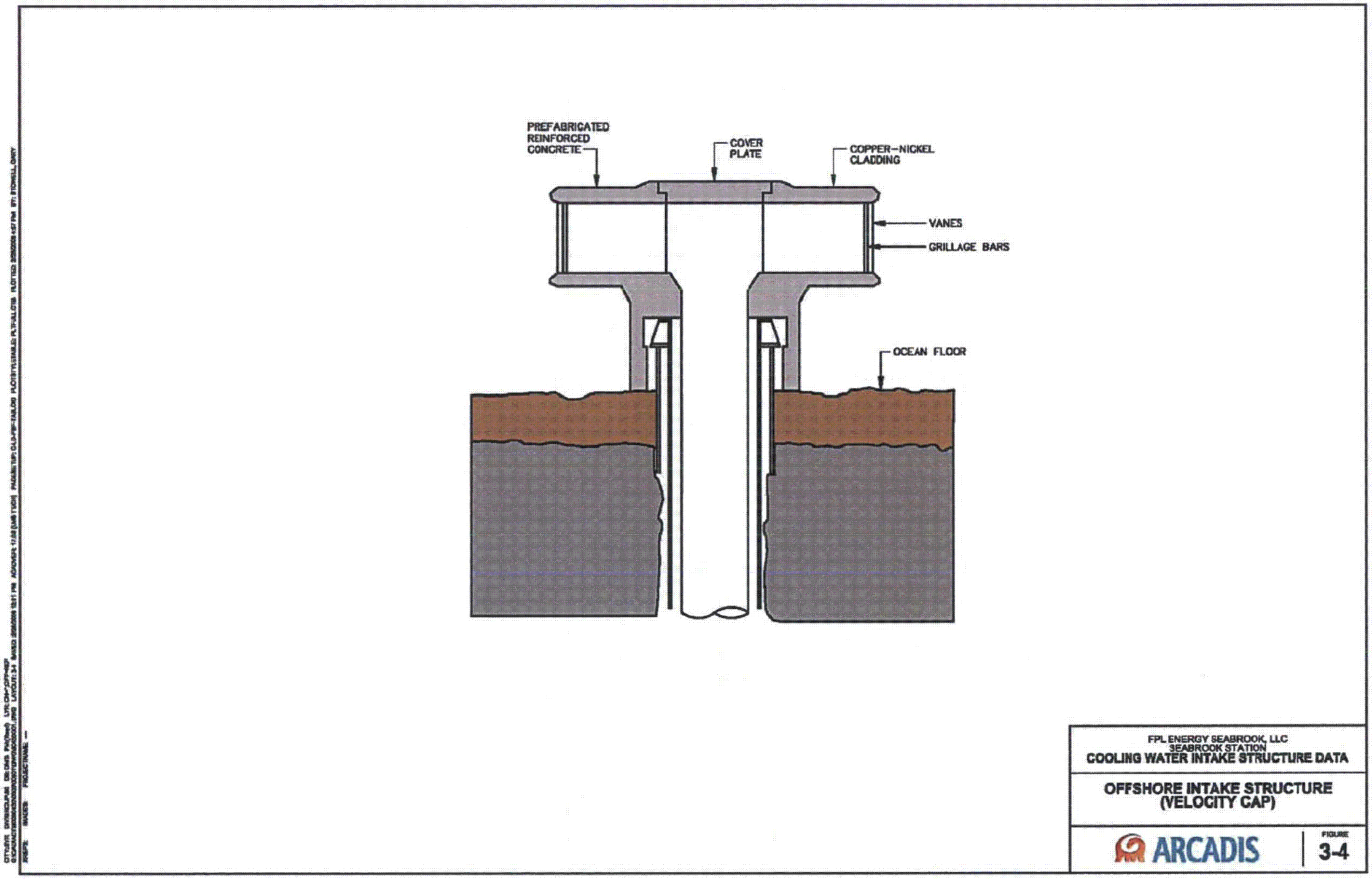


Figure 3-13. Offshore Intake (Velocity Cap) at Seabrook Station.

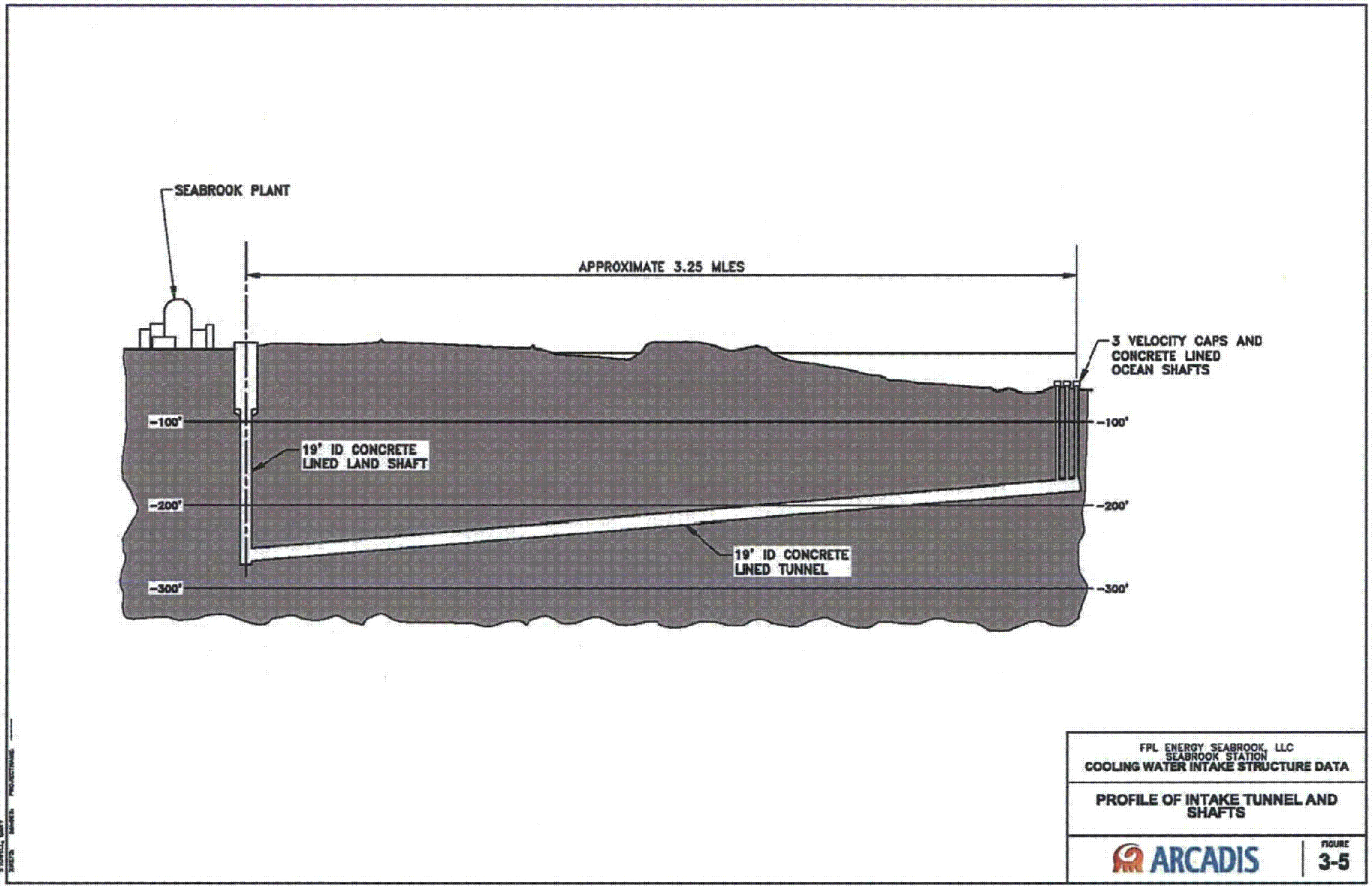


Figure 3-14. Profile of Intake Tunnel and Shafts at Seabrook Station.

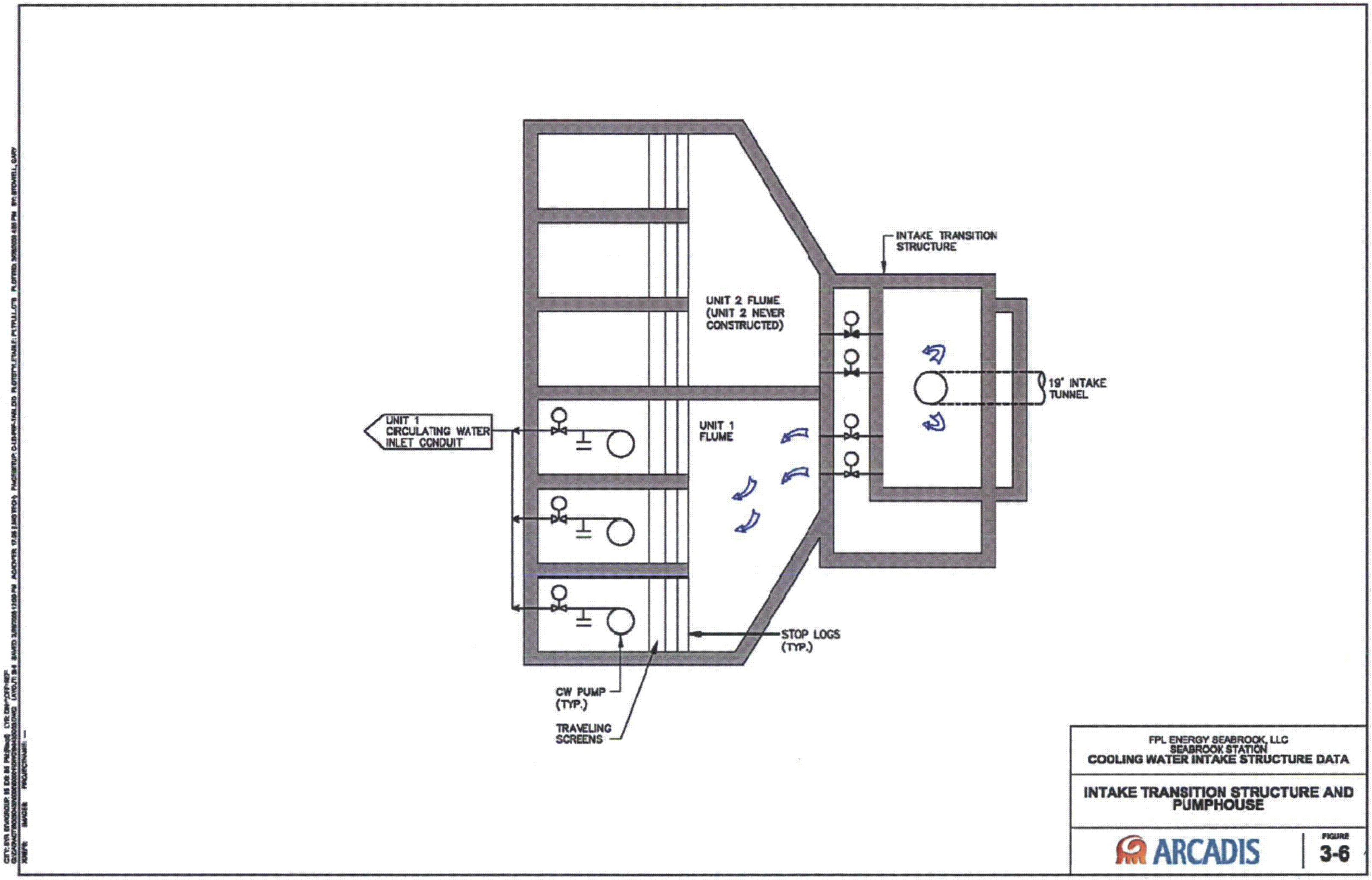


Figure 3-15. Intake Transition Structure and Pumphouse at Seabrook Station.

heated circulating water return connections were installed for Unit 2, which was planned, but never constructed.

Adjacent to the transition structure is the circulating water pumphouse. The water from the two 102-inch diameter circulating water connections at the transition structure enter a below-grade flume and the flow then separates into three screenwells (Figures 3-15 and 3-16). Each screenwell contains stop log guides, a flow-through traveling screen and a 130,000 gpm circulating water pump that supplies circulating water to the condensers. The three screens are designated as 1-CW-SR-1A, 1B, and 1C. Each screen is 14 feet wide and has ⅜-in. mesh baskets. The water depth at the screens is approximately 43 feet at MSL. The screens have two operating speeds which are 5 feet per minute (fpm) and 20 fpm. Debris is removed from the upstream (ascending) side of the screens with water sprays and is sluiced via a trough to a metal collection basket, where the debris is removed and the water drains into the intake transition structure. The screen wash water is supplied from two screen wash pumps (1-CW-SR-1A and 1-CW-SR-1B) which draw water from the discharge of the circulating water pumps.

Normally all three circulating water pumps are operated at full load conditions. As noted above, the rated design flow for each pump is 130,000 gallons per minute (gpm). Each pump has a 3,400 hp electric motor drive which operates at 400 revolutions per minute (rpm). The pumps are designated as P-39A, P-39B, and P-39C. The plant can also be operated at full load with two circulating water pumps, however the NPDES Permit only authorizes this condition for 15 days per year to support online pump maintenance.

An associated subsystem of the CWIS is the chlorination system which provides sodium hypochlorite to several locations within the CWIS. The system has the ability to inject sodium hypochlorite in the vertical shafts below the submerged intakes, the intake transition structure, circulating water pump bays, service water pump bays, and the discharge transition structure. The sodium hypochlorite prevents the growth of microorganisms on the inside of the system piping, structures, and equipment. Should this growth of microorganisms occur in the condenser tubes, the resultant fouling would prevent efficient heat transfer and reduce the condensers capability to effectively remove the heat from the turbine exhaust steam. The chlorination system is located in the chlorination building adjacent to the discharge transition structure. The major components in this system are the two metering pumps that discharge at a rate of 4 gpm each, and three sodium hypochlorite storage tanks. In 2004, due to the buildup of calcium carbonate in the chlorination system as a byproduct of the combination of sodium hypochlorite, salt water and low water temperature, a scale inhibitor (Dynacool 1383) injection system was installed. The scale inhibitor is stored in a 400 gallon tank in the circulating water pumphouse and injects the anti-scalant into the salt water supply line prior to the chlorination tank connection via the anti-scalant injection pump that discharges at a rate of 0.02 gpm.

3.3.2 Cooling Water Intake Structure Location

The three offshore submerged intake structures are located in the Gulf of Maine (Atlantic Ocean) east of Hampton Beach, New Hampshire, approximately 1.3 miles offshore. The three structures are aligned in an east-west direction and are separated by approximately 110 feet. The water depth at the intake location is approximately 60 feet at MSL and the tops of the intake structures are located 42 feet below the water surface. The intake structures are located at 42° 54′ 17" N Latitude and 70° 47′ 12" W Longitude.

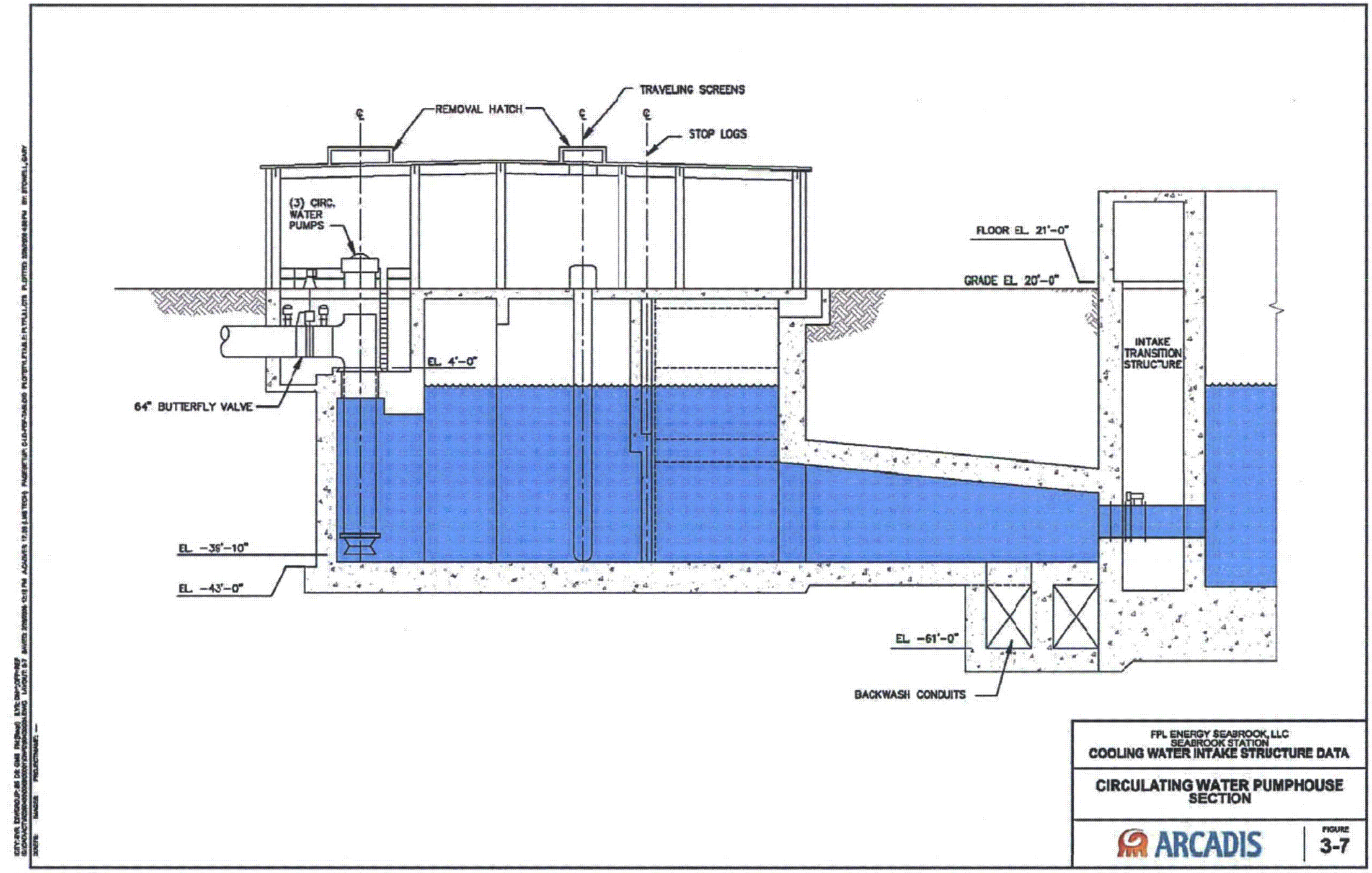


Figure 3-16. Seabrook Nuclear Power Station circulating water pumphouse section.

3.3.3 Cooling Water Intake System Operation

The CWIS provides water for condenser cooling and the plant service water system and the service water system that cools a number of primary and secondary heat loads. The CWIS is the only system for providing condenser cooling water, however service water for shutdown cooling can be provided with the closed loop cooling tower system. A flow diagram of the CWIS and the systems it serves are presented on Figure 3-17.

The CWIS at Seabrook was designed with the necessary capacity for two operating units, therefore, the intake was designed for a flow of 854,000 gpm (1,230 MGD), which would support full load operation of the two units. Only one generating unit was constructed at Seabrook, therefore, the CWIS is operating under the flow requirements of a single unit only. With the three circulating water pumps (130,000 gpm each) and the two service water pumps (11,500 gpm each) operating at their design points, the CWIS flow would be 413,000 gpm (595 MGD). At actual operating conditions, the highest average daily cooling water intake flow (circulating water and service water) during full load operation for the years 2002 through 2006 occurred during the month of August and was 471,000 gpm (678 MGD). Therefore, this flow (471,000 gpm) is representative of total CWIS flow for full load operation at maximum annual water temperature. Since the Seabrook CWIS operates at a flow considerably less than the original design of 854,000 gpm, the head loss under the current operating conditions is less than design, causing the pumps to operate at a lower total head loss and higher flow than their original design point.

At a flow of 471,000 gpm, the approach velocity at the intake (velocity cap) is approximately 0.5 feet per second (fps). As the water passes through the vertical bars, the velocity increases to 0.8 fps. It is not possible to isolate any of the submerged intakes, therefore, all three intakes are in operation at all times. It is a NPDES Permit requirement that the velocity at the velocity caps be less than 1.0 fps.

Within the 19-foot diameter intake tunnel, the velocity is 3.7 fps at 471,000 gpm. With the water level at MSL in the screen wells, the velocity through the traveling screens is approximately 1.0 fps.

Seabrook Station is a base loaded facility and the average capacity utilization rate for the last five years (2002-2006) has been 92.3%. Over this same time period, the generator operated for 92.8% of the available hours. Therefore, when the generating unit is operating, it typically runs at full load (1221 MW). Net generating capacity increased from 1151 MW to 1221 MW after the April 2005 refueling outage. Figure 3-18 demonstrates that there is not any seasonal pattern to the level of generation. For each month where the capacity utilization rate was down to 96% or less, it was the result of a refueling outage during that month in one or more of the five years.

Since the circulating water system must be in operation whenever the steam turbine/generator is operating and may also be operated for some period of time when the steam turbine/generator is idle, the CWIS is in operation over 90% of the time. The normal operation is to run all three circulating water pumps to provide the necessary cooling for full load operation, which as noted above, is where the generating unit typically operates. Operating with only two circulating water pumps running is limited due to the resulting performance penalty and due to the limitations within the NPDES Permit. Seabrook is limited to an average monthly temperature differential of 39°F and maximum daily temperature differential of 41°F. The NPDES Permit does allow for these maximum

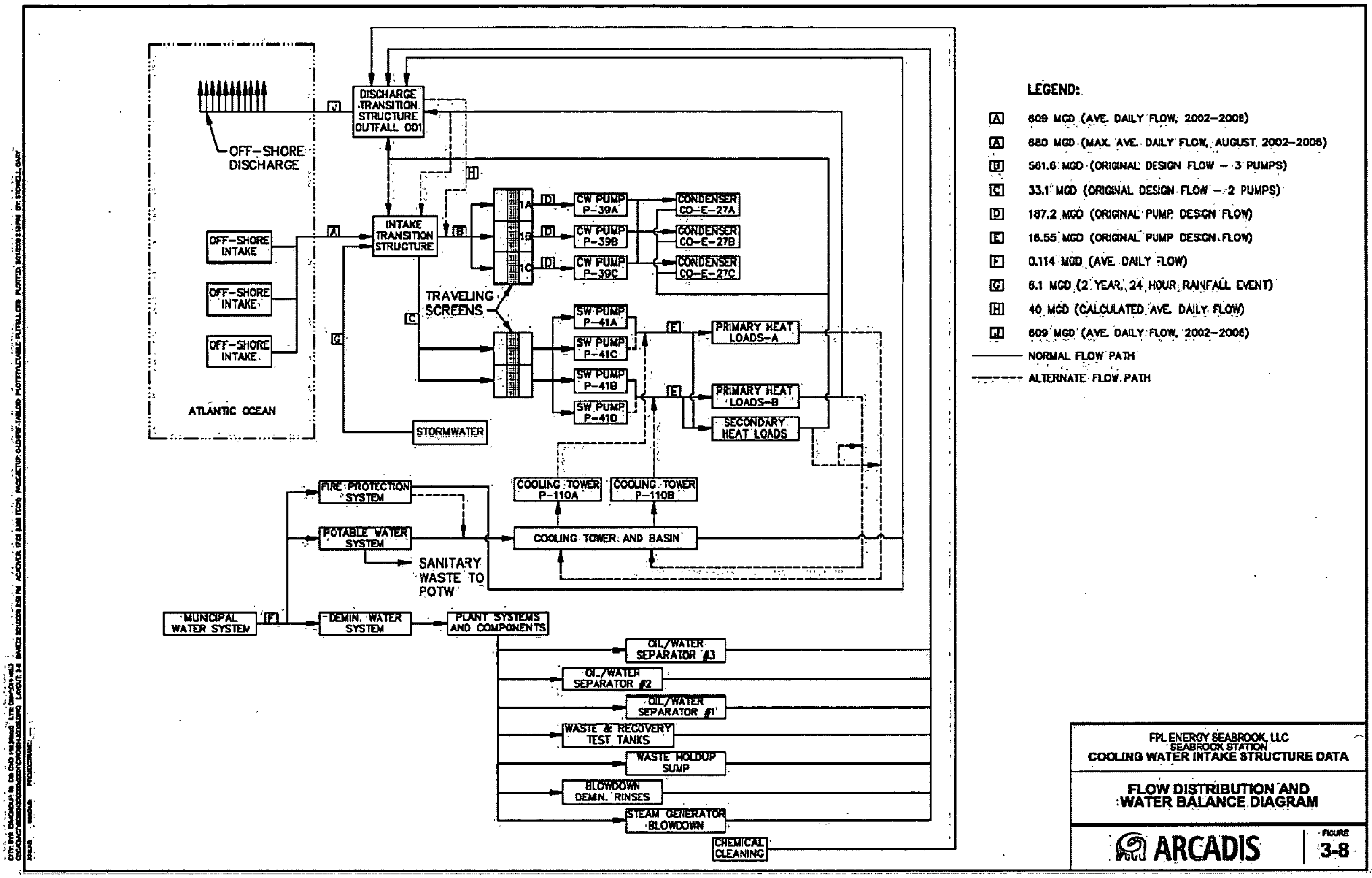


Figure 3-17. Seabrook Nuclear Power Station flow distribution and water balance diagram.

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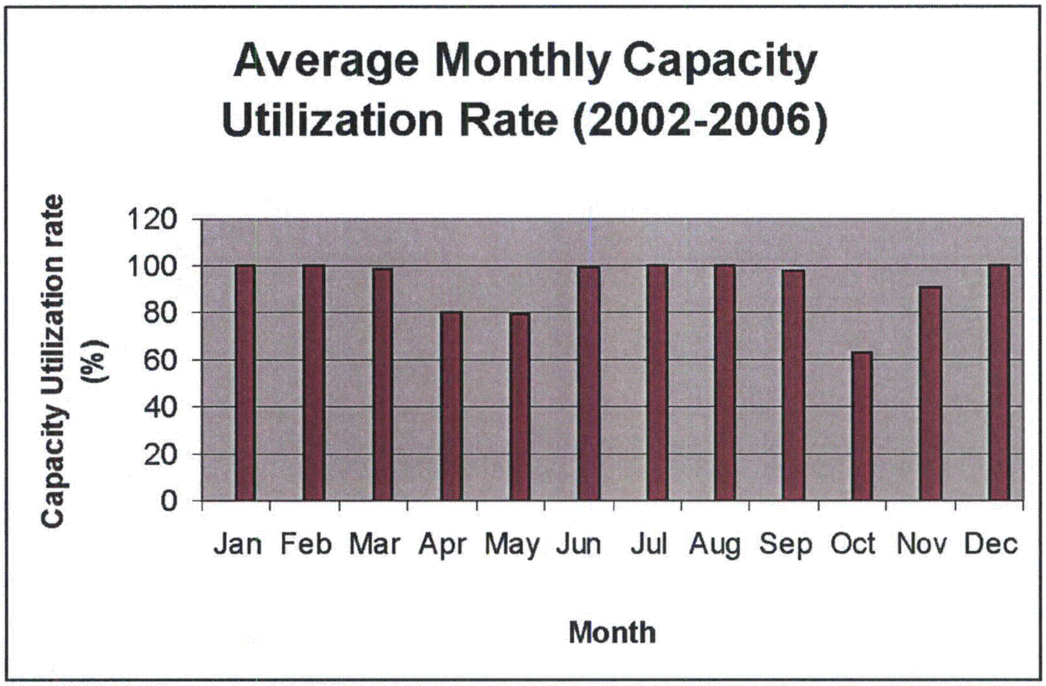

Figure 3-18. Average monthly utilization rate at Seabrook Nuclear Power Station from 2002-2006.

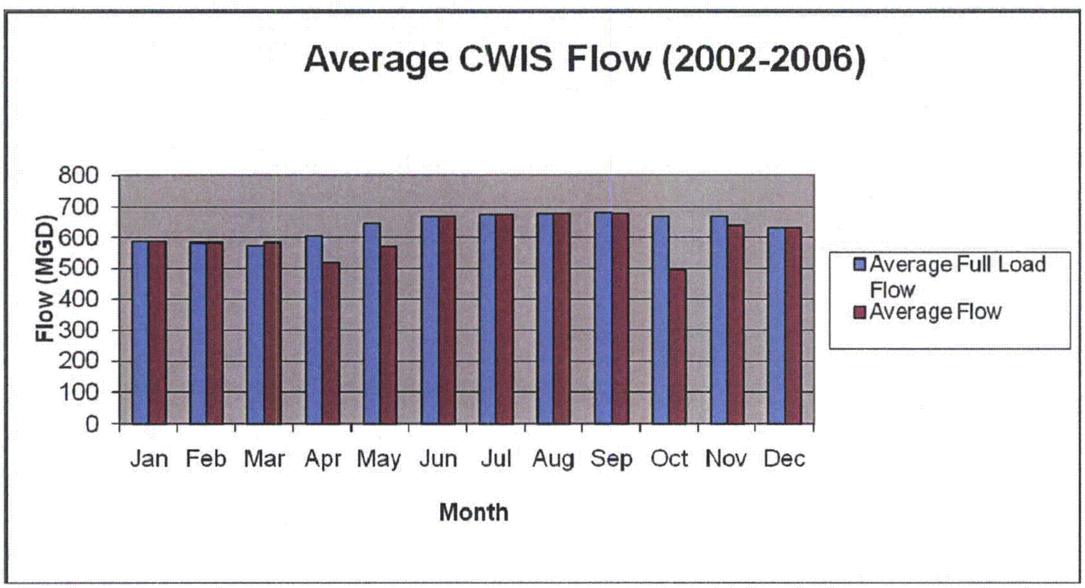

Figure 3-19. Average cooling water intake structure flow 2002-2006 at Seabrook Nuclear Power Station.

differential temperatures to be exceeded for a "maximum of 15 days per year and only when one circulating water pump has been taken out-of-service for corrective or preventative maintenance".

Historical operating data for the Seabrook CWIS is presented on Figure 3-19. The flow values represent the actual amount of water drawn into the intake from the source waterbody. The data is presented as actual average daily flow on a monthly basis for the years 2002 through 2006 and the daily average flow for the same time period when the generating unit is operating at full load. What this chart indicates is that CWIS flow is not only affected by the station capacity factor or hours of operation, but there is also a seasonal trend in flow due to the variations in water temperatures throughout the year. During unit operation, the average flow entering the intake in March (lowest) is 15.6% lower than the average flow in September (highest). The reduced intake flow when the unit is in generation in the winter months is due to the recirculation of discharge water into the intake. As circulating water temperatures drop, subcooling of the condensate will begin to occur. The subcooling of the condensate has a negative effect on the unit performance, therefore, discharge water is recirculated back to the intake to increase the intake water temperature and prevent the subcooling of the condensate. The recirculation provides the added benefit of reducing the actual water intake flow.

The traveling intake screens can be operated in either a manual or automatic mode. In the manual mode, the operator will place the selector switch in the run position, which starts the screen wash pumps and then the screens. If the water level differential pressure across the screens is greater than 12 inches, the screen will operate at fast speed, which is 20 feet per minute (fpm). If the screen differential pressure is greater than 6 inches, but less than 12 inches, the screen will operate at slow speed, which is 5 fpm. In the automatic mode, the starting of the screen wash pumps and the rotation of the screens are initiated by a screen differential pressure of 6 inches. The operating speeds are similar to the manual mode and the screens stop when the differential pressure drops below 4 inches. In the automatic mode the screens will also start once every 8 hours and run for approximately ½ hour, regardless of the screen differential. Should the differential pressure across any screen reach 60 inches, the associated circulating water pump will trip.

3.4 Cooling Water System Data

Seabrook Station has two cooling water systems which utilize the CWIS as a source of cooling water. The condenser circulating water system (circulating water) supplies cooling water to the steam surface condensers, and the service water system supplies cooling water to miscellaneous plant equipment, which are classified as primary and secondary heat loads. The following sections will provide a more thorough discussion of the operation of the plant cooling water systems as required by 40 CFR 122.21(r)(5).

3.4.1 Description of Operation

Seabrook Station has two cooling water systems that use cooling water supplied by the CWIS. The two systems are the circulating water system and the service water system. Both systems draw water through the three off-shore intakes, the intake tunnel, and the intake transition structure. After the intake transition structure, each system has an independent set of traveling screens. There are three traveling screens for the circulating water system and two traveling screens for the service water system.

The majority of all water entering the CWIS is for the circulating water system, which provides cooling water to the steam surface condenser for the condensing of the steam after it leaves the steam turbine. After the steam is condensed, the condensate can then be pumped back through the condensate and feedwater heating systems and then to the steam generator, where it is converted back to steam. The following paragraphs provide a description of the circulating water system, which is the primary use of cooling water, and the service water system, which provides cooling water to considerably smaller heat loads.

The circulating water system has three vertical, electric motor driven, circulating water pumps. Each pump is located in a separate pump well, each with a dedicated traveling intake screen. The discharge lines from each of the three pumps combine into a common line, which provides water to the steam surface condenser (three separate shells). The water exiting the condensers combines in a common line that flows into the discharge transition structure (Outfall 001). From the transition structure the water flows to the off-shore discharge.

In addition to supplying water to the condenser, a small portion of the circulating water pump discharge supplies water to the screen wash pumps. The water used for screen wash purposes is directed back to the intake transition structure after fish and debris are removed.

Each circulating water pump has a rated design flow of 130,000 gpm and the system was designed for all three pumps to be utilized for full load operation. The circulating water system was designed to operate with an average ocean temperature of 55° F and, at full load heat rejection, to maintain a circulating water temperature differential within the requirements of the NPDES Permit, which are 39° F maximum monthly average and 41° F maximum daily average.

The service water system provides cooling water for the plant's primary and secondary heat loads. The primary heat loads include the heat exchangers for the Primary Component Cooling Water System, the Diesel Generator Water Jacket, and the Auxiliary Spent Fuel Pool Cooling system. The secondary heat loads include the heat exchangers for the Secondary Component Cooling Water System and the Condenser Water Box Priming Pump. The service water system includes two trains of components with two Service Water Pumps for each train. Under normal full load operation both trains are required with one pump operating from each train. The Service Water Pumps are rated at 11,500 gpm each.

The off-shore intake is the primary source of water for the service water system. Should the intake tunnel fail or become blocked to the point where adequate flow for the service water system cannot be achieved, the cooling tower system is the alternate source of cooling for the service water system.

All intake water entering the CWIS flows through either the circulating water pumps or the service water pumps. Therefore, essentially 100% of the intake flow is for cooling purposes. At original design conditions, with three circulating water pumps and two service water pumps operating, the total intake flow would be 413,000 gpm (595 MGD). The highest average daily cooling water intake flow (circulating water and service water) during full load operation for the years 2002 through 2006 occurred during the month of August and was 471,000 gpm (678 MGD). Therefore, the total CWIS flow for full load operation at maximum annual water temperature is approximately 471,000 gpm.

Since the Seabrook Station operates at such a high capacity factor (average capacity factor for the last five years has been 92.3%), the cooling water system is in operation a very high percentage of the time. The condenser circulating water system and/or the service water system, with the cooling water intake structure as the primary source of water, essentially operates continuously. The system is typically removed completely from service for a few days during a refueling outage which occurs every 18 months.

Seabrook Station operates as a base load unit throughout the year, therefore, there is not a fluctuation in the cooling water flow associated with reduced power output. There are however, seasonal flow fluctuations during the colder months of the year when some water from the discharge transition structure is recirculated back to the intake transition structure, therefore, reducing the flow through the off-shore intakes. However, the overall cooling water flow through the circulating water system and the service water system remains unchanged when recirculation occurs.

Several operational and permit limitations also prevent major fluctuations on the cooling water flow. Within the current NPDES Permit[1], the average monthly and maximum daily circulating water discharge flow (includes condenser circulating water, service water, and some miscellaneous discharge streams which are supplied from the municipal water system) is limited to 720 MGD. In addition, the maximum temperature differential between the intake and discharge transition structures is limited to 39° F on an average monthly basis and 41° F on a daily basis. These temperatures can be increased to 45° F and 47° F respectively for a maximum of 15 days per year.

3.5 REGULATORY REQUIREMENTS AND PERFORMANCE STANDARDS

The Phase II rule in Part 125.94(b) specifies performance standards for the reduction of impingement mortality and entrainment (IM&E). These standards are based on the operating characteristics of the plant, the design of the cooling water system, and the source water body for cooling water. Seabrook Station is baseload plant with a five-year capacity factor of 92.3%, and a once-through cooling water system with marine intakes. Based on these characteristics, Seabrook Station is required to meet the performance standards for both impingement mortality and entrainment.

4.0 EXISTING AND PROPOSED TECHNOLOGY AND OPERATIONAL MEASURES

4.1 APPLICABLE PERFORMANCE STANDARDS

The performance standard specified in the Phase II rule (since rescinded) called for a reduction of impingement mortality of 80-95%, and a reduction in entrainment of 60-90% from the calculation baseline for plants with ocean intakes and capacity utilization factors over 15%. The calculation baseline is defined in Part 125.93 as an estimate of IM&E that would occur assuming:

- A once-through cooling water system,
- the opening of the cooling water intake structure is located at, and the face of the standard 3/8 inch mesh traveling screen is oriented parallel to, the shoreline near the surface of the source water body, and

[1] National Pollutant Discharge Elimination System Permit No. NH0020338, FPL Energy Seabrook, LLC, Effective date of April 1, 2002.

- the baseline practices, procedures, and structural configuration are those that would be maintained in the absence of any structural or operational controls, including flow or velocity reduction implemented in whole or in part for the purposes of reducing impingement mortality and entrainment.

In practice, this means the calculation baseline is the theoretical level of IM&E that would occur at a facility assuming there were no controls that reduced IM&E. IM&E controls at Seabrook Station include at a minimum:

- The offshore location of the intakes,
- The design of the intakes which includes velocity caps, and
- The reduced volume of cooling water withdrawn due to the colder water at the offshore location of the intakes compared to an inshore location.

To estimate the calculation baseline at Seabrook Station, comparisons will be made to Pilgrim Station in Plymouth, MA. Special concern will be taken to establish the appropriateness of this comparison through the presentation of sample collection methods, quality assurance, quality control (QA/QC) procedures, and how the data are representative of the current conditions.

4.2 EXISTING TECHNOLOGY AND OPERATIONAL METHODS

For compliance under Alternative 2 in the regulations, it is required that the facility demonstrate that it has existing design and construction technologies, operational measures, and/or restoration measures that will meet the performance standards. Seabrook Station has an intake technology that significantly reduces IM&E in the form of offshore intakes with velocity caps.

The level of IM&E at Seabrook Station that occurs with the offshore intake with the velocity cap is substantially less than the calculation baseline. There are three specific reasons for the success of the offshore intake in reducing IM&E. These are the location of the intake in an area of reduced biological activity, the tendency of fish to avoid the changes in horizontal flow created by the velocity cap, and the reduced cooling water flow requirements due to cooler water temperatures. For Seabrook Station, the baseline flow was calculated to be 744.5 MGD, as compared to the design cooling water flow of 684 MGD for the Seabrook Station (Appendix A).

The reduction in IM&E at Seabrook Station due to reduced biological activity associated with the intake location and the effectiveness of the velocity cap is quantified by a comparison of the average impingement and entrainment rates (no./unit of cooling water flow) at Seabrook to the impingement and entrainment rates at Pilgrim Station, which has a shoreline intake and is located on the same waterbody and in close proximity to where a shoreline intake would be located for Seabrook. The calculation baseline is estimated as the product of the cooling water flow for Seabrook Station if it had a shoreline intake (Appendix A) and the impingement and entrainment density at Pilgrim Station. This is a very conservative estimation because it assumes that there are no fish conservation strategies at Pilgrim Station that would reduce impingement and entrainment density. These strategies most likely do exist, therefore percent reduction from the calculation baseline are probably the smallest reductions that could be expected.

The comparison of IM&E between Seabrook and Pilgrim Stations follows a precedent set by EPA in their case studies (USEPA 2002). In the case study, EPA states that both "...facilities are located in the same ecological region, but differ in the locations of their CWIS…". Both are located in the western Gulf of Maine, and north of Cape Cod, which forms a zoogeographic boundary between a boreal fish community to the north, and a southern fish community. Further evidence of the similarity in fish communities comes from a calculation of similarity indices for the impingement and entrainment communities at the two plants for the years 2002-2006 (Table 4-1). Similarity coefficients (100 = complete similarity) for the egg entrainment community ranged from 61 to 79. The similarity indices for the larval entrainment community ranged form 64 to 78 and the indices for the impingement community ranged from 63 to 78. These coefficients generally indicated a high degree of similarity between the stations. However, because the intake structures are so different with regard to location and portion of water column from which they withdraw water, it can be assumed that the similarities would be even greater if the plants had similar intake structures.

Table 4-1. Similarity coefficients between Seabrook and Pilgrim Stations for the egg and larval entrainment communities and the impingement community.

Similarity Index[a]	Similarity Coefficient: Egg Entrainment Community	Larval Entrainment Community	Impingement Community
Jaccard	61	64	63
Sorenson	76	78	77
McConnaughey	79	78	78

[a] Clarke and Warwick (1994)

The EPA case studies concluded that : "…I&E at Seabrook's offshore intake is substantially lower than I&E at Pilgrim's nearshore intake." Furthermore, the case studies stated that impingement losses of Age 1 equivalents were 68% less at Seabrook and entrainment losses were 58% less. The EPA comparison between stations did not take into account any reductions in cooling water flow at Seabrook due to the offshore intake but did rely on two monitoring programs that have achieved a degree of credibility with regulators. A more detailed and updated comparison for the years 2002 through 2006 shows that the impingement rate at Pilgrim is 0.718 fish per million gallons, while the impingement rate at Seabrook is 0.135 fish per million gallons (Appendix Table B-1). This is a reduction of 81% due solely to the location and design of the Seabrook intake.

The estimated calculation baseline for impingement at Seabrook Station is 195,111 fish (Appendix Table B-2) based on the amount of cooling water required if the Seabrook intakes were located inshore and the impingement density from Pilgrim Station (Appendix Table B-1). The primary factor that allows for the reduction in cooling water flow at Seabrook Station from the baseline calculation is the lower temperature water at the offshore intake location (Appendix A). Actual impingement at Seabrook has never approached the calculation baseline. Assuming average annual cooling water flow (222,372 million gallons) and average impingement rate at Seabrook Station (0.135 fish/10^6 gallons) for the past five years (2002-2006) the average annual impingement would be 30,020 fish; an 85% reduction from the calculation baseline (Appendix Table B-2; calculation 1). Assuming design flow and the average impingement rate of 0.135 fish/10^6 gallons an estimated 33,704 would be impinged per year; an 83% reduction from the calculation baseline (Appendix Table B-2; calculation 2).

A similar substantial reduction in entrainment is also realized through the reduced cooling water flow at Seabrook Station (Appendix C). The average density of entrained ichthyoplankton at Pilgrim Station is 0.0092 organisms/million gallons while the density at Seabrook Station is 0.0069 organisms/million gallons (Appendix Table C-1). Therefore, there is a reduction of 25% due solely to the design and location of the Seabrook Station intakes. Using average flows, there is a 38% reduction in entrainment from the calculation baseline (Appendix Table C-2; calculation 3), and a 31% reduction using design flows (Appendix Table C-2; calculation 4).

There are many sources of variability in estimating the calculation baseline and percent reduction for IM&E. Many of these sources occur at the sample level and become propagated when means and their associated confidence intervals calculated from individual samples are combined with other means and scaled up by very large cooling water flows to estimate impingement. Further error is introduced when the percent reduction is calculated from the calculation baseline and the estimated impingement or entrainment, both of which are means with associated errors. Estimating the confidence intervals around impingement or entrainment estimates is more sophisticated than multiplying the upper and lower confidence intervals calculated from samples by the cooling water flow. However, even when proper statistical procedures are used, the percentage error can be so large as to be meaningless because multiple scaling and calculation steps. It is probably more instructive to examine how the percent reduction varies among years to get an idea of the uncertainty in the average annual reduction from the calculation baseline.

The calculation baseline is dependent on the density of organisms in the vicinity of the intake, environmental factors such as water temperature and storm action which affect impingement and entrainment vulnerability, and cooling water flow. Only cooling water flow can be considered without uncertainty and the others are variable. Therefore, the percent reduction in IM&E is calculated from two variables (calculation baseline and IM&E under design flow) that will vary annually. This annual variation can be thought of as the error in the percent reduction calculation. Figure 4-1 presents the calculation baseline impingement estimate for the years 2002 through 2006 and the impingement estimate at Seabrook under design flow conditions. The percent reduction ranged from 66% in 2004 and 93% in 2005 (Table 4-2). Based on five years of data, this is the degree of annual variation that can be expected in the future. The calculation baseline was estimated from Pilgrim Station impingement densities and the estimated impingement at Seabrook at design flow was estimated from Seabrook Station impingement densities. The impingement densities at the two plants showed the same directional trends among years and were correlated at r= 0.50, which is further indication that the impingement community is similar at both plants.

Figure 4-2 presents the presents the calculation baseline for entrainment for the years 2002 through 2006 and the entrainment estimate at Seabrook under design flow conditions. The annual percent reduction varied from -36% in 2002 to 68% in 2005. The year 2002 presents a special case where the estimated entrainment at Seabrook was larger than the calculation baseline. Ichthyoplankton are notoriously patchy, and the high entrainment estimate at Seabrook in 2002 was due to an unusually high density of cunner eggs in June 2002. This monthly entrainment estimate of cunner/yellowtail flounder eggs alone made up 62% of the annual total 2002 entrainment estimate for all species. Based on the ratio of cunner larvae to yellowtail flounder larvae, 99.7% of these eggs were cunner. Despite the unusually high density of cunner eggs in a few samples from June of 2002, entrainment densities from Seabrook and Pilgrim Stations showed the same directional annual trends. The correlation coefficient for entrainment density for all five years between the two plants was 0.42, but improved to 0.97 if 2002 was excluded, which is further evidence that entrainment density at the two plants are closely related.

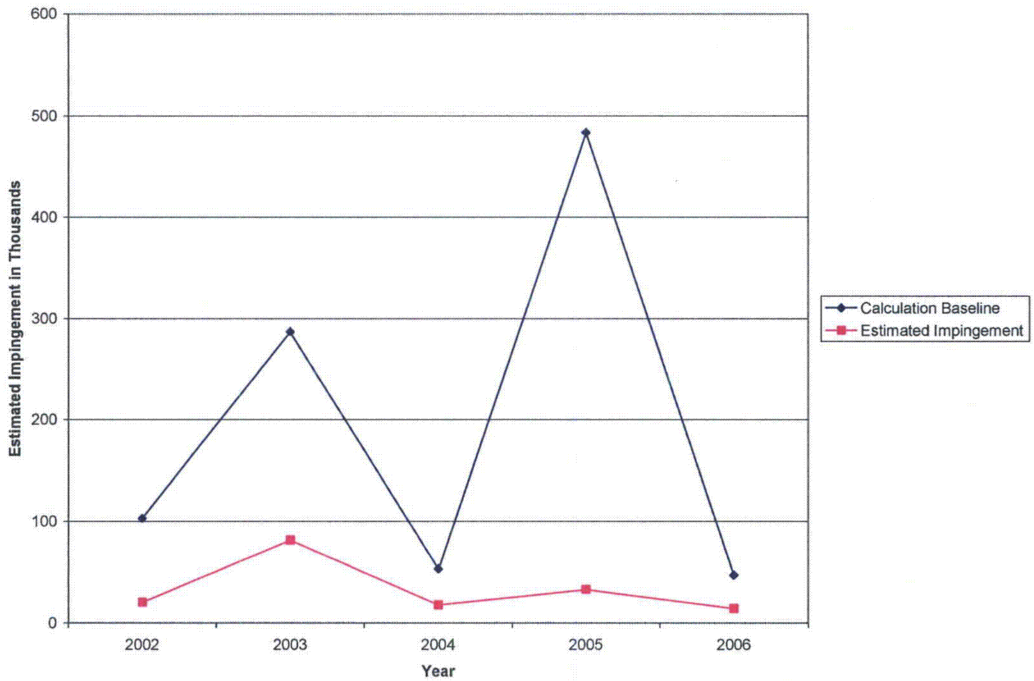

Figure 4-1. Comparison of the calculation baseline for impingement and estimated impingement at Seabrook Station 2002-2006.

Table 4-2. Annual variation in percent reduction from the calculation baseline for impingement and entrainment at Seabrook Station.

	Impingement			Entrainment		
Year	**Calculation Baseline (Fish)**	**Estimated Impingement at Design Flow (Fish)**	**Percent Reduction (%)**	**Calculation Baseline (eggs and larvae in millions)**	**Estimated Entrainment at Design Flow (eggs and larvae in millions)**	**Percent Reduction**
2006	47,484	14,772	69	2,674	1,367	49
2005	484,064	33,376	93	2,230	706	68
2004	53,685	18,173	66	3,103	2,535	18
2003	287,047	81,353	72	2,167	902	58
2002	103,252	20,608	80	2,311	3,146	-36
Average	**195,106**	**33,656**	**83**	**2,497**	**1,731**	**31**

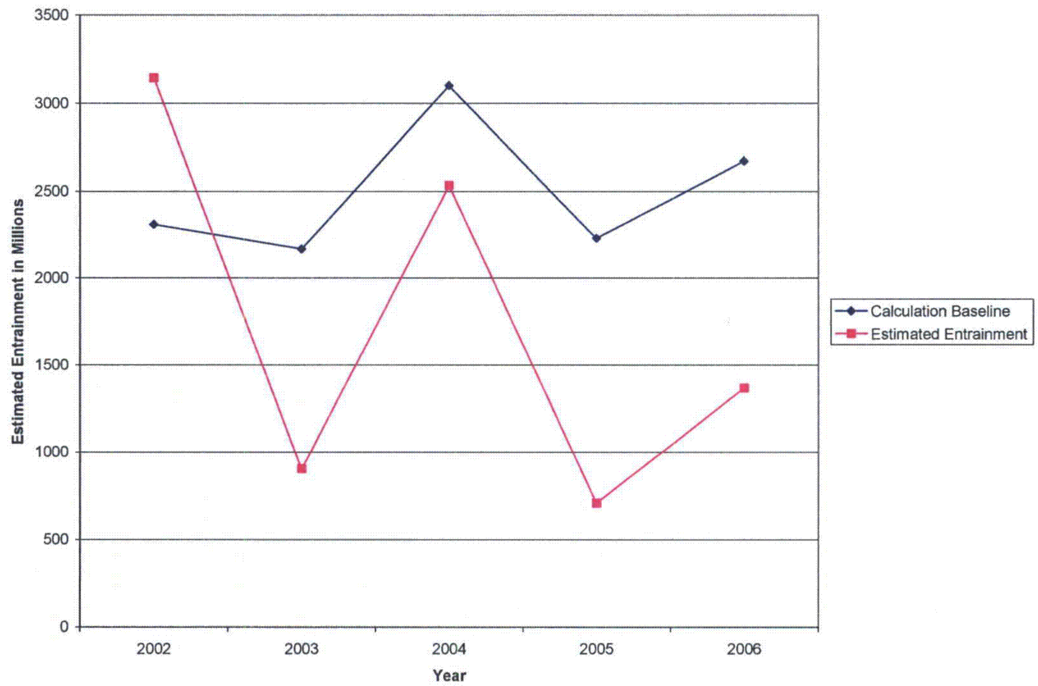

Figure 4-2. Comparison of the calculation baseline for entrainment and estimated entrainment at Seabrook Station 2002-2006.

The appropriateness of these comparisons is dependent on the validity of the data collection methods, and the representativeness of the data presented to current conditions. The validity of the data collection methods is demonstrated through the QA/QC programs of the impingement and entrainment monitoring programs at Seabrook and Pilgrim Stations. The Standard Operating Procedures (SOPs) for Seabrook Station are presented in Appendix E. These SOPs present the methods and QA/QC procedures for the collection (impingement and entrainment) and laboratory (entrainment) analysis of samples. The SOP for the Pilgrim impingement and entrainment program was deemed to be Confidential Business Information and was not made available to us by the owners of Pilgrim Station. However, these SOPs were presented in Appendix 2 of the Pilgrim Station Proposal for Information Collection.

In general, at Seabrook Station two 24-hour impingement samples were collected each week, usually on Monday and Thursday mornings. All fish and lobsters are identified and counted, and a maximum of 20 individuals of each species are measured for total length. Entrainment samples were collected four times each month from a tap off the cooling water system. Each sample consisted of a two-hour collection made within each of the following 6-hour diel periods (morning: 0415-1015; day: 1015-1615; evening: 1615-2215; night: 2215-0415) for a total of 4 collections in each 24-hour sample. Collections were made with a 0.333 mm mesh net and have a target volume of 275 m^3. All ichthyoplankton were identified to the lowest practical taxon.

At Pilgrim Station, impingement samples were collected three times per week, with each collection representing a different 8-hour diel period. Specific details are available in the SOP submitted with the Pilgrim Station PIC, but the following information was available in the annual monitoring reports. Collections were made at 0830 on Monday, 1630 on Wednesday, and 0030 on Saturday. Additional samples were collected if the impingement rate exceeded 20/hour. All fish and lobsters were identified and counted, and a maximum of 20 individuals were measured and weighed. Entrainment samples were collected at the same time as impingement samples using a 60-cm net suspended in the discharge canal. The standard mesh size was 0.333 mm except for late March through May when a 0.202-mm mesh was used and the target sample volume was 100 m^3. The data presented in the comparisons between stations are obviously related to current conditions because they are for years 2002 through 2006. These are the most recent data available.

The intake technology currently installed at Seabrook Station resulted in an average reduction in impingement mortality from the calculation baseline of 83% with an annual range of 66% to 93%. Reduction in entrainment from the calculation baseline is more variable due to the inherently patchy nature of plankton distribution, with the result that in 2002 estimated entrainment at Seabrook Station increased from the calculation baseline. The maximum reduction in entrainment was 68% with an average reduction of 31%.

4.3 PROPOSED TECHNOLOGY AND OPERATIONAL MEASURES

EPRI has identified many intake technologies for consideration in achieving compliance with the 316(b) performance standards. EPRI has categorized the intake technologies by the methods of operation. They have been categorized as Physical Barriers, Collection Systems, Diversion Systems, and Behavioral Deterrent Systems. However, most, if not all, of these technologies have been developed and tested for inshore type intakes constructed at the shoreline. We are not aware of a single technology in the Physical Barrier, Collection Systems, or Diversions Systems categories that has been installed at an offshore intake. Velocity caps, which are installed at Seabrook Station, and behavioral deterrents have been used at offshore intakes. The primary reason for the lack of installation of physical barriers, collection and diversion systems at offshore intakes is the excessive cost associated with designing and constructing these technologies in an open water environment. At Seabrook Station, the location of the intakes in 60 feet of water, 1.33 miles offshore, compounds these costs, especially when coupled with the nuclear safety concern with reducing flow to safety related systems. Therefore, we do not consider that any physical barriers, collection or diversion systems are practical for Seabrook Station. These technologies and restoration are discussed in more detail in Appendix D.

4.4 COST ESTIMATES FOR COMPLIANCE

In Appendix A of the Phase II rule, the EPA provided cost estimates for "the most appropriate compliance technology" for many plants to meet the appropriate performance standards. These cost estimates can then be used in the cost-cost benefit test specified in compliance alternative 5. EPA's cost estimates were based on, among other factors, the actual facility design intake flow and the EPA assumed facility design flow. However, EPA did not estimate the design flow for many plants including Seabrook Station as indicated by the notation N/A in the "EPA assumed design intake flow" in column 3 of Appendix A". In the preamble to the final Phase II rule on page 41646, EPA states:

> "...some entries in Appendix A have NA indicated for the EPA assumed design intake flow in column 2 (sic). These are facilities for which EPA projected that they would already meet

> otherwise applicable performance standards based on existing technologies and measures. EPA projected zero compliance costs for these facilities..."

Furthermore in the same paragraph EPA states:

> "These facilities should use $0 as their value for the costs considered by EPA for a like facility in establishing the applicable performance standard."

5.0 ECOLOGICAL STUDIES AND HISTORICAL IMPINGEMENT MORTALITY AND ENTRAINMENT STUDIES

Preconstruction environmental evaluation began at Seabrook Station in 1969. A comprehensive environmental monitoring program has been in place for some parameters (softshell clam) since 1974 providing 15 years of preoperational data. Monitoring for most parameters began in the late 1970s or early 1980s and provides approximately 10 years of preoperational data, and as of 2007, 17 years of operational data including impingement and entrainment data. These studies are relevant to current conditions because they are presently ongoing and represent the most up to data available regarding New Hampshire nearshore environmental conditions and potential impacts due to impingement and entrainment. Ecological parameters monitored included water quality and nutrients, phytoplankton, zooplankton, ichthyoplankton and fish, macroflora and macrofauna (including estuarine benthos and offshore fouling panels), *Cancer* sp. crabs and lobsters, and softshell clams and bivalve larvae. A summary of the present environmental monitoring program is presented in Table 5-1. Further information can be found in NAI (2005).

A basic assumption in the monitoring program is that there are two major sources of natural-occurring variability: (1) that which occurs among different areas or stations, i.e., spatial, and (2) that which varies in time, from daily to weekly, monthly or annually, i.e., temporal. In the experimental design and analysis, the Seabrook Environmental Monitoring Program has focused on the major source of variability in each community type and then determined the variability in each community. The frequency and spatial distribution of the sampling effort were determined based on the greatest sources of variability for each parameter (NAI 1991).

A previous Summary Report (NAI 1977) concluded that the balanced indigenous community in the Seabrook study area should not be adversely influenced by loss of individuals due to entrapment in the Circulating Water System (CWS), exposure to the thermal plume, or exposure to increased particulate material (dead organisms) settling from the discharge. The current study continues to focus on the likely sources of potential influence from plant operation, and the sensitivity of a community or parameter to that influence within the framework of natural variability. A community or species within the study area might be affected by more than one aspect of the CWS.

Table 5-1. Summary of the Study Design for the Environmental Monitoring Program at Seabrook Station.

Program	Parameter	Number of Stations	Sampling Frequency
Water Quality	Discharge Temperature	1 Farfield 1 Nearfield	Continuous.
	Water Temperature	1 Farfield 1 Nearfield (1-m increments)	4/month.
	Salinity (S and B)	1 Farfield 1 Nearfield (1-m increments)	4/month.
	Dissolved Oxygen (S and)	1 Farfield 1 Nearfield (1-m increments)	4/month.
	Estuarine water Temperature	1	Weekly at high and low tides.
	Estuarine Salinity	1	Weekly at high and low tides
Zooplankton	Bivalve larvae	1 Farfield 1 Nearfield	Paired tows weekly April-Oct.
	Macrozooplankton	1 Farfield 1 Nearfield	Paired tows 2/month.
Fish	Ichthyoplankton	1 Farfield 1 Nearfield	Paired tows 4/month.
	Fish (otter trawl)	2 Farfield 1 Nearfield	Replicate tows 2/month.
	Estuarine fish (seine)	3 Farfield	1/month, April-Nov.
Macrobenthos	Macroflora and fauna	2 Farfield 2 Nearfield	3/year destructive sampling.
	Macroflora and fauna	2 Farfield 2 Nearfield	3/year nondestructive sampling.
	Settling organisms (panels)	1 Nearfield 1 Farfield	3/year.
Epibenthic Crustaceans	Lobsters and *Cancer* sp. crabs	1 Nearfield 1 Farfield	3/week, June-Nov.
	Lobster larvae	1 Nearfield 2 Farfield	1/week, May-Oct.
Softshell clams	Adults and spat	Hampton Harbor (Farfield)	Annual population survey.
Impingement	Adult fish	1 in-plant	2/week, year round
Entrainment	Ichthyoplankton	1 in-plant	4 diel periods, 1/week, year round.
	Bivalve larvae	1 in-plant	1/week, mid April-Oct.

Results from this monitoring program will be discussed in light of that aspect of the cooling water system that has the greatest potential for affecting that particular component of the biological community. Entrainment and impingement are addressed through in-plant monitoring of the organisms entrapped in the CWS.

Several changes have occurred in the environmental monitoring program since its inception. Table 5-2 summarizes the various ecological parameters monitored and the current status of these monitoring programs. Some of the programs had sufficient data to eliminate concerns over the potential for impact, or the variability within the community studied was so high a plant impact was unlikely to ever be detected, or other monitoring programs provided sufficient data to monitor the community in question. These programs included nutrients, phytoplankton, microzooplankton, pelagic fish (gill net sampling program), surface fouling panels, macrobenthos at the deep stations,

Table 5-2. Summary of Biological Communities and Taxa Monitored for Each Potential Impact Type (NAI 2005).

			Level Monitored	
Monitoring Area	Impact Type	Sample Type	Community	Selected Species/ Parameters
Intake	Entrainment	Microzooplankton	*	*
		Macrozooplankton	x	x
		Fish eggs	x	x
		Fish larvae	x	x
		Soft-shell clam larvae	x	x
		Cancer crab larvae	x	x
	Impingement	Juvenile/Adult fish	x	x
		Lobster adults		x
		Seals		*
Discharge	Thermal Plume	Nearshore water quality		x
		Phytoplankton	*	*
		Lobster larvae		x
		Intertidal macroalgae and macrofauna	*	*
		Shallow subtidal macroalgae and macrofauna	x	x
		Subsurface fouling community	x	x
	Turbidity (Detrital Rain)	Mid-depth macrofauna and macroalgae	x	x
		Deep macrofauna and	*	*
		macroalgae		x
		Demersal fish	x	x
		Bottom fouling community	*	*
		Lobster adults		x
		Cancer crab adults		x
Estuary	Cumulative Sources	Estuarine temperature		x
		Soft-shell clam spat and adults		x
		Estuarine fish	x	x

x denotes current program

* denotes completed program

and macrobenthos at the intertidal stations, and were eliminated. Intensive ecological monitoring in the nearfield and farfield environments of almost all trophic levels from 1990 through 2006 has not detected any significant impact due to the operation of the Seabrook Station CWIS (NAI 2007).

Direct impacts due to operation of the CWIS are limited to impingement and entrainment. An impingement and entrainment monitoring program has been in place since Seabrook Station began operation in 1990. Methodology used to collect impingement and entrainment procedures are provided in Appendix E. To summarize, 24-hour impingement collection are made twice per week for a total of 104 scheduled samples in the year. Four entrainment samples, each representing one 6-hour diel period, are collected weekly using a 0.333 mm mesh net for a total of 208 samples each year. The Standard Operating Procedures are Seabrook Station controlled documents and the sampling evolution is observed by Seabrook Station personnel. Procedures for the laboratory analysis of entrainment samples are found in the Seabrook Environmental Studies Quality Program and Standard Operating Procedures Revision 10 (Section VA), which refers to the Normandeau Technical Procedures Manual (Section VI). Appropriate excerpts from both documents that pertain to the analysis of plankton samples are also presented in Appendix E.

Appendix F contains a summary of the results of the annual impingement and entrainment monitoring programs. These data are obviously relevant to current conditions because they include the most recent impingement and entrainments estimates of 2006. Fish egg and larvae entrainment estimates averaged 928 million eggs (Appendix Table F-1) and 306 million larvae (Appendix Table F-2) for the period 1995 through 2006 when sampling occurred year round. The primary fish eggs entrained were cunner/yellowtail flounder which were about 99% cunner (NAI 2005), silver hake, and Atlantic mackerel. The primary fish larvae entrained were cunner, Atlantic seasnail, and American sand lance.

Entrainment of bivalve larvae has been monitored at Seabrook Station since 1990 (Appendix Table F-3). Consistent sample collection during the bivalve larvae season (third week of April through October) occurred in 1993, and 1995 through 2006. The primary bivalve larvae entrained were *Anomia squamula*, *Mytilus edulis*, *Hiatella* sp., and *Modiolus modiolus*. Larvae of *Mya arenaria* were also entrained, but their entrainment did not appear to affect the set of young-of-the year (NAI 2007).

At Seabrook, Station mean annual impingement for 1995 through 2006 was 22,091 fish/year, and annual estimates ranged from 7,281 (2000) to 71,950 (2003; Appendix Table F-4). The most common fish impinged were Atlantic silverside (3,090/year), rock gunnel (2,532/year), and winter flounder (2,232/year).

Mean annual impingement estimates for other plants ranged from 44,755 fish/year at Pilgrim Station to 65,927 fish at Millstone 2. Based on impingement data from 1995 through 2006, it appears that the majority of the fish impinged are young-of-the-year demersal fishes taken during the spring and fall. Many common inshore demersal fishes undergo a seasonal movement in the fall and winter as they move to deeper waters as water temperatures decrease inshore. The impingement of YOY demersal fishes in the fall and winter may be a result of these fishes moving past the intakes as they complete their annual movements.

Impingement at a power plant is dependent on many factors, including the fish abundance near the intakes, the susceptibility of the species or lifestage to impingement, intake design and location, plant operating characteristics, environmental variables (e.g., water temperature, wave height, wind direction and velocity), and time of day (Landry and Strawn 1974; Grimes 1975; Lifton and Storr 1978; Turnpenny 1983). The offshore intakes at Seabrook Station are equipped with velocity caps that primarily withdraw cooling water from mid-water depths with a velocity of about 0.15 m/s (0.5 ft/s). This design has apparently been successful in reducing impingement of fish and lobsters. The majority of the fishes impinged have been demersal fishes, with the exceptions of Atlantic silverside and pollock.

Equivalent Adult (EA) analyses was used to put entrainment and impingement losses in perspective. Saila et al. (1997) concluded that entrainment losses of winter flounder, pollock, and red hake at Seabrook Station from 1990 to1995 had a negligible adverse ecological impact. This analysis was expanded to more species and used updated larval mortality data and entrainment estimates for the years when sampling occurred in all diel periods (2003 through 2006). With the additional data and expanded species list, the conclusions of Saila et al. (1997) that EA losses of fishes appear to be an ecologically insignificant fraction of any sustainable stock, were confirmed (NAI 2006). Entrainment and impingement of seven species of commercially-important fishes in 2003 through 2006 resulted in the annual estimated loss of 2 (yellowtail flounder) to 1,820 (Atlantic herring) (Table 5-3). Losses due to entrainment were larger than impingement losses for most species evaluated.

Table 5-3. Mean Annual Equivalent Adult Losses of Seven Commercially Important Species Impinged and Entrained at Seabrook Station in 2003 through 2006.

	Equivalent Adults		
Species	**Impingement**	**Entrainment**	**Total**
Atlantic Cod	42	504	546
Atlantic Herring	22	1,798	1,820
Atlantic Mackerel	0	239	239
Pollock	79	25	104
Hake spp.[a]	208	82	290
Winter Flounder	34	326	360
Yellowtail Flounder	1	1	2

[a] Includes red and white hake.

6.0 AGENCY CONSULTATIONS

6.1 ONGOING CONSULTATIONS

Seabrook Station is not engaged in any ongoing agency consultations

6.2 HISTORIC CONSULTATIONS

Consultations with the National Oceanic and Atmospheric Administration, National Marine Fisheries Service were initiated in 1997 after a number of seals were taken in the Seabrook Station cooling water system. A Limited Take Permit application was filed by Seabrook Station in June 1997. Subsequently a Limited Take Permit and Letter of Authorization were issued by NMFS in July 1999. The provisions of the Limited Take Permit and LOA included enhanced monitoring, reporting and the requirement to design and install a mitigation device to minimize or eliminate seal takes. Design and installation of a mitigation device was completed in August 1999. Additional vertical bars were installed on the intake velocity caps to reduce the bar spacing from approximately fourteen inches to five inches. The reduced bar spacing mitigation design has been completely successful in eliminating seal takes. In light of the proven effectiveness of the mitigation device design the Limited Take Permit was allowed to expire in June 2004. A copy of the Limited Take Permit and Letter of Authorization (as renewed 11/1/03) are enclosed.

Consultations with various federal agencies were initiated in April 1974 by the United States Atomic Energy Commission upon publication of the "Draft Environmental Statement" for the proposed construction of Seabrook Station Units 1 and 2. The environmental statement was prepared in accordance with the AEC regulations at 10 CFR 50 Appendix D which implemented the requirements of the National Environmental Policy Act of 1969. Letters from the following federal agencies are enclosed:

Department of the Army (June 7, 1974): Comment letter identifies the requirement for a Department of the Army Permit for dredging and disposing of dredged material for installation of intake and discharge facilities. The requisite Army Corps of Engineers Permits were subsequently obtained.

Department of Commerce (June 28, 1974): Comment letter identifies that the location of the intake structures in relation to the Hampton Harbor inlet and natural rock outcroppings could make significant numbers of organisms vulnerable to loss through impingement and entrainment. The location of the intake structures was substantially revised during the Environmental Protection Agency review and public proceeding relative to 316 (b) during the January 1975 to August 1978 time period. The initial proposed intake location 3000 feet from the shoreline was revised during the 316 (b) proceeding to a location 7000 feet from the shoreline.

Department of the Interior (June 10, 1974): Comment letter identifies that an intake velocity of less than 1 cfs may be necessary to adequately protect aquatic life. The intake velocity originally proposed for two Seabrook Station units was approximately 1 foot per second. The velocity associated with operation of a single unit is approximately .5 foot per second at the velocity caps.

Department of Transportation (June 14, 1974): Comment letter identifies the requirement for a Private Aid to Navigation for the intake and discharge structures due to the possible hazard to navigation. The requisite Private Aids to Navigation are installed and maintained at the intake and discharge locations.

Consultations with various federal agencies were initiated in May 1982 by the United States Nuclear Regulatory Commission upon publication of the "Draft Environmental Statement" for the proposed operation of Seabrook Station Units 1 and 2. The environmental statement was prepared in accordance with the NRC regulations at 10 CFR 51 which implemented the requirements of the National Environmental Policy Act of 1969. Letters from the following federal agencies are enclosed:

Department of Commerce (July 6, 1982): Comment letter identifies that since the agency's initial comments were filed on June 28, 1974, changes in plant design and operation have been instituted which will minimize impacts on fisheries resources and associated habitats.

7.0 SAMPLING PLANS

Seabrook Station is not planning any additional sampling beyond its current ongoing, extensive environmental monitoring program delineated in Table 5-1. This program will continue in the future. We believe this is the most extensive monitoring program for any power plant in EPA Region 1 and it will be sufficient to provide data for verification monitoring if required.

8.0 LITERATURE CITED

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APPENDIX A

Calculation Baseline
Cooling Water Flow at Seabrook Station

Effect of Offshore Intakes at Seabrook Station

The Seabrook once through cooling system currently draws water through the intake structure from approximately 7,000 feet offshore from Hampton Beach in the Gulf of Maine. The water enters through three separate offshore intake structures and travels through a 19 ft diameter tunnel approximately 3.22 miles long to the screen house location.

The existing cooling water intake system at Seabrook differs from the design of the cooling water intake structure identified in the regulations for use in determining the calculation baseline for IM&E. As defined in § 125.93, the "calculation baseline means an estimate of impingement mortality and entrainment that would occur at your site assuming that: the cooling water system had been designed as a once-through system; the opening of the cooling water intake structure is located at, and the face of the standard ⅜-inch mesh traveling screen is oriented parallel to, the shoreline near the surface of the source waterbody; and the baseline practices, procedures, and structural configuration are those that your facility would maintain in the absence of any structural or operational controls, including flow or velocity reductions, implemented in whole or in part for the purposes of reducing impingement mortality and entrainment".

To determine what the IM&E would be with the baseline intake configuration, it is first necessary to determine the cooling water flow requirements if that configuration were utilized. Since the baseline configuration would draw water from the waterbody surface at the shoreline, the intake water would have a higher maximum temperature than the water drawn into the existing off-shore intake. Therefore, a higher circulating water flow would be required to maintain the same discharge temperature. At the Seabrook Station the actual construction of a shoreline intake matching the description above would be faced with many technical and environmental issues that would be extremely difficult, if not impossible, to address. For this reason, any discussion of this baseline intake design is theoretical in nature only.

For this analysis it is assumed that the baseline intake would be located at the Gulf of Maine shoreline near the inlet to Hampton Harbor. At this location the temperature of the water drawn into the intake would be considerably higher than the temperature of the water drawn into the existing offshore intake structures. At the current intake location the monthly average daily water temperature ranges from a minimum of 36.9 °F in February to a maximum of 55.4 °F in September. At the theoretical baseline intake location, where water temperatures will be affected due to the proximity to the estuary and shallower water, the monthly average mean daily water temperature ranges from a minimum of 35.8 °F in February to a maximum of 62.0 °F in July. This temperature data represents the five year average from 2000 through 2004.

To determine the required cooling water flow with the baseline intake configuration, it is necessary to establish criteria for the discharge temperature. It will be assumed here that the discharge temperature will not be allowed to exceed the current discharge temperatures. Although discharge criteria can be based on many different assumptions, it is our opinion that the use of the same discharge temperature for the baseline intake is a reasonable assumption. In the current NPDES Permit for Seabrook, the maximum monthly average difference between the intake temperature and discharge temperature is 39 °F. If the maximum intake temperature is 55.4 °F at the current intake location, then the discharge temperature at the maximum allowable differential of 39 °F is 94.4 °F. Using 94.4 °F as the maximum monthly average discharge temperature for the theoretical baseline intake, the maximum allowable monthly average differential temperature with the baseline intake design must be reduced to 32.4 °F. This maximum temperature rise is similar to the limit in the NPDES Permit for the Pilgrim Nuclear Station, which has a shoreline intake and a temperature increase limit of 32 °F.

Using the criteria established above and the current design heat load rejection of 8,000 MMBtu/hr, the required circulating water flow rate must increase to 494,000 gpm. If the current service water flow rate of 23,000 gpm is kept unchanged, the total baseline flow would be 517,000 gpm (744.5 MGD). Therefore, the current total cooling water flow rate, including circulating water and service water, at full load operation of 475,000 gpm (684.0 MGD) is 8.1% less than the baseline flow.

In this analysis it is assumed that the baseline flow is determined by the design flow throughout the year. Flow reduction which could be achieved through recirculation or through the shutdown of a singe pump is not considered in the baseline flow analysis since such operational measures are not considered as flow reduction in calculation baseline unless they are implemented for the purpose of reducing impingement mortality or entrainment.

APPENDIX B

Calculation Baseline of Impingement Mortality

Table B-1. Comparison of fish impinged per unit of cooling water flow between Seabrook and Pilgrim Stations.

Year	Seabrook[a]			Pilgrim[b]		
	Annual Flow (10^6 gallons)	Fish Impinged	Fish/10^6 gallons	Annual Flow (10^6 gallons)	Fish Impinged	Fish/10^6 gallons
2006	218,953	12,955	0.059	170,032	29,711	0.175
2005	219,675	29,368	0.134	170,032	302,883	1.781
2004	229,373	16,696	0.073	170,032	33,591	0.198
2003	220,792	71,946	0.326	170,032	179,608	1.056
2002	223,066	18,413	0.082	170,032	64,606	0.380
Average	222,372	29,876	0.135	170,032	122,080	0.718

[a] Actual flows. Impingement estimate is based on actual flows.
[b] Design flows of 155,500 gpm for each of two circulating water pumps, and 2,500 gpm for each five service water pumps. Impingement estimates are based on 100% flow capacity.

Table B-2. Comparison of calculation baseline impingement and actual impingement at Seabrook Station.

Parameter	Calculation Baseline	Actual Seabrook Data[a]	Design Seabrook Flow
Cooling Water Flow (10^6 gallons/year)	271,743	222,372	249,660
Impingement Density (fish/10^6 gallons	0.718[b]	0.135	0.135
Impingement Estimate	195,111	30,020	33,704

[a] Averages from 2002-2006, see Table B-1.
[b] From Pilgrim Station data, see Table B-1.

Calculation 1. Percent reduction from calculation baseline using average Seabrook Station flows: (195,111-30,020)/195,111 = 85%

Calculation 2. Percent reduction from calculation baseline using design Seabrook Station flows: (195,111-33,704)/195,111 = 83%

APPENDIX C

Calculation Baseline for Entrainment

Table C-1. Comparison of ichthyoplankton entrained per unit of cooling water flow between Seabrook and Pilgrim Stations

	Seabrook[a]			Pilgrim[b]		
Year	Annual Flow (10^6 gallons)	Ichthyoplankton Entrained (millions)	Ichthyoplankton entrained/10^6 gallons	Annual Flow (10^6 gallons)	Ichthyoplankton Entrained (millions)	Ichthyoplankton entrained/10^6 gallons
2006	218,953	1,198.6	0.0055	170,032	1,673.6	0.0098
2005	219,675	621.4	0.0028	170,032	1,395.4	0.0082
2004	229,373	2,328.6	0.0102	170,032	1,941.8	0.0114
2003	220,792	797.9	0.0036	170,032	1,355.8	0.0080
2002	223,066	2,811.2	0.0126	170,032	1,446.0	0.0085
Average	222,372	1,551.5	0.0069	170,032	1,562.5	0.0092

[a] Actual flows. Entrainment estimate is based on actual flows.
[b] Design flows of 155,500 gpm for each of two circulating water pumps, and 2,500 gpm for each five service water pumps. Impingement estimates are based on 100% flow capacity.

Table C-2. Comparison of calculation baseline entrainment and actual entrainment at Seabrook Station.

Parameter	Calculation Baseline	Actual Seabrook Data[a]	Design Seabrook Flow
Cooling Water Flow (10^6 gallons/year)	271,743	222,372	249,660
Entrainment Density (ichthyoplankton/10^6 gallons[b])	0.0092[b]	0.0069	0.0069
Entrainment Estimate (millions)	2,500.0	1,543.3	1,722.7

[a] Averages from 2002-2006, See Table C-1.
[b] From Pilgrim Station data, see Table C-1.

Calculation 3. Percent reduction from calculation baseline using average Seabrook station flow: (2500.0-1,543.3)/2,500.0 = 38%

Calculation 4. Percent reduction from calculation baseline using design Seabrook station flows: (2,500.0-1,722.7)/2,500.0 = 31%

APPENDIX D

Fish Protection Technologies and Operational Measures

Proposed Technology and Operational Measures

EPRI has identified many intake technologies for consideration in achieving compliance with the 316(b) performance standards. EPRI has categorized the intake technologies by the methods of operation. They have been categorized as Physical Barriers, Collection Systems, Diversion Systems, and Behavioral Deterrent Systems. The technologies included in each category are as follows.

Physical Barriers:

Traveling Screens, Stationary Screens, Drum Screens, Cylindrical Wedgewire Screens, Barrier Nets, Gunderboom, Porous Dike, Radial Wells, Artificial Filter Bed, and Rotary Disc Screens.

Collection Systems:

Modified Traveling Screens and Fish Pumps.

Diversion Systems

Angled Screens, Modular Inclined Screens, Eicher Screen, Angled Drum Screens, Louvers, Inclined Plane Screen, and Horizontal Traveling Screens.

Behavioral Deterrent Systems

Strobe Light, Mercury Light, Sound Systems, Infrasound Generators, Air Bubble Curtains, and Hybrid Systems.

Other Technologies

Intake Location (Off-shore intake), Velocity Cap, and Flow Reduction

In addition to the technologies described above, operational measures can be utilized to further reduce intake flow. Flow and annual water use can be reduced by either taking pumps out of service when not required or installing variable frequency drives to reduce flow.

This assessment included an initial screening that evaluated the potential for IM&E reduction technologies at Seabrook (Appendix D). An important consideration in this assessment is biological effectiveness. In addition, for practical considerations, the successful installation and operation of the technology on large cooling water intakes is a prerequisite for passing the initial screening process.

Intake technologies that meet the initial screening criteria noted above include conventional traveling screens with a fish return system, cylindrical wedgewire screens, barrier net (impingement only), aquatic microfiltration barrier (Gunderboom), coarse mesh modified traveling screens with return system (impingement only), fine mesh modified traveling screens with return system, angled screens (impingement only), angled screens, and louvers (impingement only). Further evaluation of each of these technologies for use at Seabrook is provided below.

Due to the effectiveness of the offshore intake at Seabrook, the intake technologies reviewed in this section will be evaluated for use with the existing off-shore intake and not in place of it.

Conventional Traveling Screens with a Fish Return System

The addition of a fish return system for use with the existing conventional traveling screens is a possible option that could provide some reduction in impingement mortality for some of the more hardy species of fish when other intake design and operating conditions are conducive for fish survival. Although conventional traveling screens do not provide the same level of survival of impinged fish as modified screens, they have been shown to provide some level of impingement mortality reduction when operated continuously and combined with a fish return system.

At the Seabrook Station, any fish entering the off-shore intake structures travel down a vertical shaft to a depth of 160-ft. below MSL and then travel 17,000 feet through the intake tunnel to a depth of 240-ft. below MSL. At that point the fish move up a vertical shaft to the intake transition structure at surface level. If the fish are moving at the same velocity as the water, they will travel from 240-ft. below MSL to the surface elevation in approximately 64 seconds. At a depth of 240-ft., the pressure to which the fish are subjected is approximately eight times greater than at the surface. Due to this rapid and large change in pressure, it is unlikely that there will be a high percentage of surviving fish at the location of the intake screens. Therefore, continuous operation of the screens and the addition of a fish return system will provide little reduction in impingement mortality.

In addition to the anticipated low level of effectiveness in reducing impingement mortality, the installation of an effective fish return system at Seabrook would be difficult, if at all feasible. For a fish return system to be effective, careful consideration must be given to the return point of the system. At Seabrook, the only acceptable return point would be back to the Atlantic Ocean, which is over 8,000 feet from the screen house. Although some of the estuaries, tidal creeks, and Hampton Harbor are closer, the effect of the tide on water depth and salinity levels makes these locations unacceptable as a return point for the fish.

Since the addition of the fish return system along with the continuous operation of the screens will provide very little benefit in reducing impingement mortality and no reduction in entrainment, this alternative shall not be given further consideration.

Cylindrical Wedge Wire Screens

Submerged cylindrical wedge wire screens is the rule-specified EPA approved design and construction technology for facilities that draw cooling water from freshwater rivers or streams. These screens have also been successfully used in several lake installations. There are not, however, any full scale installations in the United States employing the use of submerged wedge wire screens for an ocean intake or for a nuclear facility.

If wedge wire screens were added to the existing off-shore intake, a slot width of 0.76 mm and through screen velocity of 0.5 fps should be sufficient to physically exclude 60 to 90 percent of the eggs and larval fish. For a cooling water flow of 475,000 gpm, approximately 18, 96-inch diameter wedgewire T-screens would be required to maintain an intake velocity of 0.5 fps. If slot width were increased to 1.75 mm, the quantity of screens required would be reduced to 12. For the two large facilities that utilize cylindrical wedgewire screens, Eddystone and Campbell, the slot widths are ¼" and ⅜" respectively.

For the 96-inch diameter screen, the minimum required water depth is 16 feet. At the location of the current off-shore intake structures the depth is approximately 60 feet, therefore, water depth is not a limiting factor.

An order of magnitude cost estimate for just the installation of wedge wire screens at the existing off-shore intake structures would be approximately $8 million. This estimate was developed using the guidelines provided in the EPA's Technical Development Document (EPA 2004). This cost is just for the installation of the screens and does not include the cost of an air burst system for the cleaning of the screens. For the Eddystone Station, an air burst system is used, but at Campbell, an air burst system was not installed and operating experience has proven that the air burst system is not necessary. The requirement of an air burst system is dependent on the amount of debris present in the vicinity of the screens and the slot opening for the screens. At Seabrook, it is assumed that an air burst system would be required if screens with small slot openings were used and due to the consequences associated with plugging of the screens. The cost of installing an air burst system at Seabrook could far exceed the cost of the wedge wire screens. For an air bust system, a 12-inch air supply line would be required for each 96-inch diameter screen. With the wedge wire screens located approximately 3.25 miles from the screen house, and using the EPA's estimate of $456 per foot for the installation of 12" diameter stainless steel pipe, the cost to install an air burst system for wedge wire screens at the Seabrook offshore intake could exceed $100 million. If a system could be engineered to move the control valves closer to the screens, the cost of the air burst system could possibly be reduced. However, even optimizing the design to the point where only one 12-inch line was required from the onshore location to the intake location, it is anticipated that the minimum cost would be approximately $24 million.

In addition to the high capital cost for wedge wire screens, the additional O&M costs could range from $50,000 to $200,000 per year, depending on screen mesh utilized and the level of debris loading. The O&M costs reflect additional energy requirements for operation of the air compressors, diving costs for cleaning and maintenance of the screens, and additional labor for maintenance of the compressed air system.

While the installation of wedge wire screens at Seabrook may be technically feasible, the addition of these screens significantly increases the probability of a loss of flow through the cooling water intake system due to plugging of the screens. This probability is increased even more with the use of the screens with the smaller slot openings, since screens with the slot openings discussed here for the physical exclusion of eggs and larvae have not been proven in a high flow application such as Seabrook. The use of such screens would require further review to determine if they would conflict with the Nuclear Regulatory Commission safety requirements and with the reliable operation of the station.

Using the order of magnitude costs developed for this technology option, the annual cost could range from $5 million to $16 million. These annual costs do not include the addition of potential pilot testing costs, lost generation costs due to an extended plant outage, and possible performance penalty costs due to a reduction in cooling water flow. It is anticipated that this annual cost will far exceed any incremental benefit and this option will be eliminated from further consideration. In addition, the operational risks associated with the addition of cylindrical wedge wire screens at this site may not be acceptable.

Barrier Net

Barrier nets have been successfully applied at several large power plants including the Ludington, Karn-Weadock, Chalk Point, and J. R. Whiting facilities. A typical mesh size for a barrier net is 3/8-inch, therefore, they provide impingement protection only.

The barrier net at Seabrook would have to be located around the existing offshore intake structures. This would be a first of a kind installation since all barrier nets currently in use are either located within or at the entrance to a canal or in front of a shoreline intake structure. A barrier net located around the Seabrook offshore intake structures would have a depth of 60 feet and would not have any protection against wave action. Since barrier nets are very susceptible to damage from waves and storm conditions and since they do not provide any reduction in entrainment, this technology would not be suitable for use at the Seabrook Station and will be eliminated from further consideration.

Aquatic Microfiltration Barrier

An aquatic microfiltration barrier system consists of a filter fabric which is installed in the waterbody around the entrance to the intake. The fabric filter is supported by floating booms and extends the full water depth. The openings in the woven fabric are small enough to prevent larval fish and eggs from passing through the fabric and entering the intake. One such system is the Gunderboom Marine Life Exclusion System™ (MLES™).

The microfiltration barrier, as with the barrier net, would have to be located around the existing offshore intake structures. The microfiltration barriers are also very susceptible to damage and failure from waves, storm conditions, and heavy debris loading. In addition, a microfiltration barrier requires an air supply for periodic cleaning of the fabric to remove accumulated debris. Due to these characteristics, a microfiltration barrier is not considered a suitable technology for use at Seabrook and will be eliminated from further consideration.

Modified Traveling Screens

Traveling screens with fish handling modifications and fine mesh overlays to reduce impingement and entrainment can be installed in the existing screenwells. In addition to the new screens, this technology requires a fish return system to transport fish and organisms removed from the screens back to the waterbody. It is anticipated that 1 mm mesh screens would be appropriate for the physical exclusion of a high percentage of eggs and larvae, with the potential of reducing entrainment by 60 to 90 percent. It is anticipated that the fine mesh overlays would be utilized during the normal high entrainment months of April, May, June, and July.

In general, an approach velocity of 0.5 to 1.0 fps is recommended when fish protection is the governing criteria for the design of an intake with traveling water screens (ASCE 1982). This is a general rule and can be adjusted to reflect the swimming capabilities and sensitivity of the fish species present. With a typical open area of approximately 50%, this approach velocity range correlates to a through screen velocity of 1.0 to 2.0 fps. This velocity range is in general agreement with research by R. Ian Fletcher, where he drew the general conclusion that the risk of impingement mortality increased sharply when the through screen velocity increased to the range of 1.6 to 2.6 fps (Fletcher 1994). At Seabrook, the calculated through screen velocities at design flow and mean sea level will be approximately 1.0 fps with coarse mesh screens and 2.5 fps with fine mesh screens. If the three additional intake bays that were constructed for the second generating unit could be incorporated into the cooling water intake system for Unit 1, the velocity would be 1.25 fps for the fine mesh screens.

Based on the same reasons discussed for conventional traveling screens, there would be very little reduction in impingement mortality with the conversion to modified screens.

During the time of the year when the fine mesh panels would be in place, there would be a reduction in entrainment. There are several factors, however, that make the feasibility of utilizing fine mesh screens at Seabrook questionable. The primary factor is the through screen velocity. With only three screens, the estimated through screen velocity of 2.5 fps is significantly higher that the normal design velocity of 1.0 fps. This velocity may be acceptable for screen operation, but the survival of any organisms impinged on the screens may be low. In addition, the fine mesh screens will plug with debris much faster than the coarse mesh screens and with a 50 percent clean screen it is estimated that the head loss across the screen would increase to approximately 9 inches, which would be acceptable, but high. Therefore, if fine mesh screen were to be applied at Seabrook, it is likely that additional screens would be required. One possible scenario for the addition of screens would be the use of the three screen wells installed for Unit 2. The feasibility of this option has not been investigated and would require additional investigation.

In addition to the technical issues of high through screen velocities and the feasibility of adding more screens, the fish return system would also present some formidable challenges as discussed under Conventional Traveling Screens. Due to the tendency for fine mesh screens to plug with debris much faster than coarse mesh screens, the probability of a trip of the circulating water system due to high screen differential increases. This is a safety consideration that could eliminate fine mesh screens from further consideration.

Should it be possible to utilize the Unit 2 intake structure, it is estimated that the minimum cost for the installation of six new modified screens with a fish return system would be approximately $9.5 million. With an incremental operation and maintenance cost of $220,000 per year, the total annual cost for the option would be $1.6 million.

Due to their potential effect on the circulating water system reliability, the technical difficulties associated with an extremely long return system, and small incremental benefit as compared to high cost, modified fine mesh screens will be eliminated from further consideration.

Angled Screens

With respect to impingement, coarse mesh angled screens have shown potential for impingement mortality reduction. At both the Brayton Point Unit 4 and the Oswego Steam Station Unit 6, installations of angled screens, high diversion capability and impingement mitigation effectiveness was demonstrated. Once diverted to the collection point, it is necessary to either lift or pump the fish back to an appropriate location in the waterbody.

The installation of angled screens at Seabrook would require the construction of a new screening structure. The existing intake structure could not be retrofitted for angled screens. Due to the need for the new intake structure and the need for a fish return system with a pump, the cost to install angled screens at Seabrook would be significantly greater than the cost of installing modified traveling screens with a fish return system. In addition, as is the case with the conventional and modified traveling screens with a fish return system, due to the pressure changes the fish will experience prior to reaching the screens, it is anticipated that fish survival prior to reaching the screens will be low. Since the angled screens would be higher cost than modified traveling screens, would only address impingement, and will provide little reduction in impingement mortality, there is no justification for further consideration of angled screens at Seabrook.

Louvers

Louvers consist of a series of panels that are placed across a channel at an angle to the flow. Each panel has a series of evenly spaced vertical rectangular bars that are set with the long side perpendicular to the flow. The panels are placed at an angle of approximately 15 to 20 degrees to the flow and lead to a collection and return system at the end of the panels. The positioning of the bars perpendicular to the flow causes an abrupt change in the flow direction and velocity, which the fish sense and have a tendency to try and avoid. As the fish attempt to swim away from this area where the change in velocity and direction occurs, they move with the current along the face of the louvers toward the point of collection and return. At this location the fish are pumped back to a suitable return point.

Louver systems can be effective in diverting fish to the return system and reducing impingement on the screens. They have been used successfully at several hydroelectric and irrigation facilities in the northwest and northeast and have been applied at one cooling water intake for a nuclear facility in California. Studies have shown that the effectiveness of louvers is very species and life-stage specific due to the technology's dependency on the swimming capability and behavior of the target species. Prior to the implementation of a louver system, studies would be required to evaluate the effectiveness for the target species and to determine the most effective angle of orientation, approach and bypass velocities, bar spacing, and other design characteristics for the site-specific hydraulic conditions.

Due to the use of the offshore intake at Seabrook, louvers, which must be installed at a location before the intake, cannot be applied and are not considered a viable option for further consideration.

Flow Reduction

Flow reduction is one method of decreasing impingement and entrainment. Flow reduction can be achieved by removing one circulating pump from service, recirculating water from the discharge back to the intake, or installing variable speed drives.

The potential effects of reducing the circulating water flow are increased turbine backpressure, an increase in circulating water differential temperature, and an increase in circulating water discharge temperature. With the increase in turbine backpressure, comes a reduction in turbine capability and performance.

Seabrook Station currently employs recirculation during the months when the water temperature is low enough. The average recirculation flow for the previous five years has been approximately 47 MGD. This accounts for an overall reduction of 7.3% of the average intake flow.

A previous study has been performed at Seabrook to determine the benefits of flow reduction by periodic operation of two circulating water pumps instead of three. From this analysis, it was determined that an annual flow reduction of 4.3% could be achieved. To achieve this flow reduction it was also necessary to increase the maximum allowable circulating water differential temperature by 5 °F. Under this operating scenario there was not any recirculation of cooling water discharge. Two cooling water pumps was eliminated from consideration due to the increased potential for plant equipment damage if one of the two operating pumps were to trip.

As noted previously, as an alternate source of cooling water for the service water system, a cooling tower was installed to provide shutdown cooling in the event the intake and/or discharge tunnels are blocked due to a seismic event. With a normal service water flow of 23,000 gpm, the potential continuous use of the cooling tower could reduce cooling water intake flow by the full service water flow. This option was investigated and it was determined that it is not practicable to operate the cooling tower on a continuous basis due to the NRC requirements associated with the cooling towers and the significant impact the additional makeup water would have on the Town of Seabrook municipal water supply. In general, the cooling tower is safety related and is strictly controlled by the NRC Operating License Technical Specifications. With continuous operation of the cooling tower it would be extremely difficult, if not impossible, to maintain the cooling tower basin water requirements associated with level and temperature. In addition, the requirement for makeup water, which is supplied by the Town of Seabrook municipal water supply, could increase from a current normal supply of 2 to 4 million gallons per month to 17 million gallons per month. Due to the current water conservation requirements and the low well level concerns that are created when water usage increases to 8 to 10 million gallons per month during refueling outages, it is anticipated that a significant increase in makeup water requirements would create supply problems for the Town of Seabrook.

The use of variable frequency drives (VFD's) for the circulating water pump motors provides the ability to alter the speed of the pumps and therefore, the flow of each pump. The use of VFD's provides more flexibility in the reduction of flow than reducing the number of pumps in operation due to the ability to operate at all flows above the minimum operating threshold. As noted earlier for two pump operation, any reduction in flow will create a higher temperature differential in the circulating water, therefore, one of the limiting factors for flow reduction is the temperature differential limit in the current NPDES Permit. Further study is required to determine if flow reduction with VFD's can achieve a greater flow reduction that is currently obtained with recirculation. An estimated capital cost for the addition of VFD's for the three circulating water pumps at Seabrook is $700,000. This cost was developed in accordance with the guidelines provided in the EPA 2002 Technical Development Document (EPA 2002). The costs presented here also assume that no major modifications are necessary for the pumps, the power supply or controls, and the equipment foundations. This cost will also increase significantly if the motors do not have an appropriate class of insulation or if adequate space is not available in the vicinity of the pumps for the VFD equipment.

Based on the results of the previous flow reduction study and the review of continuous use of the cooling tower, it is apparent that the potential for flow reduction beyond what is currently being achieved with recirculation, is low. However, should the current technologies and operational measures not meet the required performance standards, the potential use of flow reduction and VFD's would be investigated in the CDS.

Proposed Technologies and Operational Measures for Further Study

As a result of the screening study and the evaluation of the potential technologies and operational measures, no additional technologies or operational measures were identified for further evaluation in the CDS.

Appendix Table D-1. Evaluation of Fish Protection Technologies and Operational Measures.

Technology	Proven Effectiveness		Full Scale Power Plant CWIS Installation	Comments (EPRI 1999, EPA 2004)	Potential Impingement & Entrainment Reduction Technology for Seabrook
	Impingement Mortality Reduction	Entrainment Reduction			
Physical Barriers					
Conventional Traveling Screens - ⅜" Mesh	No	No	Yes – Most common of all intake screening technologies	No entrainment protection beyond baseline. If rotated continuously and with a return system, some reduction in impingement mortality will be realized. Impingement mortality will be high, except for some of the hardiest species of fish. Capable of meeting impingement mortality performance standard if velocity through the screen can be reduced to 0.5 FPS or less. [§ 125.94(a)(1)(ii)]	No - Entrainment Yes - Impingement only with continuous operation and the addition of a fish return system. Station currently has conventional traveling screens with ⅜" mesh in place. It is the current opinion that fish mortality occurs prior to impingement on screens, therefore, continuous operation with a fish return system would provide a very small reduction in impingement mortality.
Stationary Screens	No	No	Yes - Brunswick Plant –	At Brunswick Plant the screens are installed in a diversion structure at mouth of intake canal. Effective in blocking juvenile and adult menhaden, spot, and croaker at Brunswick. Screen mesh is unknown. No other proven installations.	No. No reduction of impingement mortality or entrainment.
Drum Screens	No	No	No	Used primarily at hydroelectric and irrigation facilities. No proven effectiveness in reduction of impingement mortality of entrainment. More effective version is the angled drum screen.	No. No reduction of impingement mortality or entrainment.
Cylindrical Wedge-wire Screens	Yes	Yes	Yes – Eddystone (¼" slot), J.H. Campbell (⅜" slot)	EPA approved technology when installed in freshwater river or stream with adequate counter currents, appropriate slot size to reduce entrainment, and velocity at 0.5 FPS or less.	Yes Installation of screens with appropriate slot widths should reduce impingement mortality and entrainment.
Barrier Nets	Yes	No	Yes – J.P. Pullman (6 mm mesh), J.R. Whiting (⅜" mesh), Bowline (0.95 cm mesh)	Successfully applied at several power plants to reduce impingement. Mesh size is site specific and must be such that it prevents passage of fish but does not cause fish to become gilled in the net. Impingement reductions between 85 and 99 percent have been realized.	Yes – Impingement Only Barrier nets are effective in reducing impingement mortality but provide no reduction of entrainment. Typically used with a shoreline intake or intake canal.

Appendix Table D-1. (Continued)

Technology	Proven Effectiveness		Full Scale Power Plant CWIS Installation	Comments (EPRI 1999, EPA 2004)	Potential Impingement & Entrainment Reduction Technology for Seabrook
	Impingement Mortality Reduction	Entrainment Reduction			
Aquatic Microfiltration Barriers (Gunderboom)	Yes	Yes	Yes – Lovett Gen. Station.	Technology has shown promise for impingement and entrainment reduction. Design and operational problems at only large scale installation. EPA indicates that the technology is still "experimental in nature".	Yes Installation of a Microfiltration Barrier could reduce IM&E. The few existing installations have been with a shoreline intake.
Porous Dike	Yes – laboratory and small scale testing only	No	No	No full scale installations for cooling water intakes. All studies were performed in laboratories or were small scale studies.	No Unproven technology
Artificial Filter Bed	Yes	Yes	No	Some small scale use only. Reliability problems even at small scale.	No Unproven technology
Rotary Disc Screens	No	No	No	For low flow applications with relatively constant water levels. Not appropriate for CWIS application	No Unproven technology
Collection Systems					
Modified Traveling Screens with Return System (Coarse Mesh)	Yes	No	Yes – Salem, Mystic, Indian Point, Roseton, Surry, Arthur Kill, Dunkirk, Kintigh, Calvert Cliffs, and Huntley.	Installed on many cooling water intakes. Where tested, impingement mortality has been significantly reduced for the majority of species. Mortality can be high for some of the more fragile species. Available in either through flow or dual flow configuration.	Yes – Impingement Only Provide reduction in impingement mortality but no reduction of entrainment. It is the current opinion that fish mortality occurs prior to impingement on screens, therefore, modified screens with a fish return system would provide a very small reduction in impingement mortality.
Modified Traveling Screens with Return System (Fine Mesh)	Yes	Yes	Yes – Very Limited.	Seasonal use of 0.5 mm mesh screens at Big Bend Power Station with good latent survival of drums and bay anchovy eggs and larvae. Some other pilot tests, but very limited data. High maintenance to avoid biofouling and clogging	Yes Installation of screens with fine mesh should reduce IM&E. It is the current opinion that fish mortality occurs prior to impingement on screens, therefore, continuous operation with a fish return system would provide a very small reduction in impingement mortality.

Appendix Table D-1. (Continued)

Technology	Proven Effectiveness		Full Scale Power Plant CWIS Installation	Comments (EPRI 1999, EPA 2004)	Potential Impingement & Entrainment Reduction Technology for Seabrook
	Impingement Mortality Reduction	Entrainment Reduction			
Diversion Systems					
Angled Screens	Yes	No	Yes – Brayton Point and Oswego Steam Station	Have shown potential to meet impingement standard. Large bypass flow and fish pump are required. Higher cost than modified traveling screens with return system.	Yes – Impingement Only Potential reduction in impingement mortality but no reduction of entrainment. It is the current opinion that fish mortality occurs prior to impingement on screens, therefore, modifying the intake with angled screens would provide a very small reduction in impingement mortality.
Modular Inclined Screens	Yes – Laboratory and pilot tests only	No	No	Laboratory test showed diversion efficiency between 47 and 88 percent for most species. Only one pilot test at a hydroelectric facility that also showed high diversion and survival rates.	No No proven full scale installation
Angled Drum Screens	Yes – Juvenile salmonids at hydro & irrigation facilities	No	No	Used at hydroelectric and irrigation facilities. Never applied to a generating station CWIS. Require relatively constant submergence	No No proven full scale installation
Louvers	Yes – for juvenile and adult fish	No	Yes – San Onofre – no effectiveness data	Successfully applied at several hydroelectric and irrigation facilities. Diversion efficiency is very species, life stage, and site specific.	Yes – Impingement Only Potential reduction in impingement mortality but no reduction of entrainment.
Behavioral Systems					
Strobe Light	Yes – on some species	No	No – only installations for testing.	Testing has been inconclusive and any results have been species specific.	No No reduction of entrainment and unproven technology for species of concern at Seabrook.
Sound Barriers	Yes – on some species	No	Yes	Some demonstration studies have been successful in reducing alewife impingement. Site specific design is required for targeted species.	No No reduction of entrainment and unproven technology for species of concern at Seabrook.

Appendix Table D-1. (Continued)

Technology	Proven Effectiveness: Impingement Mortality Reduction	Proven Effectiveness: Entrainment Reduction	Full Scale Power Plant CWIS Installation	Comments (EPRI 1999, EPA 2004)	Potential Impingement & Entrainment Reduction Technology for Seabrook
Air Bubble Curtains	No	No	No – no permanent installations	Conclusions from past studies are that this technology is ineffective.	No No reduction of entrainment and unproven technology for impingement reduction.
Other Technology					
Flow Reduction	Yes	Yes	Yes	Level of flow reduction must be determined from effect on turbine performance and discharge temperature limitations. Percent entrainment reduction is approximately equal to percent flow reduction. Impingement can be reduced with a reduction in flow or performance standards can be satisfied by reducing through screen velocity to less than 0.5 FPS.	Yes Flow reduction will reduce IM&E. Potential level of flow reduction should be evaluated.
Closed Loop Cooling	Yes	Yes	Yes	90 percent or greater reduction in intake flow	Yes
Intake Location	Yes	Yes	Yes	Intake can be located to an area of decreased biological productivity. Offshore intakes can be located in these areas of reduced biological productivity and achieve reduced levels of impingement and entrainment from baseline conditions.	Yes An off-shore intake is currently in use at Seabrook.
Velocity Cap	Yes	No	Yes – El Segundo, Redondo Beach, San Onofre, Huntington Beach, Edgewater, and Seabrook	Used to create a horizontal flow at off-shore intake. Fish tend to avoid this rapid change in horizontal flow. Effectiveness has exceeded 90 percent on West Coast offshore intakes. Appropriate velocity is species specific, therefore, site specific testing is required. Not effective on eggs, larvae, and early life stage fish.	Yes – Impingement only A velocity cap is currently installed at Seabrook.

APPENDIX E

Quality Control and Quality Assurance Methods for the Seabrook Station Environmental Monitoring Program

SECTION VA
PLANKTON SAMPLE PROCESSING

1.0 INTRODUCTION

The Plankton Department analyzes several types of samples taken for the Seabrook Environmental Studies (Appendix IIA,Table 2.0-1). For the most part, procedures described in the Technical Procedures Manual (TPM), No. 14, Section VI, are applicable to the processing of Seabrook Environmental Studies samples. Any deviations from these procedures specific to the Seabrook Environmental Study are described in the following sections.

2.0 SAMPLE PROCESSING

Refer to Section VI,2.0 of the TPM, No. 14, for sample processing procedures.

2.1 MACROZOO-ICHTHYOPLANKTON SAMPLES

Macrozoo-ichthyoplankton samples collected four times per month at Seabrook Stations P2, and P7 will be analyzed according to the following schedule: Ichthyoplankton will be analyzed from one of the two tows at each station (tow A); macrozooplankton will be analyzed from one of the two tows (tow A) at each station for sample periods one and three when samples have been collected in all four weeks of the month. Samples not analyzed will be archived. Procedures described in the TPM, No. 14, Section VI,2.1 shall apply to the processing of Seabrook Environmental Studies macrozoo-ichthyoplankton samples. Ichthyoplankton entrainment samples are collected with a mesh size of 0.333 mm during four sample events per month. Each sampling event consists of four replicates of a duration of about 2 hours and a sample volume of 100 m^3 representing each of the six hour diel periods (night: 2215-0415; morning: 0415-1015; day: 1015-1615; evening 1615-215). These samples will be analyzed using the same procedures as described for ichthyoplankton samples.

Exceptions/Cautions:

1. Ichthyoplankton will be identified to the lowest practical taxon. Larvae include entire specimens, heads and bodies of fish larvae. In filling larval quotas, only entire specimens and heads will be counted.
2. The minimum count criteria for ichthyoplankton analyses are as follows:
    a. Samples will be split so that a minimum of 200 eggs and 100 larvae (total of all species) are removed, not necessarily from the same size split.
    b. A maximum of approximately 400 ml settled plankton volume will be examined, regardless of whether the criteria in 2a are met, using a Folsom plankton splitter to obtain an aliquot in which the settled plankton volume is between 200 and 400 ml.
3. Fish eggs will not be staged.
4. Lengths of all measurable fish larvae, up to a maximum of 20 per sample, will be measured from two samples per station per sampling period for the following species: American sand lance (*Ammodytes americanus*), Atlantic herring (*Clupea harengus*), Atlantic cod (*Gadus morhua*), yellowtail flounder (*Limanda ferruginea*), pollack

(*Pollachius virens*), winter flounder (*Pseudopleuronectes americanus*), Atlantic mackerel *(Scomber scombrus*), cunner (*Tautogolabrus adspersus*), and hake (*Urophycis* sp.). Lengths measured will be notochord length (or standard length if the hypurals are fully formed) to the nearest 0.5 mm. Variation is determined by dividing the third highest of the 20 lengths by the third lowest. If the variation among lengths for a species in a sample exceeds 2.0, an additional 10 larvae of that species (if present) will be measured from that sample.

5. Macrozooplankton will be identified to the lowest taxonomic level listed in Table VA,2.1-1 for each taxonomic group. Fourteen copepod taxa (designated by * in Table VA,2.1-1) will be enumerated from the Stempel pipette subsamples (TPM, No. 14, Section VI,2.1.1), seven other copepod taxa (** in Table VA,2.1-1) will be enumerated from the Folsom splitter aliquots along with the other macrozooplankters (TPM, No. 14, Section VI,2.1.3). When hydrozoans appear in high densities, preventing an even distribution of copepods, the sample will be split into aliquots using the Folsom splitter. One hydrozoan taxon (*** in Table VA,2.1-1) will be noted as present but not enumerated from the folsom splitter aliquots along with the other macrozooplankters (TPM, No. 14, Section VI,2.1.3).

6. *Calanus finmarchicus, Cancer* species, *Crangon septemspinosa, Neomysis americana* and *Carcinus maenas* will be staged in all samples, using the stages listed in Table VA,2.1-1. Other macrozooplankton taxa will not be staged.

7. The volume of water filtered by the 1.0-m diameter macrozoo-ichthyoplankton net will be calculated using 0.785 m^2 as the net mouth area.

8. Data coding specifications for the Copepod and Macrozooplankton Analysis Data Sheet (Figure VA,2.1-1) are listed in Table VA,2.1-2. Data coding specifications for the Ichthyoplankton Egg Data Sheet and Ichthyoplankton Larval Data Sheet (Figure VA,2.1-2 and Figure VA,2.1-3, respectively), are listed in Table VA,2.1-3. Data coding specifications for the Ichthyoplankton Entrainment Egg Data Sheet and Ichthyoplankton Entrainment Larval Data Sheet (Figure VA, 2.1-4 and Figure VA, 2.1-5, respectively), are listed in Table VA, 2.1-4.

9. For the copepod analysis a minimum of 150 total copepods and a minimum of 30 of the most abundant species will be counted.

10. For macrozooplankton analysis approximately 30 organisms per taxon will be counted with the following exceptions.

    a. A minimum of 30 organisms will be counted for the dominant taxon.

    b. A maximum of 1/4 of the sample will be examined for macrozooplankton. Process 1/2 or the total sample, depending on time constraints, if the sample contains an unusually low number of organisms.

    c. If the settled plankton volume of a sample is greater than approximately 400 ml, then the sample will be split, using a Folsom plankton splitter, to obtain an aliquot in which the settled plankton volume is between 200 and 400 ml. A maximum of 1/4 of this aliquot will be analyzed for macrozooplankton.

    d. Enumeration of small rare organisms in a dense sample may be terminated at the discretion of an experienced taxonomist. The terminating aliquot will be determined based on the taxonomist's ability to reasonably expect to locate all of the rare organisms in the aliquot. The taxa subject to the cutoff may vary seasonally and spatially and will be designated on a sample-by-sample basis.

e. Enumeration of the lifestages of a species will be terminated when the count of the dominant lifestage of that species is approximately 30.

2.4 BIVALVE LARVAE SAMPLES

Duplicate bivalve larvae samples are collected by plankton tows at Seabrook Plankton Stations P2, P7 and Estuarine Station P1; and by a barrel sampling device at the intake forebay at the Seabrook Station (entrainment samples). Sampling frequency is once per week, commencing the third week of April through the end of October. All samples will be analyzed for all bivalve taxa. Procedures described in the TPM, No. 14, Section VI 2.4, shall apply to the processing of Seabrook Environmental Studies bivalve larvae samples. Bivalve larvae entrainment samples will be analyzed using the same procedures as described for bivalve larvae samples from plankton tows.

Exceptions/Cautions:

1. Data coding specifications for the Bivalve Larvae Analysis Data Sheet (Figure VA,2.4-1) are listed in Table VA,2.4-1.

2. The volume of water filtered by the 0.5-m diameter bivalve larvae net will be calculated using 0.196 m^2 as the net mouth area, and will be both low-speed and high-speed calibration data (refer to TPM No. 14, Section VI,4.1, Step 6(b)).

3. Straight-hinge larvae will not be counted.

4. Only the following taxa will be identified separately; all other taxa present will be enumerated as Bivalvia:

Heteranomia squamula	*Mytilus edulis*
Hiatella sp.	*Placopecten magellanicus*
Macoma balthica	Solenidae
Modiolus modiolus	*Spisula solidissima*
Mya arenaria	*Teredo navalis*
Mya truncata	

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ICHTHYOPLANKTON - EGG

Analyzed By: ______________________ Date: __________

PROJECT	METHOD	SAMPLE PERIOD	DATE	STATION	REP	SAMPLE CONTROL No.
	I E					

SCALING RATIO	SPLIT FOR VOLUME
0	

SPECIES NAME	SPECIES CODE	LIFE STAGES	COND.	COUNT/PCNT
Empty Sample	1		E	
Windowpane flounder	2 8 1 2 0 1			
Atlantic Menhaden	5 2 0 2 0 4			
Four-beard rockling	7 7 0 5 0 1			
Atlantic Cod	7 7 0 6 0 2			
Silver hake	7 7 0 9 0 1			
Pollock	7 7 1 2 0 1			
Hake species	7 7 1 5 0 0			
Tautog	9 5 1 0 0 1			
Cunner	9 5 1 1 0 1			
Witch Flounder	1 3 7 0 4 0 1			
Plaice	1 3 7 0 5 0 2			
Yellowtail flounder	1 3 7 1 0 0 2			
Atlantic Mackerel	1 5 7 0 6 0 2			
Pleuronectidae/Labridae	9 9 9 0 0 0 1			
Cod/Haddock	9 9 9 0 0 0 2			
Cod/Haddock/Witch	9 9 9 0 0 1 0			
Rockling/Hake	9 9 9 0 0 1 2			
Osteichthyes	2 0 0 0 0 0 0			

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Figure VA, 2.1-2. Icthyoplankton Egg.

ICHTHYOPLANKTON LARVAE

Page 1 Of 1

Analyzed By: ______________________ **Date:** ____________

PROJECT	METHOD	SAMPLE PERIOD	DATE	STATION	REP	SAMPLE CONTROL No.
	I L					

SCALING RATIO	SPLIT FOR VOLUME
0	

SPECIES NAME	SPECIES CODE	LIFE STAGES	COND	COUNT	LENGTH
Empty Sample	1		E		
Alligator fish	3,0,4,0,2		X		
American eel	1,1,0,1,0,1		X		
Windowpane flounder	2,8,1,2,0,1		X		
Grubby sculpin	5,6,2,5,0,1		X		
Longhorn sculpin	5,6,2,5,0,4		X		
Shorthorn sculpin	5,6,2,5,0,8		X		
Lumpfish	5,8,0,5,0,1		X		
Seasnail (L. atlanticus)	5,8,0,7,0,1		X		
Gulf seasnail (L. coheni)	5,8,0,7,1,0		X		
Four-beard rockling	7,7,0,5,0,1		X		
Silver hake	7,7,0,9,0,1		X		
Smelt	1,2,7,0,4,0,1		X		
Rock gunnell	1,3,6,0,2,0,5		X		
Witch Flounder	1,3,7,0,4,0,1		X		
Plaice	1,3,7,0,5,0,2		X		
Redfish	1,5,9,0,6,0,0		X		
Radiated shanny (Ulvaria)	1,6,9,1,8,0,1		X		
Osteichthyes	2,0,0,0,0,0,0		X		

Figure VA,2.1-3. Ichthyoplankton Larvae.

TABLE VA,2.1-3. DATA CODING SPECIFICATIONS

YEAR: * PROJECT NAME: Seabrook DATA TYPE: Ichthyoplankton
MAJOR: * LABOR ACTIVITY: 261 CODING FORM: PL-1 (Eggs), PL-3 (Larvae)

FIELD	PRECODED	BLANK	CODED	ACCEPTABLE CODES	COMMENTS
Project			x	Integers	Seabrook Laboratory current year project number
Method (Ichthyoplankton only)			x	IE, IL	Ichthyoplankton eggs, Ichthyo-plankton Larvae (oblique, 1-m net, 505 µm mesh)
Sample Period Date			x	01-48 Integers	4 times per month Month/Day/Year
Station (Ichthyoplankton only			x	P2, P7	Seabrook Plankton Stations
Replicate (Ichthyoplankton only)			x	Integers	Only A is processed; B is a contingency replicate
Sample Control No.			x	Integers	NAI Sample Control Number
Scaling Ratio			x		Reciprocal of fraction analyzed (first split sorted), in tenths (if ⅛ of sample is analyzed then split sorted=8.0). Repeat for last split sorted. If no additional splits are sorted, draw a line through last split sorted box. Scaling ratio=first split sorted (if last split sorted is blank) or scaling ratio=1/2 last split sorted (if more than one split was sorted).
Split for volume			x	1, blank	1 = sample split for volume due to large amount of sample quotas not filled, scaling ration ≠ 1.0 blank = sample processed in the normal way.

TABLE VA,2.1-3. DATA CODING SPECIFICATIONS (Continued)

YEAR: * PROJECT NAME: Seabrook DATA TYPE: Ichthyoplankton
MAJOR: * LABOR ACTIVITY: 261 CODING FORM: PL-1 (Eggs), PL-3 (Larvae)

FIELD	PRECODED	BLANK	CODED	ACCEPTABLE CODES	COMMENTS
Species			x	Alphabetic	For QC purposes, not keypunched
Species Code			x	Integers	NNAS Code
Lifestage					E = no eggs, V = void sample
Condition (eggs only)			x	E, V	
Condition (larvae only)			x	E, V, D, X	E = no larvae, V = void sample, D = no length due to damage, X = no length for other reason (>30 in sample, or lengths not required for this species or sample)
Count			x		Blank if condition = V
Length (larvae only)			x		SL in tenths of millimeters (e.g., 5.6 mm = 56) for selected species only, blank if condition = V, E, D or X

*Refer to current year project code as specified by project management.

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ENTRAINMENT ICHTHYOPLANKTON - EGG

Analyzed By: ______________ Date: ______________

PROJECT	METHOD	SAMPLE PERIOD	DATE	STATION	REP	SAMPLE CONTROL No.
	E E					

SCALING RATIO	SPLIT FOR VOLUME
.0	

SPECIES NAME	SPECIES CODE	LIFE STAGES	COND.	COUNT/PCNT
Empty Sample	1		E	
Windowpane flounder	281201			
Atlantic Menhaden	520204			
Four-beard rockling	770501			
Atlantic Cod	770602			
Silver hake	770901			
Pollock	771201			
Hake species	771500			
Tautog	951001			
Cunner	951101			
Witch Flounder	1370401			
Plaice	1370502			
Yellowtail flounder	1371002			
Atlantic Mackerel	1570602			
Labridae/Limanda	9990001			
Cod/Haddock	9990002			
Cod/Haddock/Witch	9990010			
Rockling/Hake	9990012			
Osteichthyes	2000000			

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Figure VA, 2.1-4.

ENTRAINMENT ICHTHYOPLANKTON LARVAE

Page 1 Of 1

Analyzed By: ______________ Date: ______________

PROJECT	METHOD	SAMPLE PERIOD	DATE	STATION	REP	SAMPLE CONTROL No.
	E L					

SCALING RATIO	SPLIT FOR VOLUME
0	

SPECIES NAME	SPECIES CODE	LIFE STAGES	COND	COUNT	LENGTH
Empty Sample	1		E		
Alligator fish	3 0 4 0 2		X		
American eel	1 1 0 1 0 1		X		
Windowpane flounder	2 8 1 2 0 1		X		
Grubby sculpin	5 6 2 5 0 1		X		
Longhorn sculpin	5 6 2 5 0 4		X		
Shorthorn sculpin	5 6 2 5 0 8		X		
Lumpfish	5 8 0 5 0 1		X		
Seasnail (L. atlanticus)	5 8 0 7 0 1		X		
Gulf seasnail (L. coheni)	5 8 0 7 1 0		X		
Four-beard rockling	7 7 0 5 0 1		X		
Silver hake	7 7 0 9 0 1		X		
Smelt	1 2 7 0 4 0 1		X		
Rock gunnell	1 3 6 0 2 0 5		X		
Witch Flounder	1 3 7 0 4 0 1		X		
Plaice	1 3 7 0 5 0 2		X		
Redfish	1 5 9 0 6 0 0		X		
Radiated shanny (Ulvaria)	1 6 9 1 8 0 1		X		
Osteichthyes	2 0 0 0 0 0 0		X		

Figure VA, 2.1-5.

TABLE VA,2.1-4. DATA CODING SPECIFICATIONS

YEAR: * PROJECT NAME: Seabrook DATA TYPE: Entrainment Ichthyoplankton
MAJOR: * LABOR ACTIVITY: 521 CODING FORM: PL-1 (Eggs), PL-3 (Larvae)

FIELD	PRECODED	BLANK	CODED	ACCEPTABLE CODES	COMMENTS
Project				Integers	Seabrook Laboratory current year project number
Method				EE EL	Entrainment eggs, Entrainment Larvae
Mesh		x			Oblique, 1-m net, 505 µm mesh; 333 µm mesh
Sample Period			x	01-48	4 times per month
Date			x	Integers	Month/Day/Year
Station			x	EL	
Replicate			x	1,2,3,4	
Sample Control No.			x	Integers	NAI Sample Control Number
Scaling Ratio			x		Reciprocal of fraction analyzed (first split sorted), in tenths (if ⅛ of sample is analyzed then split sorted=8.0). Repeat for last split sorted. If no additional splits are sorted, draw a line through last split sorted box. Scaling ratio=first split sorted (if last split sorted is blank) or scaling ratio=1/2 last split sorted (if more than one split was sorted).
Split for Volume			x	1, blank	1 = sample split for volume due to large amount of sample quotas not filled, scaling ration ≠ 1.0 blank = sample processed in the normal way.

TABLE VA,2.1-4. DATA CODING SPECIFICATIONS (continued)

YEAR: * PROJECT NAME: Seabrook DATA TYPE: Entrainment Ichthyoplankton
MAJOR: * LABOR ACTIVITY: 521 CODING FORM: PL-1 (Eggs), PL-3 (Larvae)

FIELD	PRECODED	BLANK	CODED	ACCEPTABLE CODES	COMMENTS
Species			x	Alphabetic	For QC purposes, not keypunched
Species Code			x	Integers	NNAS Code
Lifestage					
Condition (eggs only)			x	E,V	E = no eggs, V = void sample
Condition (larvae only)			x	E,V,D,X	E = no larvae, V = void sample, D = no length due to damage, X = no length for other reason (>30 in sample, or lengths not required for this species or sample)
Count			x		Blank if condition = V
Length (larvae only)			x		SL in tenths of millimeters (e.g., 5.6 mm = 56) for selected species only, blank if condition = V, E, D or X

*Refer to current year project code as specified by project management.

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BIVALVE LARVAE

Analyzed By: ____________________ Project: ______________ Page 1 Of 1
Analyzed On: ____________________ Time: ______________

PROJECT	METHOD	SAMPLE PERIOD	DATE	PHOTO PERIOD	TIDE	STATION	DEPTH CODE	DEPTH	REP
	B L					P			

SAMPLE CONTROL No.	TIME	FIELD VOLUME	SUB-SAMPLE	No. OF SUBSAMPLES	TYPE
			OF		A

	SPECIES NAME	SCALING RATIO	SPECIES CODE	LIFE STAGES	COND.	COUNT/PCNT
1/2	Heteranomia squamula		0,0,0,0,1,9,3			
	Bivalvia		0,0,0,1,2,0,2			
	Hiatella sp.		0,0,0,0,2,0,7			
1/16	Macoma Balthica		0,0,0,5,2,1,3			
	Modiolus modiolus		0,0,0,0,1,8,6			
	Mya arenaria		0,0,0,0,2,0,5			
	Mya truncata		0,0,0,0,2,0,6			
1/128	Mytilus edulis		0,0,0,0,1,8,3			
	Placopecten magellanicus		0,0,0,0,1,9,2			
	Solenidae		9,0,1,7,0,0,1			
	Spisula solidissima		0,0,0,0,2,0,0			
1/1024	Teredo navalis		0,0,0,4,5,9,9			

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Figure VA,2.4-1.

TABLE VA,2.4-1. DATA CODING SPECIFICATIONS

Bivalve Larvae and Bivalve
YEAR: * PROJECT NAME: Seabrook DATA TYPE: Larvae Entrainment

MAJOR: * LABOR ACTIVITY: 264/573 CODING FORM: PL-1

FIELD	PRECODED	BLANK	CODED	ACCEPTABLE CODES	COMMENTS
Project			x	Integers	Seabrook Laboratory current year project number
Method	x			BL	Bivalve larvae tows
Sample Period			x	01-29	Weekly Apr-Oct
Date			x	Integers	Month/Day/Year
Photoperiod		x			
Tide		x			
Station			x	P2,P7, PE	Bivalve larvae tows Entrainment samples
Depth Code			x	3,6	3=oblique, 6=vertical
Depth		x			
Replicate			x	A,B	
Sample Control			x	Integers	NAI Sample Control Number
No.		x			
Time		x			
Field Volume		x			Two aliquots are analyzed (one, if densities are low), but not coded separately
Subsample					
		x			
# of Subsamples	x			A	All taxa
Type					

*Refer to current year project code as specified by project management.

SECTION I
SAMPLE AND DATA MANAGEMENT SYSTEMS

2.0 SAMPLE AND DATA MANAGEMENT SYSTEMS

2.1 SAMPLE MANAGEMENT SYSTEM

The Biological Laboratory sample management system consists of three phases: 1) receiving of samples as they are delivered from the field; 2) storage of samples prior to, during and immediately after analysis; and 3) archiving of completed samples for a time period specified by the client. The objective of this system is to track a sample through all phases of its processing in order to facilitate efficient analysis of the sample, quality control and budgetary tracking.

2.1.1 Receiving of Samples

1. Samples are delivered with a completed and signed "Field Card/Sample Submittal Form" (Figure I,2.1-1).
2. Person receiving samples acknowledges reception of samples on submittal form after checking and approving:
   a. That the submittal form is completely filled out.
   b. That all samples listed have been received.
   c. That the condition of the samples (including preservation, if appropriate) is satisfactory.
   d. That all samples are properly labeled.
3. If the condition of one or more of the samples is unsatisfactory, the project manager is to be notified and a replacement taken as soon as possible.
4. A photocopy of the submittal form is made and filed in the generators file.
5. When a sample or portion of sample is transferred to another department it must be accompanied by the original of the submittal form.
6. The sample information is logged in the appropriate departmental log.

SECTION VI
PLANKTON SAMPLE PROCESSING

1.0 INTRODUCTION

The Plankton Department routinely analyzes samples from marine, estuarine, and fresh waters. Generally, five categories of samples are processed: 1) Macrozoo-Ichthyoplankton (including epibenthic macrozooplankton); 2) Microzooplankton; 3) Whole Water Phytoplankton; 4) Bivalve Larvae; and 5) Neuston. Macrozoo-ichthyoplankton sample analysis is further separated into three phases: 1) Copepods; 2) Ichthyoplankton and 3) Macrozooplankton. Neuston samples are separately analyzed for lobster larvae and ichthyoneuston. The procedures for these analyses are found in this section.

2.0 SAMPLE PROCESSING

2.1 MACROZOO-ICHTHYOPLANKTON SAMPLES

Macrozoo-ichthyoplankton samples are processed according to the scheme presented in Figure VI,2.1-1.

2.1.1 Copepod Analysis

The objective of the copepod analysis is to identify and enumerate the calanoid copepods collected in a macrozoo-ichthyoplankton sample. The analysis is performed on a Stempel pipette subsample in the following manner. If, however, the number of copepods is unusually low, subsampling for copepods can be done by Folsom plankton splitter instead (Section 2.1.2.2), and then continuing with Step 6 below.

1. Rinse the 5% formalin from the sample through a clean ≤505-µm mesh net into a holding jar under a working hood.
2. Transfer the complete sample to a calibrated sample jar using a minimal amount of water.
3. Dilute sample by adding water, or concentrate sample to a level indicated on the calibrated jar to yield between 150 and 200 copepods per 1-ml subsample.
    a. Record the (working) sample volume on the data sheet.
4. Mix sample thoroughly by moving a Stempel pipette in a figure-eight pattern.
5. Extract a 1-ml subsample with a Stempel pipette.
6. Put subsample into a Wards® counting wheel.
7. Place counting wheel on a dissecting microscope for identification and enumeration.
8. Count and identify calanoid copepods. Do not count "empty" copepods (exuviae). If minimum count criteria are not met (refer to project SOP), repeat Steps 4 through 8 until these criteria are met and record the number of 1-ml subsamples extracted on the

Plankton Count Form (Figure VI,2.1-2). (A complete subsample must be counted even though the criteria have been met before its completion.)

9. When sample is completed:
    a. Calculate scaling ratio from sample volume and sub-sample size and record on Plankton Count Form (Figure VI,2.1-2). (Scaling ratio = sample volume in ml divided by number of 1-ml subsamples examined.)
    b. Record counts for each taxon (sum for all subsamples examined) on Plankton Count Form.
    c. Transcribe sample identification information from the original sample jar onto the Plankton Count Form, following project coding specifications (refer to project SOP), and initial and date the form. File in the project file with copepod data.
    d. Log completion of each sample in the Quality Control Log (Figure I,3.2-2).
    e. Recombine copepod subsamples with the original sample.
    f. Log completion of each sample in Plankton Sample Control Log (Figure VI,2.1-3), as described in Section I,2.1.1.
    g. Represerve macrozoo-ichthyoplankton sample in 6% buffered formalin and place on shelf to await ichthyoplankton sort.
    h. Notify alternate taxonomist to keep quality control up to date.

2.1.2 Ichthyoplankton Analysis

The objective of the Ichthyoplankton analysis is to identify and enumerate the fish eggs and larvae collected in a macrozoo-ichthyoplankton sample. The analysis is performed in the following manner:

2.1.2.1 Ichthyoplankton Sorting

1. After the sample information has been logged as described in Section I,2.1.1, rinse the 6% formalin from the sample through a clean 0.333 mm mesh net or sieve into a holding jar under a working hood, and retain formalin for future represervation.
2. Replace the rinsed sample back into the original sample jar using enough water to yield a fluid mixture.
3. Split sample in Folsom splitter as described in Section VI,2.1.2.2 so that the smallest split contains the minimum number of eggs or larvae required for the analysis (refer to project SOP for count criteria).
4. Begin sorting with the smallest aliquot:
    a. Place a workable amount of the sample in a gridded petri dish under a dissecting microscope.
    b. Remove eggs and larvae with forceps or pipette and place in vials.
    c. Enumerate eggs and larvae separately on tabulator as they are removed.
    d. Reserve sorted portion of sample.
    e. Repeat Steps 4a through 4d until aliquot is completely sorted.
    f. Label the sorted portion with the size (fraction) of the split.

5. Continue to sort successively larger splits by the procedure in Step 4 removing eggs or larvae or both until the minimum count criteria have been met. When the mini-mum count is reached partway through a split, continue to sort until that split is completely sorted.
6. When sorting is completed, retain the fractions of the sample in separate jars:
   a. Sorted for both eggs and larvae
   b. Sorted for eggs only
   c. Sorted for larvae only
   d. Not sorted
7. Preserve the eggs and larvae with 6% buffered formalin, insert inside label and place outside label on cap.
8. Record date of completion and sorters initials in Plankton Sample Log (Figure VI,2.1-4) and in the Quality Control Log (Figure I,3.2-1).
9. If the sample is a quality control check and cannot be analyzed immediately, preserve the sample fractions from Step 6 with 6% buffered formalin, and label each jar with sample number, station, replicate, split fraction, and life stage(s) removed from that fraction.
10. After quality control check is completed, recombine all split fractions into original sample by rinsing through a .505-mm mesh net.
11. Represerve in original formalin.
12. Place sample on shelf to await further analysis or storage.
13. Place vials of eggs and larvae in temporary storage location for identification at a later time by taxonomists.
14. File plankton count form in the project file with ichthyoplankton data.

2.1.2.2 Ichthyoplankton and Macrozooplankton Subsampling

1. Level Folsom plankton splitter.
2. Rinse splitter thoroughly before use.
3. Place approximately 500 ml or less of the sample in splitter.
4. Rotate splitter six or more times to assure equal separation.
5. Pour into two receiving trays being careful not to com-bine any portion of the splits.
6. Repeat Steps 3 through 5 until entire sample is split.
7. With a flip of a coin, determine which half is to be split further. Continue splitting one half until a workable amount of sample is obtained.

   i.e., 1 Ý 1/2 Ý 1/4 Ý 1/8 Ý 1/16 Ý etc.
   1/2 Ý 1/4 Ý 1/8 Ý 1/16
8. Place splits in jars marked 1/2, 1/4, 1/8, 1/16, etc.
9. Rinse splitter thoroughly when finished.

2.1.2.3 Ichthyoplankton Identification

1. Transfer eggs and larvae to water in petri dish.
2. Using a dissecting microscope, identify all eggs and larvae to lowest practical taxon and count them. Do not count empty egg membranes.
3. Measure larvae. Refer to project SOP for which species to measure and type of measurement used.
4. Header information: project number, sample number, station, replicate, sample period, method, collection date, split information, scaling ratio and counts (if no eggs or larvae were found enter zero).
5. Record species, length and counts on Ichthyoplankton Lab Data Sheet (Figure VI,2.1-5) along with taxonomist's initials and date completed, following project coding specifications (refer to project SOP).
6. Record completion of sample in Plankton Sample Log (Figure VI,2.1-4) and in Quality Control Log (Figure I,3.2-2). Record Quality Control results on the Quality Control Worksheet (Figure I, 3.2-3).
7. Return larvae and eggs to original vials in 6% buffered formalin.
8. Place vials on shelf to await quality control check.
9. File Plankton Count Form and Count/Length Form in the project file with ichthyoplankton data.

2.4 BIVALVE LARVAE SAMPLES

Bivalve larvae are temporarily preserved in approximately 1% formalin and approximately 1 ml (1/8 to 1/4 teaspoon) each of borax and sugar per liter. Since they are in a weak preservative they must be refrigerated until analysis. Since color is a key characteristic and the sample will deteriorate with time, they must be analyzed as soon as possible, but may be held up to a week if necessary.

1. Remove sample jar from refrigerator and pour contents through a ≤76 µm mesh sieve. Discard filtrate into appropriate waste container. Rinse sample from sieve into a 1000-ml beaker.
2. Swirl contents of beaker and allow the bivalve larvae and residue (i.e.: copepods and other plankton) to settle to the bottom. Sand and bivalve larvae will settle first, residue will settle on top of bivalve larvae.
3. Carefully pour supernatant and residue into another 1000_ml beaker. Rinse bivalve larvae and sand (if any) into a petri dish.
4. Remove bivalve larvae remaining in the residue by:
    a. swirling residue and supernatant, allowing bivalve larvae to settle to the bottom of the beaker and removing them with a pipette or;
    b. carefully discarding the supernatant, pouring the residue into a petri dish (by portions as necessary) and swirling the petri dish to concentrate bivalve larvae in the center where they can be removed with a pipette.

Method 4a is generally quicker in samples containing a large amount of debris and residue.

5. Continue removal process until about 99% of the larvae have been extracted. Discard the residue.
6. After all larvae are removed from the residue, swirl dish on a flat surface in a circular motion causing larvae to collect in a circular mass in the center of the petri dish.
7. If there are fewer than 600 larvae, analyze the whole sample.
8. Samples containing more than 600 larvae should be split into equal halves. Each half should then be serially split. To serially split each half sample:
   a. swirl the dish to concentrate larvae in a circular pile;
   b. divide the pile to the 1/2, 1/4 or 1/8 fraction using a bivalve probe (camel hair in a glass pipette) or a razor blade and; if necessary, remove the 1/8 portion to another petri dish and repeat steps a and b until a subsample of 150 to 300 bivalve larvae is attained.
9. Record the split factors by shading the appropriate fraction of the data sheet splitting symbol during each stage of splitting. The scaling ratio represents the fraction of the entire sample that was analyzed; the sum of the two split factors (i.e.; in a sample where each half was split to a 1/32, the scaling ratio would be 1/32 + 1/32 = 1/16).
10. Identify and enumerate the bivalve larvae from each split.
    a. Do not count shells which are empty of cytoplasm.
    b. If two taxonomists are available, it is recommended that each analyze a replicate from each station.
11. After identification of the fractions:
    a. Complete the header information and record the counts and scaling ratios on the Plankton Count Form (Figure VI,2.1-2) following project coding specifications (refer to project SOP) including the taxonomist's initials and date completed. If two counts are made per sample, record in the margin and combine in count column.
    b. Log completion of each sample in the Plankton Sample Control Log (Figure VI,2.1-3) as described in Section I,2.1.1 and in the Quality Control Log.
    c. Determine if sample is a QC. If so, have alternate taxonomists immediately do a QC.
    d. Recombine the sample into a vial containing 3% borax buffered formalin.
    e. File the plankton count form in the project file with bivalve larvae data.

3.0 QUALITY CONTROL

Sorting and identification tasks for macrozoo-ichthyoplankton and identification for bivalve larvae (sorting does not apply to bivalve larvae samples) are subject to quality control checks consisting of reanalysis of randomly selected samples. Samples are inspected using a quality control (QC) procedure derived from MIL-STD (military-standard) 1235B (single and multiple level continuous sampling procedures and tables for inspection by attributes) to achieve a 10 percent or better AOQL (Average Outgoing Quality Limit). QC checks are performed by Senior Taxonomists. The QC procedure used is the CSP-1 continuous sampling plan, which is conducted in two modes as follows:

- *Mode 1.* Reinspect one hundred percent of the samples until "i" consecutive samples pass.
- *Mode 2.* After "i" consecutive samples pass QC reinspection, randomly choose (using a random numbers table) the fraction "f" of the samples for reinspection. If any QC sample fails then return to Mode 1.

For this application of CSP-1, **i=10** and **f=1/10**, because the total number of samples analyzed by an individual was more than 500. QC inspections are performed as soon as possible after the original analysis. Keeping the QC program as current as possible insures that problems are detected and remedied quickly, minimizing the additional number of samples that are analyzed before the problem is addressed. Samples for reanalysis are selected using a random number table. The original analyzer does know whether a sample is to be checked before the analysis of that sample has been completed. All quality control checks are performed "blindly" (i.e., the individual performing the QC inspection had no knowledge of the original analyst's results prior to their completion of the reinspection). The QC plan is applied on an individual processor basis, so that each person's work is subjected to the QC plan independently of others, starting at 100% inspection. A resolution (third person) value may be determined for any sample found defective.

For the task of sorting, a sample is considered defective if the sorter fails to remove 10 percent of the total organisms in the sample (or subsample). Percent error is calculated as follows (where "QC count" denotes the number missed by the sorter):

% error = 100% x QC count/(sorter's count + QC count)

When the total count (sorter's plus QC) is ≤20, then the sample is considered defective only if the sorter missed more than two organisms.

For the task of identification, a sample is considered defective if an error of 10 percent or more is made in identifying, assigning a life stage, or counting any species. In determining whether a sample is defective, analyzer and QC results are compared within each taxon/life stage combination. For each taxon (or for a life stage within a taxon) the percent error is calculated as follows (except where the QC count is ≤20, the percent error is considered to be zero if analyzer and QC counts differ by no more than two organisms):

% error = 100% x | analyzer count – QC count | /QC count

A sample with a percent error of greater than or equal to 10% for any life stage for any taxon is considered defective.

For each defective sample, a resolution could be determined in which a third person reanalyzes the sample (resolution value). The error for each species and life stage is then calculated using the resolution counts as the divisor. This was done for both identification and QC counts:

$$\% \text{ error} = 100\% \times |\text{identifier count} - \text{resolution count}| / \text{resolution count}$$

$$\% \text{ error} = 100\% \times |\text{QC count} - \text{resolution count}| / \text{resolution count}$$

If the resolution vs. identifier error is <10 percent, the sample passed. If they are not, the sample failed and identifier counts were replaced by QC counts for all cases, provided the QC vs. resolution error is <10 percent.

Figure I.2.1-1. Field card/sample submittal form. side 1 of 2

FIELD CARD / SAMPLE SUBMITTAL FORM

Project ________ Date ________ Sampling Period ____

Tide ____ Collectors ____________________

Sample Number	Task	Sample Type	Collect Method	Collect Time	Station	Depth Meters	Rep. No.	Sample Status	Sample Size / # Cont.	Sample Reading		

Delivered by: ____________________ Date: __________ Received by: ______________ Date: __________

Received at: ______________

SAM 10_side 1.ai

PLANKTON PUMP CALIBRATION								
Pump No	Volume	Time	Pump No	Volume	Time	Pump No	Volume	Time

Comments:

Laboratory Instructions:

Side 2
Form SAM-10
Rev. 1/7/91

Figure I,2.1-1. (continued)

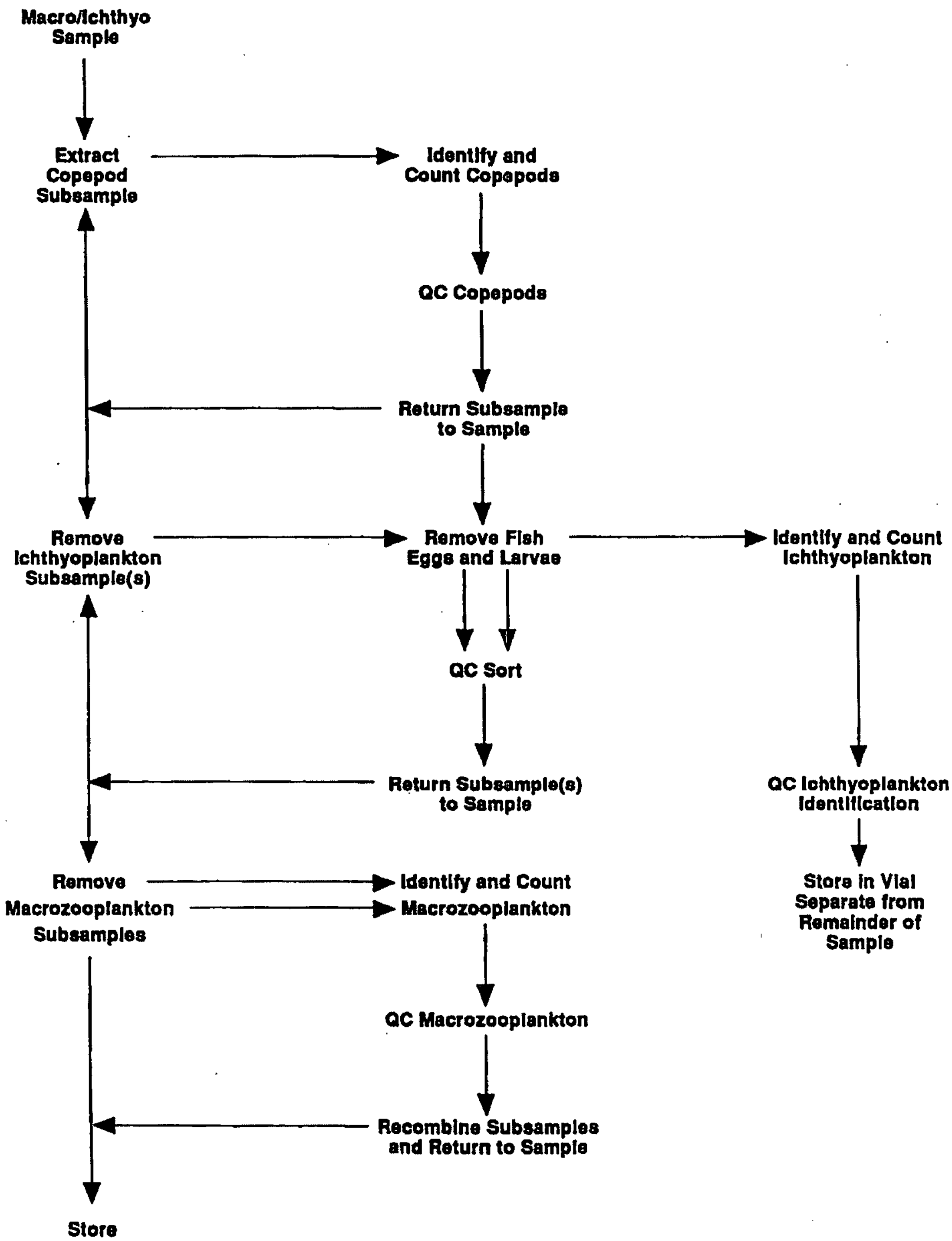

Figure VI,2.1-1. .... General Procedure for analysis of macro/ichthyoplankton samples

PLANKTON COUNT FORM

Analyzed By: ______________________ **Project:** ____________ **Page** ____ **Of** ____

Analyzed On: ______________________ **Time:** ________________________

PROJECT	METHOD	SAMPLE PERIOD	DATE	PHOTO PERIOD	TIDE	STATION	DEPTH CODE	DEPTH	REP

SAMPLE CONTROL No.	TIME	FIELD VOLUME	SUB-SAMPLE		No. OF SUBSAMPLES	TYPE
				OF		

SPECIES NAME	SCALING RATIO	SPECIES CODE	LIFE STAGES	COND.	COUNT/PCNT

mz1-1.al 12/10/96

Figure VI,2.1-2. ....Plankton count Form.

Page ____

Quality Control Log: Ident

Project
Name: ____________________
Code: ____________________
Year: ____________________

Taxonomist: ____________________

Sample No.		Ident Date	Qc'er		Results		Comments
			Name	Date	% Diff	P/F	

QC Log-Ident 9/9/05

Figure I, 3.2-2. .... Quality Control Log: Ident.

SAMPLE CONTROL SHEET

SAMPLE TYPE: ____________________________

SAMPLE No.	DATE TAKEN	STATION				

Figure VI,2.1-3. .... Sample Control Sheet.

Figure VI, 2.1-4. .... Plankton Count Form (PL)

Sample Log: Plankton

Page: ______

Project Name: ______________________

Code: ______________________

Year: ______________________

SP	Sample No.	Collection Date	Station	Sort			Scaling Ratio			Vol. Split	Vials			ID			Date to DP
				Initials	Date	Hours	E	L			E	L		Initials	Date	Hours	

PlanktonSampleLog.a1 10/25/07

Quality Control Log: Sort

Project Name: ____________________

Code: ____________________

Year: ____________________

Sorter: ____________________

Sample No.		Qc'er		Counts			Results		Comments
		Name	Date	Orig	QC	Total	% Diff	P/F	

QC Log-Sort.doc 4/18/05

Figure I,3.2-1. Quality Control Log: Sort.

Plankton Count Form

PAGE 1 OF ___

Project Name:__________ **Project No:** __________ **Plant:** __________

SAMPLE [ ] CARD TYPE [L 1] CATCH_CD [ ] ANALYZED BY: __________ DATE: ________ NO. VIALS: _____

SPL_FACT	TAXON	STAGE	COUNT	SPECIES NAME

STAGE CODES

0 = unknown

1 = egg

2 = yolk-sac larva

3 = post yolk-sac larva

4 = young-of-the-year

5 = yearling or older

SAMPLE [ ] CARD TYPE [L 2] CONVERSION FACTOR [ ]

TAXON [ ] STAGE [ ] | TAXON [ ] STAGE [ ] | TAXON [ ] STAGE [ ]

	SCALE MEASUREMENT		SCALE MEASUREMENT		SCALE MEASUREMENT		SCALE MEASUREMENT		SCALE MEASUREMENT		SCALE MEASUREMENT
1		11		1		11		1		11	
2		12		2		12		2		12	
3		13		3		13		3		13	
4		14		4		14		4		14	
5		15		5		15		5		15	
6		16		6		16		6		16	
7		17		7		17		7		17	
8		18		8		18		8		18	
9		19		9		19		9		19	
10		20		10		20		10		20	

LabL1.ai 7/05

Figure VI,2.1-5. ....Plankton Count Form, Side One.

Plankton Count Form

PAGE ___ OF ___

Project Name: ________________ **Project No:** __________ **Plant:** __________

SAMPLE [ ] **CARD TYPE** [L 2]

STAGE CODES
0 = unknown
2 = yolk-sac larva
3 = post yolk-sac larva
4 = young-of-the-year
5 = yearling or older

TAXON [ ] **STAGE** [ ]

SCALE MEASUREMENT		SCALE MEASUREMENT	
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8		18	
9		19	
10		20	

TAXON [ ] **STAGE** [ ]

SCALE MEASUREMENT		SCALE MEASUREMENT	
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8		18	
9		19	
10		20	

TAXON [ ] **STAGE** [ ]

SCALE MEASUREMENT		SCALE MEASUREMENT	
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8		18	
9		19	
10		20	

TAXON [ ] **STAGE** [ ]

SCALE MEASUREMENT		SCALE MEASUREMENT	
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8		18	
9		19	
10		20	

TAXON [ ] **STAGE** [ ]

SCALE MEASUREMENT		SCALE MEASUREMENT	
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8		18	
9		19	
10		20	

TAXON [ ] **STAGE** [ ]

SCALE MEASUREMENT		SCALE MEASUREMENT	
1		11	
2		12	
3		13	
4		14	
5		15	
6		16	
7		17	
8		18	
9		19	
10		20	

LabL2.ai 7/05

Figure VI,2.1-5. Plankton Count Form, Side Two

Quality Control Worksheet

Project Name ______________________ **Project Code** __________

Sample ______________________ **Date** __________

Sorter/Taxonomist ______________________ **Date** __________

QC by ______________________ **Date** __________

Resolution by ______________________ **Date** __________

- ☐ **PASS with no Changes made to original data**
- ☐ **PASS WITH DISCREPANCIES with Corrections made to original data**
- ☐ **FAIL with Corrective action taken**

Action taken: ______________________

____

Signature ______________________ **Date** __________

Categories		Data	QC		Resolution		Results			Data Correction
		Orig.	QC	% Diff.	Resolv.	% Diff.	Pass	Discrp.	Fail	

Quality Control Worksheet.doc 12/11/03

Figure I, 3.2-3. ....Quality Control Worksheet.

APPENDIX F

Results of Annual Impingement and Entrainment Monitoring Programs

Appendix Table F-1. Annual Estimated Numbers of Fish Eggs Entrained (in millions) by the Cooling Water System at Seabrook Station from 1995 through 2006 (NAI 2007).

Eggs

TAXON	1995[f]	1996[f]	1997[f]	1998[f]	1999[f]	2000[f]	2001[f]	2002[f]	2003[f]	2004[f]	2005[f]	2006[f]
American plaice	14.8	78.2	15.6	13.7	24.8	16.7	26.8	22.4	37.8	33.4	11.7	5.27
Atlantic cod	2.2	8.1	2.9	8.4	5.3	2.9	11.0	13.4	7.9	2.9	4.4	8.23
Atlantic cod/haddock	2.2	1.4	0.2	0.3	0.4	1.6	0.1	0.2	0.4	0.8	0.9	0.80
Gadid/witch flounder	32.6	47.2	8.9	77.3	47.2	59.0	21.0	67.4	11.2	15.6	12.8	11.10
Atlantic mackerel	74.5	305.1	23.1	39.3	44.6	266.9	330.4	56.7	26.4	71.3	37.7	475.60
Atlantic menhaden	0.2	0.1	0.2	0.1	0.2	0.1			<0.1			
Butterfish		0.1			<0.1						0.4	
Cod family	0.2				<0.1							
Cunner			35.9	9.3	21.7	207.5	18.0	2.4	15.6	208.0	1.6	4.51
Cunner/yellowtail flounder	18.6	110.2	186.1	56.2	232.4	1001.9	229.7	1396.5	128.3	939.1	254.6	486.03
Cusk	0.2	1.8	0.2	0.1	<0.1	0.1	3.0	0.3		0.6	0.2	0.77
Fourbeard rockling	4.2	10.9	4.8	2.9	2.7	13.7	14.1	3.23	5.9	5.6	5.2	7.40
Goosefish				0.9		0.9				0.1	0.1	0.03
Grubby					0.1							
Hake	25.1	184.0	68.6	7.4	6.1	114.0	4.4	79.6	5.0	5.3	2.8	7.23
Hake/fourbeard rockling	27.5	57.0	45.0	31.1	24.8	231.1	33.0	58.3	38.4	41.1	63.6	30.08
Lumpfish	6.0	1.2	0.3						<0.1			
Pollock	0.4	0.4	0.2	2.9	0.2	<0.1	0.3	0.6	1.0	0.9	1.0	4.13
Rainbow smelt		0.1										
Silver hake	22.5	73.6	271.1	18.6	139.9	90.4	48.9	341.4	235.6	22.3	30.7	9.39
Tautog		0.3	0.1	0.1			0.1	3.8		0.1	0.2	
Unidentified	6.4	0.8	0.1	0.1	0.1	2.0	0.6	<0.1		0.6	0.1	0.08
Unidentified sculpin					<0.1			0.6	0.1			
Windowpane	17.4	44.2	28.5	17.9	43.2	95.1	33.4	39.1	15.5	22.7	26.2	24.71
Winter flounder						0.3			0.3			
Witch flounder	0.7	0.1	0.9	0.1	0.1	0.2					0.2	
Yellowtail flounder	0.2	1.6				0.1	0.2	0.7				0.02
TOTAL	**255.9**	**926.4**	**692.7**	**286.7**	**593.9**	**2104.4**	**775.1**	**2086.8**	**529.4**	**1370.1**	**454.4**	**1075.38**

Appendix Table F-2. Annual Estimated Numbers of Fish Larvae Entrained (in millions) by the Cooling Water System at Seabrook Station from 1995 through 2006 (NAI 2007).

Larvae

TAXON	1995[f]	1996[f]	1997[f]	1998[f]	1999[f]	2000[f]	2001[f]	2002[f]	2003[f]	2004[f]	2005[f]	2006[f]
Alligatorfish	0.3	0.1	0.1	0.2	0.1			<0.01	0.1	<0.1		0.03
American eel				<0.1	0.1							0.03
American plaice	7.9	8.1	7	2.9	4.9	1.6	8.7	11.3	9.1	2.6	1.4	0.64
American sand lance	9.5	14	10.1	10.7	7.8	1.0	5.3	10.5	27.1	107.1	28.3	14.05
Atlantic cod	2.3	0.3	0.7	2.2	1.0	0.4	2.5	34.6	2.5	0.5	1.6	0.27
Atlantic herring	11.2	4.3	2.1	9.5	8.6	0.2	15.2	11.7	15.3	8.8	9.7	12.79
Atlantic mackerel		0.1	0.4	0.0	0.1	0.3	0.1	0.4		20.2	0.1	0.48
Atlantic menhaden				0.1	0.1			0.1		<0.1		0.15
Atlantic seasnail	26.5	60.6	1.2	38.5	76.5	34.3	19.7	29.0	43.2	64.2	37.5	20.24
Atlantic silverside									<0.1			
Bluefish			0.1									
Butterfish	0.3	0.1										
Cunner	4.4	9.2	203.8	8.4	4.7	111.0	13.6	391.1	22.5	451.2	2.5	8.75
Cusk				<0.1			0.4	1.8	0.1	2.1		0.09
Fourbeard rockling	3.9	11.7	22.4	13.1	21.0	8.2	19.6	176.4	19.3	61.4	2.0	4.93
Fourspot flounder			0.1	<0.1				<0.01				
Goosefish						2.0				0.1		
Gadidae												0.04
Grubby	17.4	18.6	12.8	17.3	6.4	2.2	12.4	6.6	27.5	51.8	7.8	9.32
Gulf snailfish	0.2	2.8	0.6	1.5	0.3	0.3	0.1	4.4	2.0	9.5	2.3	1.04
Haddock											0.1	
Hake	0.7	12.3	1.7	<0.1	0.1	29.8		0.3	0.1	1.0		0.15
Herring family											0.5	0.04
Liparis sp.												0.16
Longhorn sculpin	0.4	1.3	0.7	0.8	0.6	0.3	0.3	0.6	2.0	5.2	1.2	0.97
Lumpfish	0.6	0.1	0.2	0.5	0.1	0.3	0.6	0.1	0.1	0.3	0.2	0.50
Moustache sculpin		0.6	0.3	<0.1							<0.1	
Northern pipefish		0.1			0.1		0.1	0.1		0.1	<0.1	0.02
Northern searobin											<0.1	
Ocean pout									<0.1			
Pleuronectidae		0.3										

(continued)

Appendix Table F-2. Continued

TAXON	1995[f]	1996[f]	1997[f]	1998[f]	1999[f]	2000[f]	2001[f]	2002[f]	2003[f]	2004[f]	2005[f]	2006[f]
Pollock				<0.1				<0.1	0.6	0.1	0.1	0.76
Radiated shanny	2.1	2	0.3	1.7	3.5	14.0	2.4	8.3	12.3	3.6	7.0	0.76
Rainbow smelt				0.2		0.3	0.1		0.5	<0.1	0.5	4.27
Redfish											<0.1	
Rock gunnel	15.6	33.8	25.1	16.9	18.2	3.5	4.6	12.3	56.0	109.0	54.2	30.31
Sea raven				<0.1	<0.1				<0.1	0.2	0.1	0.02
Shorthorn sculpin	0.5	0.1	1.1	2.1	1.0	0.1	0.5	0.2	3.9	11.6	2.1	0.16
Silver hake	0.9	16.9	69	0.2	0.4	33.2	0.6	5.9	0.5	0.2	<0.1	0.09
Snailfish		0.4						<0.1			0.2	
Snakeblenny												0.02
Summer flounder				<0.1					<0.1			
Tautog		0.2				0.1			0.1			
Unidentified	30.4	2.5	4.3	0.5	1.4	0.6	1.7	4.8	1.5	4.8	1.0	0.72
Unidentified sculpin		0.6	0.05		0.1			<0.1	0.5	4.4	1.2	0.42
Unidentified searobin		0.1				0.1						
Windowpane	2	2	5.6	1.4	3.7	2.3	1.3	6.5	0.5	0.4	0.5	0.52
Winter flounder	8	10.3	2.2	4.7	7.4	14.3	14.3	4.5	20.0	34.8	4.9	7.17
Witch flounder		0.8	1.2	<0.1	0.1	0.5		1.7	1.4	0.8	0.2	0.18
Wrymouth					<0.1					<0.1		
Yellowtail flounder	0.1	1.6	0.5	0.3	0.8	0.3	0.5	0.9		0.1	<0.1	0.02
TOTAL	**145.3**	**215.7**	**373.4**	**134.1**	**171.8**	**261.2**	**124.3**	**724.4**	**268.5**	**958.5**	**167.0**	**123.23**

[f] Represents 12 months.

Appendix Table F-3. Estimated Number of Bivalve Larvae Entrained ($X\ 10^9$) by the Cooling Water System at Seabrook Station 1993, and 1995-2006[a] (NAI 2007).

Species	1993[e]	1995[e]	1996[e]	1997[e]	1998[e]	1999[e]	2000[e]	2001[e]	2002[e]	2003[e]	2004[e]	2005[f]	2006[g]
Anomia squamula	3922.7	8905.9	23521.6	2883.3	3827.3	36495.2	7542.2	4128.7	8203.5	3218.1	2595.0	1217.4	3965.8
Bivalvia	334.5	797.1	671.4	71.	64.	651.3	228.6	483.0	194.2	73.	89.	40.	73
Hiatella sp.	2405.5	2598.2	4670.2	923.7	609.7	4416.5	1920.8	1575.2	567.3	1203.9	1024.2	352.9	604.0
Modiolus modiolus	1283.9	546.4	5144.8	614.7	241.7	2376.0	2520.7	251.6	776.4	240.8	843.2	292.9	715.
Mya arenaria	22.	4	33.	53.	11.	45.	23.	26.	60.	5	15.	9	11
Mya truncata	2	27.	123.0	0	8	66.	34.	26.	1	13.	5	2	0
Mytilus edulis	10050.7	13231.0	17931.8	1744.5	1493.0	22374.0	10254.7	9621.3	3318.4	2199.0	1526.1	921.5	1351.4
Placopecten magellanicus	16.	6	31.	0	0	11.	9	8	0	0	0	0	0
Solenidae	102.5	1092.3	241.9	49.	20.	773.2	150.4	922.9	150.8	85.	113.4	57.	65
Spisula solidissima	48.	112.5	171.1	22.	14.	175.5	33.	50.	44.	3	10.	14.	20
Teredo navalis	0	4	7	1	0	29.	1	0	2	0	0	0	0
Total	**18189.8**	**27326.5**	**52547.4**	**6366.3**	**6293.4**	**67414.9**	**22721.1**	**17094.8**	**13320.0**	**7043.1**	**6223.0**	**2909.3**	**6808.5**

[a] No sampling occurred in 1994.
[f] Sampling occurred from the fourth week in April through the fourth week in October.
[g] Sampling occurred from the fourth week in April through the fourth week in September

Appendix Table F-4. Species Composition, Annual Totals, and Nine-Year Total of Finfish, and American Lobster Impinged at Seabrook Station From 1995 to 2006[a] (NAI 2007).

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
Acadian redfish	0	0	0	0	0	0	0	0	0	0	3	0	3
Alewife	8	1,753	2,797	14	16	4	35	1	9	212	87	255	5191
American lobster	16	31	20	4	6	0	1	23	19	0	77	5	233
American plaice	0	0	0	0	2	0	0	0	0	0	3	0	5
American shad	0	20	21	1	6	10	3	7	10	7	7	0	92
American sand lance	1,324	823	182	708	234	423	114	245	3396	665	1029	213	10571
American eel	5	6	42	1	2	0	2	0	0	9	0	0	67
Atlantic menhaden	7	97	0	1	957	142	19	1022	7	361	7226	94	9933
Atlantic hagfish	0	0	0	0	0	0	0	0	1396	0	0	0	1396
Atlantic torpedo	1	5	0	0	0	0	0	0	0	0	0	0	6
Atlantic silverside	1,621	1,119	210	834	1,335	31	282	1410	20507	877	2717	788	37079
Atlantic tomcod	0	0	0	0	0	0	0	0	0	0	0	0	1
Atlantic wolffish	2	13	0	1	0	0	1	0	0	0	0	4	21
Atlantic cod	119	94	69	38	66	29	30	199	3091	467	454	113	4827
Atlantic mackerel	0	1	0	0	0	0	1	0	0	4	4	0	10
Atlantic herring	0	485	350	582	20	5	11	159	198	118	93	189	2210
Atlantic moonfish	3	0	0	1	0	0	0	50	0	0	0	0	54
Bigeye soldierfish	0	0	0	0	1	0	0	0	0	0	0	0	1
Blackspotted stickleback	0	0	0	2	28	0	0	0	107	12	0	3	152
Black sea bass	3	0	0	3	3	17	12	12	10	11	4	0	75
Blueback herring	0	111	323	7	53	1	59	475	50	380	130	138	1740
Bluefish	0	0	0	0	0	0	0	7	0	0	0	0	7
Butterfish	14	3	223	9	5	1	28	1170	4	35	54	44	1593
Cunner	342	1,121	233	309	255	324	341	291	554	625	893	687	6007
Cusk	0	19	0	0	0	0	0	0	0	0	0	0	19
Flounders	0	0	0	0	0	0	0	0	0	0	0	0	77
Flying gurnard	0	0	0	0	1	0	0	0	0	0	0	0	1
Fourbeard rockling	6	0	0	3	1	1	1	0	0	7	3	0	22
Fourspine stickleback	0	0	0	23	24	0	6	3	0	0	0	0	56
Fourspot flounder	1	2	3	4	1	11	0	7	0	7	24	0	62
Goosefish	13	0	0	7	17	15	59	18	10	0	8	0	150
Gray triggerfish	0	0	0	0	0	0	1	0	0	0	1	3	5

(continued)

Appendix Table F-4 (Continued)

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
Grubby	2,415	1,457	430	3,269	3,953	1,174	549	1089	2523	676	531	235	20979
Haddock	1	397	0	1	3	2	1	0	0	0	7	3	415
Hakes	2,188	156	122	4	68	113	523	1813	166	35	11	6	8027
Herrings	231	72	218	0	0	0	0	0	0	0	0	0	1035
Killifishes	0	0	0	0	0	0	0	0	0	0	0	0	4
Lefteye flounder	0	2	0	0	0	0	0	0	0	0	0	0	2
Longhorn sculpin	165	84	88	38	127	54	27	73	45	98	268	58	1230
Lookdown	0	0	0	0	0	0	1	0	0	0	2	0	3
Lumpfish	190	51	62	137	344	85	158	84	370	68	61	176	1968
Mummichog	0	47	24	0	0	0	0	0	0	0	4	0	75
Northern kingfish	0	2	0	0	0	0	0	0	0	0	0	0	2
Northern pipefish	579	1,200	243	268	748	370	714	936	2716	1413	1724	1288	12387
Northern puffer	0	0	5	0	0	0	0	12	0	3	0	0	20
Northern searobin	0	0	11	1	2	0	1	2	564	0	11	0	592
Ocean pout	6	1	0	7	3	2	21	1	13	3	3	6	66
Planehead filefish	15	0	0	0	8	1	0	3	0	0	0	0	27
Pollock	899	1,835	379	536	11,392	534	405	719	499	80	218	73	19250
Radiated shanny	92	40	2	39	108	11	53	4	158	18	49	44	618
Rainbow smelt	213	4,489	365	535	100	8	65	323	3531	2085	3314	878	16451
Red hake	16	1,478	371	903	1,120	112	155	52	271	892	821	546	6738
Righteye flounder	3	4	0	0	0	0	0	0	0	0	0	0	7
Rock gunnel	1,298	1,122	459	2,929	2,308	1,514	2,251	2066	6274	4137	1752	3782	30386
Sand tiger shark	0	57	0	0	0	0	0	0	0	0	0	0	57
Sculpins	0	0	0	0	0	0	0	0	0	0	0	0	205
Scup	14	9	0	3	1	0	3	11	11	0	21	4	77
Sea raven	125	1,015	223	137	132	206	271	166	217	129	221	138	3058
Sea lamprey	0	1	6	7	2	0	2	0	0	0	3	0	21
Sheepshead	0	0	0	0	0	0	1	0	0	0	0	0	1
Shorthorn sculpin	156	282	123	190	296	923	621	642	7450	876	2214	1258	15045
Silver hake	49	58	108	13	100	41	5	1177	22	212	306	31	2122
Skates	157	225	177	41	41	42	17	299	145	60	170	33	1597
Smooth flounder	0	0	0	2	0	0	0	0	0	0	0	0	2

(continued)

Appendix Table F-4 (Continued)

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
Snailfishes	165	1,013	351	856	2,356	690	334	616	451	185	442	330	7969
Snakeblenny	0	0	0	0	2	0	0	0	0	0	0	0	2
Spotted hake	0	0	0	0	0	0	1	0	0	0	0	0	1
Spiny dogfish	0	6	0	0	0	1	0	6	8	11	8	0	41
Striped bass	4	1	0	0	1	1	0	0	14	0	4	0	25
Striped cusk-eel	0	0	3	0	0	0	0	0	0	0	0	0	3
Striped mullet	0	0	0	0	1	0	0	0	0	0	0	0	1
Striped searobin	0	0	0	0	5	0	0	0	3	0	0	0	8
Summer flounder	0	0	0	0	0	0	0	0	0	0	0	4	7
Tautog	0	34	0	3	5	1	1	3	0	0	0	3	50
Threespine stickleback	155	320	174	773	506	10	280	34	1549	130	307	139	4444
Unidentified	40	88	49	0	15	0	0	0	0	0	0	0	198
Whiptail Conger	0	0	0	0	0	0	0	6	0	0	0	0	6
White hake	7	967	0	6	19	18	30	16	65	62	103	20	1314
White perch	0	4	0	1	1	0	0	0	201	0	3	0	210
Windowpane	943	1,164	1,688	772	692	251	161	2242	4749	936	2034	572	17184
Winter flounder	1,171	3,231	468	1,143	3,642	102	777	897	10491	783	1875	767	26782
Wrymouth	9	206	3	21	10	1	135	17	72	7	64	15	615
Yellowtail flounder	1,149	4	23	11	97	0	8	5	0	0	0	10	1307
TOTAL	**15940**	**26825**	**10648**	**15198**	**31239**	**7281**	**8577**	**18413**	**71946**	**16696**	**29368**	**12955**	**284298**

[a] Impingement data prior to October 1994 were underestimated.