From: "DeWald, Lynn" <ldewald@entergy.com>
To: "Richard Emch" <RLE@nrc.gov>
Date: 05/07/2007 2:56:13 PM
Subject: Additional information as requested

Rich,

As requested, Entergy is providing for your information, two power point slides and an excel workbook relative to salmon and shad impingement, which were presented at the recent (April 2007) EAC meeting. Please note that there are several tabs within the excel workbook. Also as requested, I've attached an electronic copy of Entergy's final 316(b) Proposal for Information Collection (PIC), which was submitted to the Vermont Agency of Natural Resources as required under EPA's Phase II Rule, prior to the Rule being suspended. The hard copy of the Station's PIC is slightly different from this electronic version in that the hard copy contains a dozen or so large prints of the Station's intake structure. I can mail you copies of these prints if you would like them. Members of your environmental assessment team also asked for information relative to Entergy's 1 degree F NPDES Permit amendment and what was appealed when the final amended permit was is issued in March 2006. Since you already have the amended permit, the fact sheet, and the responsiveness summary, I am providing a copy of our amendment application, and two statements of question documents that outline what was appealed to the Vermont Environmental Court. Please do not hesitate to call if you have questions about the attached documents or require additional information.

Thank you, Lynn

Lynn DeWald

Entergy Nuclear Vermont Yankee, LLC

320 Governor Hunt Road

Vernon, VT 05354

802-258-5526 (phone)

802-258-5865 (fax)

802-380-4493 (cell)

CC: "BUCKLEY, RICKY N" <RBUCKLE@entergy.com>

Mail Envelope Properties (463F7638.D2C : 20 : 64812)

Subject: Additional information as requested
Creation Date 05/07/2007 2:52:43 PM
From: "DeWald, Lynn" <ldewald@entergy.com>

Created By: ldewald@entergy.com

Recipients
nrc.gov
OWGWPO02.HQGWDO01
RLE (Richard Emch)

entergy.com
RBUCKLE CC (RICKY N BUCKLEY)

Post Office	Route
OWGWPO02.HQGWDO01	nrc.gov
	entergy.com

Files	Size	Date & Time
MESSAGE	1544	05/07/2007 2:52:43 PM
TEXT.htm	5526	
Vermont Yankee Final PIC.pdf	5477221	
(019) 06-02-2006 CRWC Final Statement of Questions.pdf	12926	
1 deg F amendment application.pdf	1609353	
13-2006 Second Revised Statement Filing (Signed).pdf	218687	
Shad and Salmon Historical impingement at VY 1974-2006-lwb & mtm.xls	83968	
Shad and Salmon Smolt Impingement at Vermont Yankee.ppt	24064	
Mime.822	10174196	

Options
Expiration Date: None
Priority: Standard
ReplyRequested: No
Return Notification: None

Concealed Subject: No
Security: Standard

Junk Mail Handling Evaluation Results
Message is eligible for Junk Mail handling
This message was not classified as Junk Mail

Junk Mail settings when this message was delivered
Junk Mail handling disabled by User
Junk Mail handling disabled by Administrator
Junk List is not enabled
Junk Mail using personal address books is not enabled
Block List is not enabled

PROPOSAL FOR INFORMATION COLLECTION TO ADDRESS COMPLIANCE WITH THE CLEAN WATER ACT §316(b) PHASE II REGULATIONS AT VERMONT YANKEE NUCLEAR POWER PLANT (NPDES NO. VT 0000264) VERNON, VERMONT

19 APRIL 2006

Proposal for Information Collection To Address Compliance With the Clean Water Act §316(b) Phase II Regulations at Vermont Yankee Nuclear Power Plant (NPDES No. VT 0000264) Vernon, Vermont

Prepared for
ENTERGY NUCLEAR VERMONT YANKEE, LLC
185 Old Ferry Road
Brattleboro, Vermont 05302

Prepared by
NORMANDEAU ASSOCIATES, INC.
25 Nashua Road
Bedford, New Hampshire 03110-5500

R-20455.001

19 April 2006

TABLE OF CONTENTS

PAGE

APPENDICES

1.0 INTRODUCTION

Entergy Nuclear Vermont Yankee, LLC ("Entergy") owns and operates the Vermont Yankee Nuclear Power Plant ("Vermont Yankee"). Vermont Yankee withdraws non-contact cooling water from the Connecticut River subject to and with the benefit of a NPDES Permit VT0000264, No. 3-1199 (the Permit), which was issued by the Vermont Agency of Natural Resources, Department of Environmental Conservation (VANR) on August 29, 2001 and expired on March 31, 2006. This NPDES Permit was recently amended on 30 March 2006, and the permit is administratively continued through Entergy's timely and complete application for permit renewal. Vermont Yankee is located on the western shore of Vernon Pool, an impoundment on the Connecticut River in Vernon, Vermont, and withdraws its cooling water from Vernon Pool. The shoreline where the Vermont Yankee cooling water intake structure (CWIS) is found is located within the state of Vermont. The Connecticut River source water body for the Vermont Yankee CWIS is considered waters of the United States because Vernon Pool is bounded by Vermont on the western shore and New Hampshire on the eastern shore.

The primary activity of Vermont Yankee is the generation of electric power. Vermont Yankee was issued an Atomic Energy Commission license to operate in 1973 and currently generates at a core thermal power of 1,593 mWe which produces a rated capacity of 537 mWe (gross) at maximum core thermal power. This results in 1,056 MW of waste heat that is removed by the cooling water system. Vermont Yankee has proposed a plant uprate which would result in an approximate 20% increase to core thermal power (1,912 mWe), gross generation (approximately 650 mWe), and waste heat (1,267 MW).

The final regulations implementing §316(b) of the Clean Water Act ("CWA") at existing electricity-generating stations, 69 Fed.Reg. 41576 (July 9, 2004) (the "Phase II Regulations"),[1] among other things, establish performance standards for the reduction from a calculated baseline of impingement mortality by 80 to 95 percent and, under certain circumstances, for the reduction of entrainment by 60 to 90 percent. See 69 Fed. Reg. 41576 (July 9, 2004). The applicability of these performance standards is determined by several factors, including the type of water body from which a plant withdraws cooling water and the plant's capacity utilization factor. Under the Phase II Regulations, applicable performance standards can be met by design and construction technologies, operational measures, restoration measures, or some combination of these compliance alternatives.

Entergy has requested an extended submission schedule for the Proposal for Information Collection ("PIC") and Comprehensive Demonstration Study (CDS) for Vermont Yankee in a letter from Ms. Lynn DeWald of Entergy to Ms. Carol Carpenter of the Vermont Agency of Natural Resources (VANR) dated 3 June 2005, as is allowed by the Phase II Regulations. This document is filed in response to the April 22, 2005 letter from Mr. Brian Kookier, Chief of the VANR Discharge Permits Section to Ms. Lynn DeWald of Entergy, requesting that Entergy proceed with submitting a PIC for Vermont Yankee. The submission schedule for Vermont Yankee's CDS is to be included in the renewed NPDES permit.

---

[1] Entergy, along with several other parties, has filed a petition for review of the Phase II regulations which is pending in the United States Court of Appeals for the Second Circuit. Entergy's submission of this document should not be construed as a waiver of any argument presented by Entergy in that appeal, and this document is filed with Entergy's full reservation of rights to continue to contest the validity of the Phase II regulations as currently written.

To the extent that the Phase II Regulations apply to Vermont Yankee, this document constitutes the information requested by VANR in the April 22, 2005 letter in the form of a PIC for Vermont Yankee. Entergy reserves its right to supplement or amend this PIC in response to comments from the Vermont Agency of Natural Resources (VANR), United States Environmental Protection Agency ("USEPA"), or any other governmental agency, results of the activities proposed in this PIC, or any litigation challenging the Phase II Regulations.

2.0 SOURCE WATER PHYSICAL DATA

2.1 PHYSICAL DESCRIPTION OF CONNECTICUT RIVER IN THE VICINITY OF VERMONT YANKEE

The Vermont Yankee Nuclear Power Plant (Vermont Yankee) is located 0.75 miles upstream of the Vernon Hydroelectric Dam (owned and operated by TransCanada), and 142.6 miles upstream from the mouth of the Connecticut River (the River) on a reach known as Vernon Pool. The River in Vernon, VT is fresh water. Vernon Pool extends upstream from Vernon Dam approximately 25 miles to the base of the Bellows Falls Dam in Bellows Falls, VT and comprises 2,481 surface acres and 0.19366 billion cubic feet of water retained at a full-pond elevation of 220.13 ft behind the Vernon Dam (Normandeau Associates, 2004). Vernon Pool varies in width from approximately 400 feet to 3,000 feet and in depth from approximately 15 feet to 50 feet (average depth is 16 feet). The hydraulic retention time of Vernon Pool is approximately two days under Mean Annual Flow (MAF) conditions (~10,500 cubic feet per second or cfs), and about 16 days under regulated minimum flow conditions. Accordingly, for purposes of the §316(b) Phase II Regulations, the source water body type for the Station is "freshwater river or stream", since the average hydraulic retention time is less than seven days.

Connecticut River Discharge

An annual cycle of River discharge is clearly evident at Vernon Dam (Figure 2-2), with a reported daily mean discharge that is at moderate levels (typically 10,000 cfs) from mid-October through mid-March, the peak daily mean discharge of 30,000 cfs or higher is observed during the April spring snow melt and runoff period, the annual minimum discharge (typically 5,000 cfs or less per day) occurs in late July through early September, and then discharge increases towards moderate levels again by mid-October (Luxenberg, 1990).

The River serves as the source water body for Vermont Yankee. River flows are highly controlled by hydroelectric generation activities both upstream and downstream of Vermont Yankee. There are nine hydroelectric dams and three storage dams on the mainstem River upstream of the Vernon Dam, and there are three hydroelectric dams and one pumped-storage facility downstream. Although storage in the Vernon head pond provides some flexibility of flow release from Vernon Dam, independent of inflow, the upriver hydro stations and Vernon Station are generally operated more or less in unison to maximize power output during times of peak power demand. This situation leads to two characteristic patterns of regulated River discharge: one of high and gradually varying flow, and one of frequent (two or more flow changes during each 24-hour period) cycling between lower and higher flows characterized by rapid transitions. The duration and magnitude of both the lower and higher flow during periods of daily cycling appears to be determined largely by the availability of water from upstream sources and may also be related to power demand.

Vernon Station has nine hydroelectric units that range in maximum capacity from 1,280 cfs to 1,970 cfs. "Lower" flows are maintained by operating one unit and may likewise vary from 1,250 cfs (the permitted minimum flow if River flow is above 1,250 cfs) to 1,970 cfs. "Higher" flows are generated by operating multiple units and may vary from 2,560 to 13,280 cfs. Typically, "lower" flows would be maintained for a period of several hours during each day, while "higher" peaking power flows would be maintained the rest of the time. However, under very low flow conditions, Vernon Station may operate continuously at or near 1,250 cfs, the FERC-licensed minimum flow if River flow is above 1,250 cfs, for several consecutive days.

Connecticut River Ambient Water Temperature

The annual cycle of ambient River water temperature is representative of the north temperate climatic zone (Figure 2-1). Mean daily River water temperatures remain near freezing from mid-December until early March, increase steadily from March until the seasonal maximum is observed during the period from late July through mid-August, and then decrease steadily until near freezing temperatures are reached again in mid-December (Luxenberg 1990). A significant portion of Vernon Pool is covered with ice during the winter months.

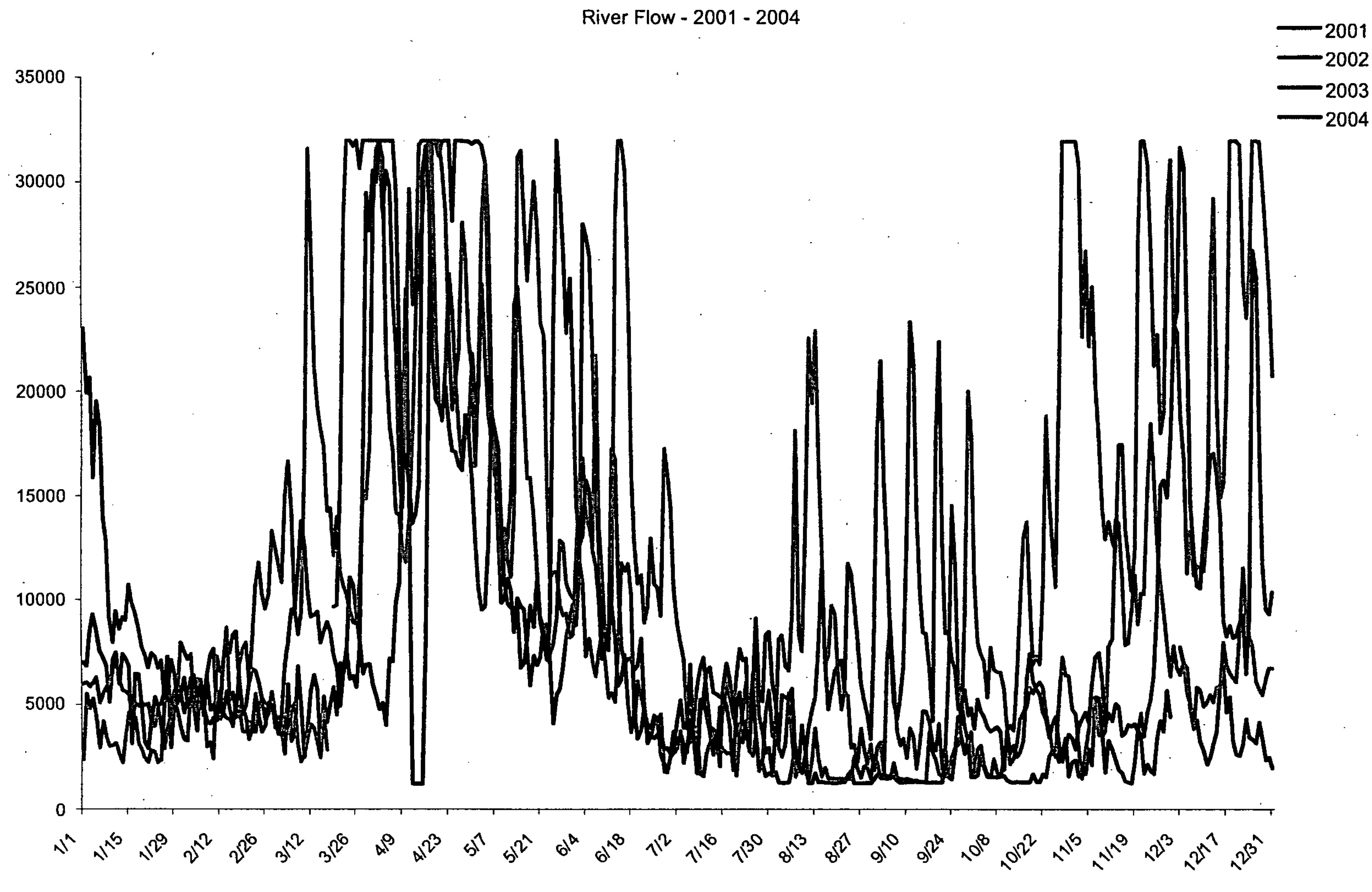


Figure 2-1. Daily average Connecticut River (cubic feet per second) flow at Vernon Dam, 1998-2004.

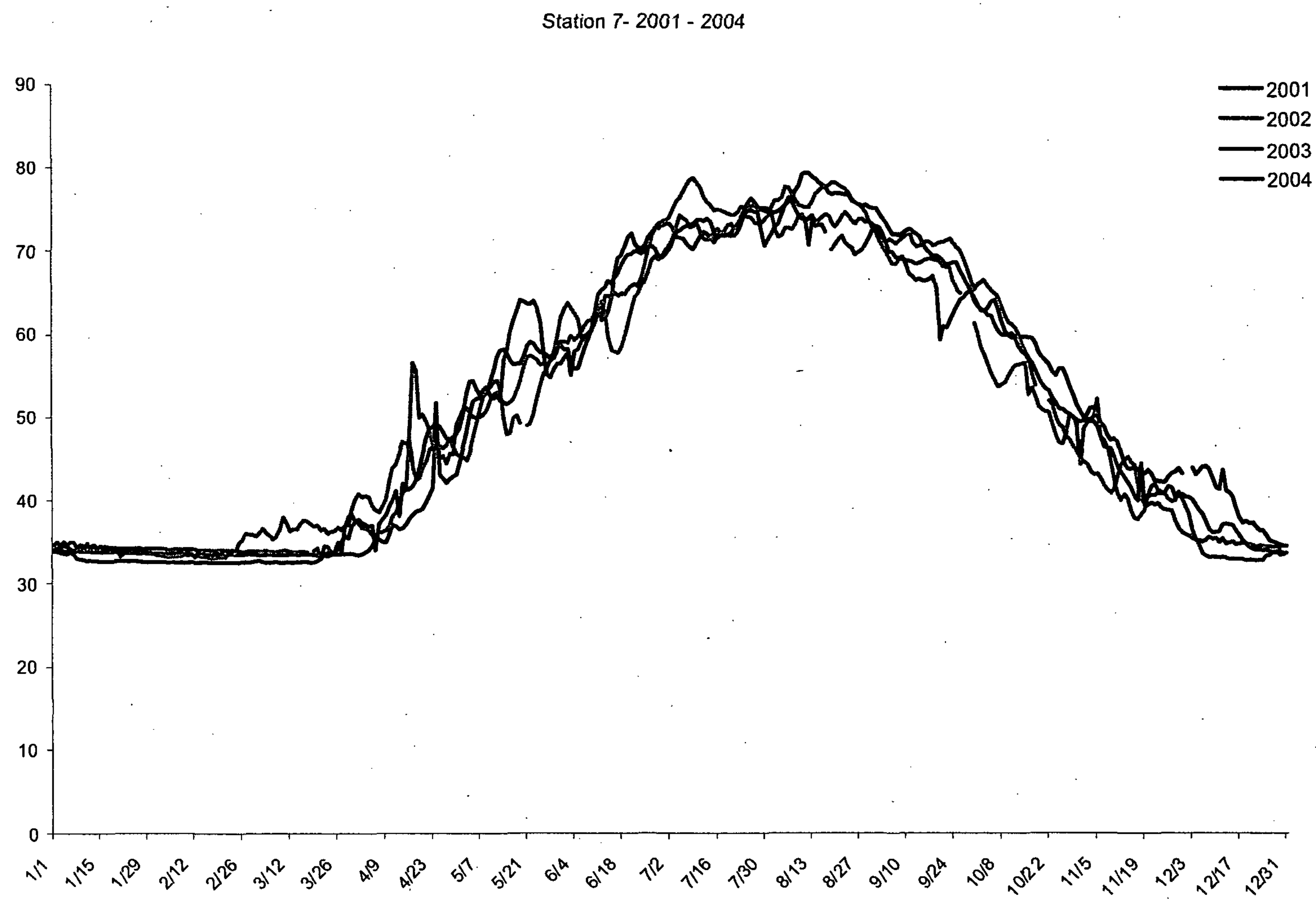


Figure 2-2. Daily average Connecticut River water temperature (°F) measured in Vernon Pool at Station 7 located upstream from Vermont Yankee's cooling water intake structure, 1998-2004.

3.0 COOLING WATER INTAKE SYSTEM DESCRIPTION

Vermont Yankee was originally designed with a once through circulating water (CW) system. However, the conditions of Vermont Yankee's operating license issued by the Atomic Energy Commission in 1973 required the use of closed cycle condenser cooling. Accordingly, mechanical draft cooling towers were built and used during the early operational years. A §316 demonstration was made in 1978 following a series of tests between 1974 and 1978 that confirmed open cycle cooling during the (winter) period 15 October through 15 May assured the protection and propagation of a balanced, indigenous community of shellfish, fish, and wildlife in the River (Binkerd et al. 1978). Accordingly, Vermont Yankee has operated in an open cycle mode during the winter period under the conditions of each NPDES permit issued since the 1978 demonstration. Limited open cycle operations were subsequently permitted during the 16 May through 14 October period of each year beginning with the NPDES permit issued in 1991 following an additional 10-years of engineering, hydrological and biological studies culminating in a 316(a) and 316(b) demonstration (Downey et al. 1990).

The Vermont Yankee cooling water intake system consists of an intake structure and cooling towers that are configured to allow a continuous range of condenser cooling operations from closed cycle, to hybrid cycle, to open cycle. Closed cycle cooling occurs when the entire waste heat load from non-contact cooling in the condenser is dispersed to the atmosphere via mechanical draft cooling towers and the cooling water is recirculated back to the intake structure without passing into the River. Open cycle cooling occurs when the waste heat is removed by the flow of ambient River water that passes "once through" the condenser cooling system and is returned directly to the River. Hybrid cycle cooling occurs when a proportion of ambient River water passes through the cooling towers and is recirculated while the remaining portion is discharged to the River. The existence of these three operating modes means that Vermont Yankee's cooling water intake system operates with hourly, daily and seasonally varying intake flows using intake pumps, recirculation gates, and cooling towers. A general description of typical patterns of operation among these structures and operating modes is provided in the sections below.

3.1 PHYSICAL DESCRIPTION, LOCATION AND DEPTH OF COOLING WATER INTAKE STRUCTURE

The cooling water intake structure (CWIS) at Vermont Yankee is located in a reinforced concrete bulkhead near the west shore of the River, in the impoundment area immediately upstream of the Vernon Hydroelectric Station, in the town of Vernon, Windham County, Vermont. The CWIS is located at the north side of the plant at approximately 42 degrees 47 minutes north latitude by 72 degrees 31 minutes west longitude. The CWIS is shared by the Circulating Water (CW) and Service Water (SW) systems, each within separate and isolated forebays. The CW system provides cooling water as a heat sink to condense the plant's main process steam after it is processed by the main generating turbine. The SW system provides cooling water as a heat sink for smaller heat loads generated by coolers in a variety of pumping equipment and heat exchangers within the plant. The SW portion of the intake structure also provides a suction path for the infrequently used Fire Protection System pumps. The Fire Protection System is used to protect the safety of the plant by providing a source of water for a variety of sprinkler systems throughout the plant, and is normally not operating but is maintained in standby readiness.

The CWIS extends from slightly above normal plant grade of elevation 252'-6" down to the intake floor elevation 190.0', which is approximately 30' below normal River surface elevation of approximately 119.0' - 220.0'. The intake forebay for the CW system is adjacent to but south of and separate from the intake bay for the SW system. The CW intake bay is designed to provide an independent flow path to each of three CW pumps through independent intake gates that may be raised or lowered provided that stop logs are installed in the pump forebay. The intake flow through any and all CW intake gate position combinations enters a common forebay servicing all three CW pumps. The SW intake bay is separated into two forebays. Each forebay contains two SW pumps.

3.2 AS-BUILT PLAN AND SECTIONAL VIEWS OF INTAKE STRUCTURE

The following drawings (Appendix 1) provide plans and sections of the intake structure. These drawings show both the structure and major equipment and are included herein.

G-191233	Intake Structure Piping Plans and Sections
G-191451	Circulating Water System Intake Structure – M – Sh. 1
Gi191452	Circulating Water System Intake Structure – M – Sh. 2
G-191453	Circulating Water System Intake Structure – M – Sh. 3
G-191735	Intake Structure – Steel
G-191454	Circulating Water System Intake Structure – R – Sh. 1
G-191736	Intake Structure – Screens & Misc Steel
G-200362	Circulating Water System Intake Structure – R – Sh. 5

3.3 FIXED SCREEN (BAR RACK) DESCRIPTION, DIMENSIONS, OPERATION, AND DEBRIS LOADING

The Vermont Yankee CWIS has two sets of fixed screens (bar racks), with one set covering the CW intake and one set covering the SW inlet.

The fixed screens at the CW intake forebay are installed on the outer-most face of the intake structure. Mechanical agitators are used to prevent surface ice from forming in front of these screens during winter months.. Each fixed screen consists of 3 inch by 3/8 inch rectangular vertical bars on 3 inch centers across each intake gate opening. Although the fixed screens and gates extend all the way above the River surface for ease of maintenance, the actual opening in the concrete face of the intake structure through which CW enters the intake structure forebay extends from elevation 212'-0" (approximately eight feet below normal River elevation) to the bottom of the intake structure at elevation 190'-0". The size of the free open area across each of the three gates and fixed screens is nominally 22'-0" by 12'-0", or 264 sq. ft. These fixed screens prevent the intake from clogging due to the buildup of frazil ice and/or large debris, and they also will exclude large fish from entering the CW forebay. There are no installed systems to remove large debris from these fixed screens. Any debris removal is performed manually by maintenance workers from installed platforms or boats. Opening the recirculation gate allows all or a portion of the CW effluent to return from the discharge structure to the CW intake forebay, allowing a slight head increase in the forebay above normal River level to aid in removing debris from the screens. The design (maximum) water velocity through each CW fixed screen is nominally about 1.0 feet per second (fps) with all three CW pumps operating in open cycle cooling mode. The actual water velocity through each CW fixed screen varies throughout the year from 1.0 fps down to 0.0 fps as the operating mode for the plant is changed from open cycle to closed cycle.

The SW forebay portion of the intake structure is immediately north of the CW forebay, and is separated from the CW forebay flow path by a reinforced concrete wall. A floating stop log is used as a barrier to prevent surface debris from entering the SW forebay. The entrance to each of the two SW pump bays is protected from debris intrusion by an independent fixed screen (bar rack). Mechanical agitators are used to prevent surface ice from forming in front of these SW fixed screens. Each fixed screen consists of 3 inch by 3/8 inch rectangular vertical bars on 3 inch centers across each SW pump bay opening. Although these fixed screens extend all the way above the River surface for ease of maintenance, the actual opening in the concrete face of the intake structure through which SW enters the intake structure forebay extends from normal River elevation of 220'-0" to the bottom of the intake structure at elevation 190'-0". The size of the free open area across each of the openings in the SW forebay and each fixed screen is nominally 30'-0" by 9'-2", or 275 sq. ft. These SW fixed screens prevent the service water intake from clogging due to the buildup of frazil ice and/or large debris, and they also will exclude larger fish from entering the SW forebay. There are no installed systems to remove large debris from these fixed screens. Any debris removal is performed manually by maintenance workers from installed platforms or boats. The design (maximum) water velocity through each SW fixed screen is nominally about 0.1 fps during maximum flow summertime operations with all four SW pumps operating.

3.4 TRAVELING SCREENS DESCRIPTION, DIMENSIONS, OPERATION, AND DEBRIS LOADING

The traveling water screens (furnished by the Rex Chainbelt Company of Milwaukee, WI) are vertical, single speed, single entry/exit mechanical devices providing a basic fish and debris handling system at the Vermont Yankee CWIS. These traveling screens are located at the in-board (west) side of the CW intake forebay and are recessed from the fixed screens and intake gates by about 55 feet. This enlarged CW forebay provides sufficient room for the recirculation water outlet to enter and mix with the ambient flow of River water passing through the fixed screens and intake gates. Each traveling water screen is installed between the CW forebay and the pump well of each of the three CW pumps (three screens). One traveling screen is installed between the SW forebay and each of the two SW pump bays. Each of the five traveling screens consists of 54 fiberglass basket elements that are chain driven in a continuous loop. Each basket screen is formed from 0.080" diameter stainless steel wire cloth with 3/8" openings. Each CW traveling screen has a nominal design capacity of 120,000 gallons per minute (gpm) at a low water depth of 30 feet in the intake structure through a clean screen surface at a velocity of 1.96 fps. A single speed motor rotates the screens to provide for backwashing accumulated debris into a collection trough. The concrete collection trough traverses the length of all five traveling screens and empties the backwashed debris and any impinged fish into a collection basket that is located on the north side of the CW and SW intake forebays. [**NOTE**: in a March 30, 2006 submission to the Vermont Agency of Natural Resources containing a narrative description of the Vermont Yankee traveling screens and their operation, the location of the fish basket was mistakenly identified as being between the circulating water and service water traveling screens. The description has been corrected in this document; the fish basket is north of all traveling screens]. The perforated collection basket can be emptied manually as needed; while a 12" carbon intake forebay in between the CW intake and the SW intake structures. The perforated collection basket can be emptied manually as needed; while a 12" carbon steel drain pipe discharges accumulated backwash water back to the River. All fish and debris removed from the collection basket are placed in a dumpster and disposed of in a sanitary landfill off-site.

A portion of the SW pump discharge is diverted to the SW traveling screens through air operated isolation valves to provide backwash spray water for removing debris from the screen baskets. The spray system utilizes non-clogging, wear-resistant deflector type nozzles, designed to project overlapping fan shaped jets of spray water across the width of the screen so that all material picked up on the screen will be jetted off when the panels are ascending. Debris is jetted in a direction opposite the direction of flow of water in the intake structure. The design screen wash spray flow rate for each screen is 206 gpm, at a minimum of 80 pounds per square inch (psi) gauge pressure (psig).

The traveling screens are equipped with an automatic differential level control, and can be operated manually or in automatic mode. When in the automatic mode, each traveling screen will independently start and the backwash spray isolation valves will open when the screen wash line pressure is > 70 psig, and traveling screen high screen differential level (4 inches H_2O) is sensed by level detectors across the screens. Once initiated automatically, a timer ensures a minimum of 10 minutes of backwash, which is sufficient to provide one full rotation of all screens, even if differential pressure across the screen has reduced below 4 in. H_2O.

4.0 COOLING WATER INTAKE SYSTEM DESCRIPTION

4.1 CIRCULATING WATER SYSTEM INTAKE PUMPS DESCRIPTION, DESIGN PARAMETERS, AND OPERATION

The total nominal design intake flow for the Vermont Yankee CW system is 360,000 gallons per minute (gpm). The total nominal design intake flow for the SW system is 13,400 gpm. The Vermont Yankee CW intake structure terminates at three vertical, centrifugal circulating water pumps. Each single speed (350 rpm) CW pump has a rated 86 feet of total dynamic head (TDH), and a rated flow of 120,000 gpm. The pump drivers are open, drip-proof, with induction motors rated at 1,250 HP. Two CW pumps are typically operated during the winter period. In the springtime, as River temperature rises and plant condenser vacuum increases, all three CW pumps are typically operated. The operation of three CW pumps continues throughout the summer and fall until River temperatures decrease sufficiently to allow the condenser cooling requirements to be met by operating two CW pumps.

4.2 SERVICE WATER SYSTEM PUMPS DESCRIPTION, DESIGN PARAMETERS, AND OPERATION

The Vermont Yankee SW system provides cooling water to plant equipment loads, such as the spent fuel pool, diesel generators, and various pumps and heat exchangers. Four vertical, 3350 gpm capacity, vertical wet-pit, SW pumps take suction from the SW intake forebay, downstream of the traveling screens. During winter operations, two SW pumps are operated. As River temperature increases or equipment heat loads increase, a third SW pump will be operated. During certain summer conditions with low River flow and high River temperatures, all four SW pumps may be operated. Although the SW intake forebay is physically separated from the CW intake forebay, the discharge of the SW system is combined with the discharge of the CW system.

4.3 ADDITIONAL PUMPS TAKING SUCTION FROM THE COMMON INTAKE BAY

Although the primary intake flows are for the CW and SW systems, there are also periodic, minor flows drawn from the River through the SW intake forebay by the electric and diesel driven Fire Protection System pumps. These fire protection pumps are periodically tested for readiness, but are infrequently (or never) in continuous use. The flow from these fire protection pumps is considered process water and not cooling water for the purpose of calculating the percentage of Vermont Yankee's intake flow used for cooling. Two radiological waste dilution pumps are never used and are abandoned in place.

4.4 BIOFOULING CONTROL

Biofouling control is applied twice weekly at the Vermont Yankee CWIS when ambient River water temperatures are greater than 40°F. The application of biocides is performed during closed cycle operation, typically for one or two hours on the selected days. Chemicals, injection pumps, and controls for the biofouling control system are located in the intake structure chemical treatment shed. The CW system may be treated with sodium hypochlorite only or together with sodium bromide. The NPDES Permit requires monitoring, while treating the CW system and establishes discharge limits.

The SW system is chemically treated to reduce corrosion, the accumulation of deposits, and biological fouling, all of which affect the efficiency of heat exchanger components. The primary treatment to reduce biological fouling is through the use of an oxidizing biocide created by mixing sodium bromide and sodium hypochlorite solutions; however, other chemicals are authorized, with established discharge limits, for use in the NPDES Permit. Oxidizing biocide treatment of the SW system in open cycle is permitted, with no detectable oxidant in the CW system at the discharge structure.

4.5 BASELINE MAXIMUM COOLING WATER USE BASED ON PUMP NAMEPLATES OR DESIGN RATED CAPACITY

The baseline maximum cooling water intake flow for the Vermont Yankee CW system is nominally 360,000 gpm with all three of CW pumps running at 120,000 gpm each. The baseline maximum service water intake flow is nominally 13,400 gpm with all four of the SW pumps running at 3350 gpm each.

5.0 COOLING WATER DISCHARGE SYSTEM DESCRIPTION

The cooling water discharge system is an integral part of Vermont Yankee's ability to operate the condenser cooling system in an open, hybrid, or closed cycle mode. There is a direct relationship between the amount of recirculation flow supplied from the discharge structure back into the CW intake forebay and a reduction in CW intake flow. The cooling water discharge structure and its operation control the flow of water to the cooling towers, recirculation to the intake structure, and discharge directly to the River. In general, Vermont Yankee's cooling water intake flow is withdrawn from the River in direct proportion to the amount of water discharged plus the water lost (evaporated) to the atmosphere during cooling tower operations. The paragraphs below describe the cooling water discharge structure, its operation, and its relationship to cooling water intake flow.

5.1 CIRCULATING WATER AND SERVICE WATER SYSTEM DISCHARGE DESCRIPTION, DESIGN PARAMETERS, AND OPERATION

The discharge of the CW system is directed to a discharge structure on the shoreline of the Vermont Yankee site, downstream (south) of the intake structure. Hydraulically operated sluice gates can direct the CW discharge to the River, to the cooling towers, or back to the intake structure through a 126" diameter recirculation line, or a combination of the three. The discharge of the SW system is normally combined with the CW system effluent inside the plant and is completely mixed prior to discharge to the River. During cold weather operations, the SW discharge is diverted to the deep basin (a 1.4 million gallon storage pool beneath the west cooling tower) to prevent icing, prior to the SW being discharged to the River. All CW and SW flows returned to the River are discharged over an aerating structure referred to as the discharge weir.

5.2 COOLING TOWER OPERATIONS AND RECIRCULATION FLOWS

Two 11 cell, cross flow, mechanical draft helper cooling towers are provided on the south side of the Vermont Yankee site. The cooling towers are rated for a total water quantity of 366,000 gpm, with a cooling tower duty of 2600 X 10^5 Btu/hr (Vermont Yankee UFSAR) at an ambient wet bulb temperature of 75°F. The cooling towers have been recently upgraded by the installation of 21 cells of 10 blade fans driven by 200 hp motors. One cell has been left with the prior 8 blade fan and 125 hp motor. The overall length of each cooling tower is 462'-7-1/2", with an overall width of 59'-6" at the top and 45'-6" at the bottom. To provide enough head to lift the CW effluent to the top of the cooling towers, three CW booster pumps are provided within the discharge structure. Each CW booster pump is a single stage centrifugal pump with a nominal flow of 122,000 gpm. The pump drivers are open, drip-proof, induction motors rated at 2,500 HP.

During winter operations, CW flows are discharged to the discharge structure forebay, where through manipulation of the discharge sluice gates, the flow is discharged in open cycle directly to the River over the discharge weir. Two CW pumps are operated, and no CW booster pumps are needed since the cooling towers are not in operation. SW is discharged from the plant to the cooling tower deep basin to prevent icing, and from there flows to the discharge structure afterbay and over the discharge weir to the River.

In early spring (typically March or April), as River temperature increases, the third CW pump is operated to maintain the correct condenser vacuum. No other changes to the pattern of CW or SW flows occur. When freezing concerns no longer exist for the cooling tower deep basin, the SW discharge flow is diverted into the CW flow within the plant, resulting in combined SW and CW flow being released from the plant into the discharge structure forebay.

River thermal discharge limits become more restrictive on 16 May of each year, and these restrictions continue through 14 October of each year. The waste heat removed by the condenser cooling system is generally constant at 100% power throughout the year. However, as River flow rate decreases and River temperature increases during this summer period (16 May – 14 October), the NPDES permit thermal limits restrict the discharge flow of this non-contact cooling water, requiring more of the heat to be removed through use of the cooling towers, thus reducing the intake flow. Historically, by the end of May, it is necessary to operate the cooling towers in a helper mode to limit the heated discharge to the River. Cooling tower operation continues throughout most or all of this summer period and until the end of October of most years.

Two CW booster pumps are operated at the onset of cooling tower operations to supply the discharge of nominally two thirds of the CW and SW systems flow through both cooling towers in natural circulation mode, which then flows out of the towers at a cooler temperature, into the discharge structure afterbay, and finally is discharged over the discharge weir into the River. The remaining third of the flow discharges on open cycle directly to the River.

As River flow continues to decrease during the summer period and ambient River temperature increases, the third CW booster pump is started, causing all of the CW and SW systems discharge flow to be processed by the cooling towers on natural circulation before being discharged to the River.

As River flow continues to decrease and ambient River temperature increases during mid-July through mid-September of most years, cooling tower fans are started as necessary to remove the additional heat before the SW and CW discharge flow is discharged to the River. At this time the ambient wet bulb temperature becomes a third factor in addition to upstream ambient River water temperature and flow that determines the need for, and effectiveness of, heat removal by the cooling tower fans. This is because wet bulb temperature is a measure of humidity in the air, and the cooling towers work more efficiently when the air is dry and less humid than during periods of high wet bulb temperatures. The highest wet bulb temperatures are typically observed at Vermont Yankee during the same period as low River flows and warm ambient River water temperatures (i.e. mid-July through mid-September). When two towers operating with all fans running cannot maintain the discharge heat load from the condenser cooling system below that which the NPDES permit thermal limits allow, the recirculation line sluice gate is partially opened to divert part or all of the CW and SW heated effluent back to the intake structure instead of releasing it to the River.

As the fall approaches, River flow typically increases, ambient River water temperature decreases, and wet bulb temperature also decreases, allowing the recirculation gate to be closed to discharge the condenser cooling water directly to the River. Once the recirculation gate is closed, cooling tower fans are turned off. Historically, this occurs around late-September or October of each year. When all three CW booster pumps are no longer needed to supply water to the cooling towers, one is secured and one third of the CW and SW flow is discharged to the River in hybrid cycle mode. When River flows have increased and River temperatures have decreased sufficiently, the remaining two CW booster pumps are secured, and the SW and CW system flow is directed to the River in open cycle mode of operation. When winter approaches and freezing concerns exist, the SW effluent is again diverted to the west cooling tower deep basin to prevent icing.

During chlorination to reduce biofouling, the discharge structure gates are configured to place the plant in closed cycle operations. In closed cycle mode, 100% of the discharge flow is recirculated back to the CW intake forebay, and all of the suction of the three CW pumps is supplied by this recirculated water. During closed cycle mode, cooling towers are placed in operation as needed, and there is no discharge flow to the River. Chlorination is performed when ambient River water temperatures are greater than 40°F. The plant is not returned to open cycle or hybrid operations until chemistry samples reveal an acceptable dissipation of the chlorine to within the limits established in the NPDES Permit. The normal chlorination duration is twice per week for two hours a day, Mondays and Thursdays.

6.0 CALCULATION OF MONTHLY AND ANNUAL FLOW REDUCTION FROM BASELINE

The "calculation baseline" is defined in the Phase II Regulations as "an estimate of impingement mortality and entrainment that would occur at your site assuming that: the cooling water system has been designed as a once-through 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 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". Although it is not entirely clear exactly how this language would apply to each regulated facility, it is clear that historic plant operations, and in particular, historic and future cooling water inflow reductions due to cooling tower operations, will play a major role in defining "calculation baseline" and a compliance strategy for Vermont Yankee.

Determination of intake flow is not a simple matter for Vermont Yankee primarily because of the plant's hybrid operational capabilities and because discharge flow is not directly measured. As described above in Sections 3, 4 and 5, intake flows cannot be directly determined due to design and continually varying operation of the cooling system (recycling directly into the intake forebay) dictated by the NPDES thermal limits. Even so, plant outflow can be accurately calculated and since inflow must equal outflow, inflow can therefore be indirectly, but accurately calculated. An appropriate method will be developed and used in the Comprehensive Demonstration Study to estimate the actual monthly and annual total cooling water flows for Vermont Yankee under representative historical operating conditions and under the expected future conditions of the power uprate and the amended NPDES permit issued 30 March 2006.

7.0 DESCRIPTION OF PROPOSED AND/OR IMPLEMENTED TECHNOLOGIES, OPERATIONAL MEASURES AND/OR RESTORATION MEASURES

7.1 CURRENTLY IMPLEMENTED TECHNOLOGIES AND OPERATIONAL MEASURES

The primary technological design feature currently implemented at the Vermont Yankee CWIS to comply with the 316(b) impingement and entrainment performance standards is the cooling towers allowing reductions in intake flows during hybrid or closed cycle operations. Flow reductions due to cooling tower operations are expected to be greatest during the summer months when entrainment and impingement mortality are likely to be at their highest throughout the year. A secondary technological design feature of the Vermont Yankee CWIS is the recessed position of the traveling screens from the River shoreline about 55 ft inboard from the fixed racks of the intake bulkhead. Operational measures currently implemented at the Vermont Yankee CWIS that can be credited toward meeting the 316(b) impingement and entrainment performance standards are intake flow reductions, including those resulting from pump differentials, maintenance/refueling outages, and from recirculation of heated condenser flow that is used during hybrid operating mode for compliance with thermal permit limits. The intake flow reductions also reduce the through screen velocities at the fixed bar racks of the CWIS.

7.2 PROPOSED TECHNOLOGIES AND OPERATIONAL MEASURES

7.2.1 Impingement

Entergy expects that the present intake design and operation of the cooling towers at Vermont Yankee will either meet or contribute substantially to meeting the impingement mortality standard for the 316(b) Phase II Regulations. However, Entergy may consider three additional technological options during the CDS phase to further reduce impingement mortality at Vermont Yankee if warranted: (1) providing survival for impinged fish by designing and installing a fish return system, (2) installing a new fish handling and return system that incorporates conservation devices such as fine mesh screens and baskets and uses continuously rotating traveling screen and a low pressure wash water spray header system to remove juvenile and adult fish from the traveling screens for return to the source water body, and (3) addition of a seasonally deployed fish net barrier system.

Under the assumption that impingement abundance is directly proportional to CWIS flow (a fundamental assumption upon which the Phase II Regulations are based), Entergy may also consider one or more operational flow reductions as a condition or conditions of a renewed NPDES discharge permit to further reduce impingement mortality at the Vermont Yankee CWIS. Operational flow reductions for the purpose of reducing impingement mortality at Vermont Yankee may be achieved by one or more of the following measures: (1) seasonal flow reductions achieved through scheduling of refueling outages from the present 18 month cycle providing flow reductions in April or October to a 24 month cycle with the outage occurring during periods of high impingement mortality, (2) installation and operation of variable speed intake pumps to replace the existing intake pump or pumps and reduce intake flows during periods of excess cooling capacity within the amended NPDES permit thermal limits, (3) reduced intake flows due to increased cooling tower operations during seasonal periods of high impingement mortality.

If appropriate, in accordance with 40 C.F.R. §125.94(a)(5), Entergy may estimate whether the costs of these technological or operational options will be significantly greater than (a) the costs considered by USEPA for a like facility in establishing the applicable performance standards, corrected to the extent necessary to account for errors in USEPA's calculation, or (b) the demonstrable benefits of complying with the applicable performance standards (i.e., demonstrable reductions in impingement mortality that would be obtained by installation or implementation of the measures proposed in the preceding two paragraphs). If appropriate, Vermont Yankee may request a site-specific determination of best technology available for minimizing adverse environmental impacts in accordance with 40 C.F.R. §125.94(a)(5).

USEPA estimated the §316(b) compliance costs for Vermont Yankee and presented these in Appendix A of the preamble to the final Phase II Regulations (See 69 Fed. Reg. 41671). For the Vermont Yankee CWIS, USEPA estimated that the annualized compliance cost would be $1,812,711 (Appendix A, Column 7), the total capital cost would be $12,788,752 (Appendix A, Column 4), and the total net revenue losses from net construction down would be $17,224,807 (Appendix A, Column 8). The USEPA-estimated annualized 316(b) compliance costs comprise the annualized capital and operation and maintenance ("O&M") using a USEPA design intake flow (See 69 Fed. Reg. 41646). These costs reflect a USEPA-selected technology #7 (Appendix A, Column 12) of "Relocation of an existing intake to a submerged offshore location with passive fine-mesh screen inlet with mesh width of 1.75 mm".

7.2.2 Entrainment

Entergy expects that the present intake design and operation of the cooling towers at Vermont Yankee will meet the entrainment performance standard for the 316(b) Phase II Regulations. However, Entergy may consider one additional technological option to further reduce entrainment at Vermont Yankee if warranted: (1) a seasonally deployed aquatic filter barrier system.

Under the assumption that entrainment abundance is directly proportional to CWIS flow (a fundamental assumption upon which the Phase II Regulations are based), Entergy may also consider one or more operational flow reductions as a condition or conditions of a renewed NPDES discharge permit to further reduce entrainment at the Vermont Yankee CWIS. Operational flow reductions associated with entrainment at Vermont Yankee are the same as described above in Section 7.2.1 for reducing impingement mortality, although they may be implemented in a different period or periods depending on the seasonal occurrence of entrainment.

If appropriate, in accordance with 40 C.F.R. §125.94(a)(5), Entergy may estimate whether the costs of these technological or operational options will be significantly greater than (a) the costs considered by USEPA for a like facility in establishing the applicable performance standards, corrected to the extent necessary to account for errors in USEPA's calculation, or (b) the demonstrable benefits of complying with the applicable performance standards (i.e., demonstrable reductions in entrainment that would be obtained by installation or implementation of the measures proposed in the preceding two paragraphs). If appropriate, Entergy may request a site-specific determination of best technology available for minimizing adverse environmental impacts in accordance with 40 C.F.R. §125.94(a)(5).

8.0 HISTORICAL STUDIES CHARACTERIZING IMPINGEMENT MORTALITY AND ENTRAINMENT AND/OR PHYSICAL AND BIOLOGICAL CONDITIONS

Extensive environmental monitoring has been performed annually in the Connecticut River in the vicinity of Vermont Yankee since 1967. These monitoring studies have covered a wide range of river temperature and flow conditions, and have included the major aquatic community components, including phytoplankton, zooplankton, benthic macroinvertebrates, and both resident and migratory fish. They have been performed over all CWIS operating conditions ranging from pre-operation (1967-1973), closed-cycle, hybrid-cycle (partial use of cooling towers) and once-through cooling. The Connecticut River study area where the biological monitoring programs were performed during the 1991- present period includes areas both upstream and downstream of Vermont Yankee within the lower Vernon Pool, and in the tailrace waters immediately below Vernon Dam (Figure 8-1). Vernon Dam divides the study area into two primary habitat types, lentic and lotic. The slow-flowing or ponded areas of the River found in lower Vernon Pool represent the lentic habitat. The rapid-flowing or turbulent area of the River found in the Vernon Dam tailrace represents the lotic habitat. Lower Vernon Pool is the source water body for cooling water withdrawal at the Vermont Yankee CWIS, and therefore this lentic habitat is an appropriate study area to characterize the biological community exposed to entrainment and impingement mortality.

8.1 WATER QUALITY

Water quality samples were collected every 15 days from Stations 3 and 7 (Figure 8.1) in 1969, 1974, and 1983 using similar methodology to facilitate comparison over the 15 year period (Binkerd 1985). Dissolved oxygen concentration was highest in the winter (typically 13-14 mg/l), corresponding with the seasonal minimum in water temperature (32°F). Dissolved oxygen was lowest in the late July through early August period when water temperature was highest, river flow is low, and biological activity is increased compared to other times of the year. The minimum dissolved oxygen observed was 6.15 mg/l in July, 1983. Seasonal variation in pH was minimal and ranged from 6.7 in February 1984 to 7.5 in September 1983. Total phosphate was lowest in the summer months reflecting the summer activity of plant and phytoplankton growth removing soluble phosphate from the water.

Several water quality parameters were monitored from monthly grab samples taken at Stations 7, 3, and the plant discharge from 1991-present (Table 8-1). Beginning in 1996, monthly grab samples from Stations 7, 3, and the plant discharge were monitored only for copper, iron, and zinc concentrations as outlined in NPDES Permit #3-1199. Metal concentrations in the grab samples were generally low, with higher iron (> 1.0 mg/L), zinc (> 0.02 mg/L), and copper (>0.01 mg/L) concentrations associated with storm events which may have re-suspended river sediments into the water. Turbulent flow through Vernon dam during high flow events likely re-suspended river sediments, and contributed to the higher metal concentrations generally observed at Station 3 (below dam) compared to Station 7 (upstream).

8.2 PLANKTONIC COMMUNITY

8.2.1 Phytoplankton

Binkerd et al. (1978) summarized the 1968-1977 analyses conducted on entrainment and thermal effects on the phytoplankton community due to Vermont Yankee's CWIS operation. The conclusion of this study was that the "operation of Vermont Yankee in hybrid or open cycle condenser cooling modes had not effected a demonstrable change in the phytoplankton community of the river." In addition, that study found that entrainment does not usually result in a complete loss of viability of phytoplankton. Observations of phytoplankton composition in the Connecticut River near Vernon during 1981-1989 revealed a continued diversity in the number of species present (Downey et al. 1990). Phytoplankton sampling conducted from April through November at the intake and discharge of Vermont Yankee was discontinued in 1996. The EAC direction to Vermont Yankee at the time of the 1990 §316(a) and §316(b) Demonstrations (Downey et al. 1990) was that the phytoplankton, zooplankton, and benthic macroinvertebrate communities were classified as "low potential impact" biotic categories, per USEPA guidance (1977). Pursuant to the EAC recommendation, VANR removed phytoplankton sampling from the annual monitoring program requirements of the renewed NPDES permit issued by VANR on 21 March 1996.

Shambaugh (1987) reports aspects of the temporal and spatial distribution of phytoplankton in Upper Turners Falls Pool (downstream from Vernon Dam) in the Connecticut River near Vernon, VT during July-October, 1986. Although not specifically the source water body for the Vermont Yankee CWIS, the Shambaugh (1987) report is summarized here to represent the species composition and relative abundance of the phytoplankton community in Vernon Pool, the next upstream impoundment. Phytoplankton representing seven phyla were reported: Bacillariophycophyta (diatoms), Chlorophycophyta (green algae), Chrysophycophyta (golden-brown algae), Cryptophycophyta (Cryptomonads), Cyanochloronata (blue-green algae or cyanobacteria), Euglenophycophyta (Euglenoids), and Pyrrophycophyta (dinoflagellates). Cryptomonads (*Chroomas* sp.) were the most abundant phytoplankton in all collections; they contributed from 40 to 90% of the total algal density. The chryptomonads, golden-brown algae, and diatoms contributed to the majority of phytoplankton biomass. Diatom density increased in the fall while green algae were abundant before August. Cyanobacteria were low at all stations except for a period in September when there appeared to be an *Anabaena* bloom. The cryptomonads reached their highest abundance during August and early September. The golden-brown algae were most abundant in early summer and the euglenoids and dinoflagellates occurred in low numbers infrequently throughout sampling. Phytoplankton density and biomass during diel collections on June 25-26 were found to be highest during morning hours and lowest in the afternoon; there was no diel difference in relative community composition. Spatial variability in phytoplankton density, biomass or composition was not detected during the 16 week study. Selected water quality parameters (temperature, dissolved oxygen, nitrates, phosphates, BOD, pH) were not correlated with phytoplankton abundance or biomass.

8.2.2 Zooplankton

The zooplankton of the Connecticut River near Vernon, VT was monitored from 1970 to 1995. The 1978 §316(a) and §316(b) demonstrations (Binkerd et al. 1978) evaluated both entrainment and thermal effects of Vermont Yankee's hybrid or open cycle modes of operation on the zooplankton community. Large annual variability in zooplankton and community composition was reported. These trends reflected natural seasonal and annual cycles. During hybrid or open cycle operations, there was no statistical differences in the density or diversity of zooplankton downstream (Station 3) or upstream (Station 7) of Vernon Dam. As part of the 1986 NPDES permit, monthly zooplankton samples were required only at the intake and discharge structures, April through November. Two additional investigations on zooplankton were conducted in 1986 and 1988 (Timmons 1988, Shambaugh and Downey 1990).

Timmons (1988) conducted temporal and spatial investigations of zooplankton populations downstream of the Vernon Dam in the upper Turners Falls pool during the summer (July-October) of 1986. Although not specifically the source water body for the Vermont Yankee CWIS, the Timmons (1988) report is summarized here to represent the species composition and relative abundance of the phytoplankton community in Vernon Pool, the next upstream impoundment. A diel study conducted on June 25-26 found that zooplankton density just below the surface was greatest during the evening (18:00-20:30 hours) with an average of 690 zooplankton/100 liters (6,900/m^3). Lowest zooplankton concentrations were observed in the mid-day (13:00-17:30) samples which averaged 130 organisms/100 liters (1,300/m^3). Morning and night densities averaged 390 and 540 organisms/100 liters (3,900 and 5,400/m^3) respectively. Many of these observed differences in zooplankton densities were the result of relative changes in the rotifer populations during the diel study. Total zooplankton densities at all stations and times were predominantly rotifers. Rotifer density was highest during July and late August, and lowest in October. Cladocerans and copepods represented approximately 4% and 22%, respectively, of the total zooplankton population and their density and biomass did not vary significantly among stations or during the months sampled. Overall zooplankton density was consistent with past monitoring programs.

The NPDES monitoring program for zooplankton documented that a diverse zooplankton community exists in Connecticut River near Vernon, VT (Downey et al. 1990). No alteration of zooplankton standing crop beyond natural population fluctuations either upstream or downstream of Vernon Dam was observed during hybrid operations (Downey et al. 1990). Pursuant to the EAC recommendation, VANR removed zooplankton sampling from the annual monitoring program requirements of the renewed NPDES permit issued by VANR on 21 March 1996.

8.3 BENTHIC MACROINVERTEBRATE COMMUNITY

Regular annual NPDES sampling documented a diverse benthic macroinvertebrate community with over 200 taxa, representing nine phyla (Downey et al. 1990). The absence of commercial and endangered species and the lack of measurable change to the community indicated that appreciable harm to the macroinvertebrate community by hybrid operations during the summer period (Project SAVE) did not occur (Downey et al. 1990). The EAC direction to Vermont Yankee at the time of the 1990 §316(a) and §316(b) Demonstrations (Downey et al. 1990) was that the phytoplankton, zooplankton, and benthic macroinvertebrate communities were classified as "low potential impact" biotic categories, per USEPA guidance (1977). Pursuant to the EAC recommendation, VANR removed phytoplankton and zooplankton sampling from the annual monitoring program requirements of the renewed NPDES permit issued by VANR on 21 March 1996, but retained annual monitoring requirements for benthic macroinvertebrate and fish communities.

Vermont Yankee's 316(a) Demonstration Report (April 2004, Normandeau 2004) provides an evaluation of the results of the VANR- and EAC-approved benthic macroinvertebrate and fish monitoring studies performed during 1991 through 2002, a period following adoption of the incrementally higher temperature discharge limits requested in Vermont Yankee's 1990 §316(a) and §316(b) Demonstration. The results of these studies demonstrate that the existing discharge has not caused appreciable harm to these biological communities and that a balanced indigenous community of aquatic biota has been maintained in the vicinity of Vermont Yankee and will be maintained under the proposed changes in thermal discharge limits described in the Demonstration Report (Normandeau 2004). This conclusion was reached in part by statistical analysis of the results of NPDES permit-required biological monitoring programs that were performed to inter-annual trends in abundance of benthic macroinvertebrates and fish populations during 1991-2002 (Normandeau 2004). Normandeau (2005) performed this same analysis with the addition on data from 2003 and 2004. Results are summarized below.

Macroinvertebrate samples were collected at four locations in the River from 1991 through 2001 and at two stations from 2002- present. Two locations (Stations 2 and 3) are downstream of Vernon Dam and two (Stations 4 and 5) are upstream of the Dam (Figure 8.1). Sampling effort has varied during the 1991-2005 period due to equipment loss, changes in gear, and changes in permit monitoring requirements. Two sampling methods were employed: grab sampling and "rock basket" colonization samplers. Ponar or Ekman grab samples were collected in June, August, and October in each year from 1991 until 2001 when grab sampling was discontinued pursuant to the EAC's direction. Rock basket samples were collected after 30 to 60 days River exposure on two occasions during the interval of June through October in each year, except in 2001 when VANR directed in the current NPDES permit that an additional sampling effort be undertaken at Stations 2 and 3, and that sampling at Stations 4 and 5 (in the Vernon Pool source water body for the CWIS upstream of Vernon Dam) be eliminated.

All invertebrates collected for a given year were grouped into nine major taxonomic groupings (Crustacea, Diptera, Ephemeroptera, Gastropoda, Oligochaeta, Other, Pelecypoda, Trichoptera, and Turbellaria). Rock basket effort was standardized across samples by converting total abundance of a major taxonomic grouping in a year to numbers of that taxon per basket per 30 days of deployment. Ponar grabs were converted to numbers of each major taxonomic grouping per 27 Ponar grabs. A nonparametric Mann-Kendall test was used to examine the 1996-2004 annual time series of each major grouping of macroinvertebrate CPUE for significant increasing or decreasing trends (Helsel and Hirsch 1991, Chapter 12).

Fourteen years of monitoring produced samples that contained a diverse mixture of taxa representative of a balanced indigenous population, including invertebrate species considered sensitive to poor water quality or habitat disturbance. Variations in abundance and diversity were well within the range of natural stochastic and response processes affecting benthic invertebrate populations (Normandeau 2004, 2005). Total numbers of macroinvertebrates collected by Ponar grab and rock baskets at the stations upstream from Vernon Dam (Stations 4 and 5) is presented in Figure 8-2. In general, greater numbers were collected in the grabs upstream of Vernon Dam in lower Vernon Pool (Stations 4 and 5) than were collected at Stations 2 and 3 located downstream of the Dam while there was no discernable relationship between station location and total numbers of macroinvertebrates collected with the rock baskets (Normandeau 2004). This relationship among the stations for the grab samples was consistent and likely reflective of differences in habitat productivity due to the predominance of sediments and rocky substrate upstream and downstream of Vernon Dam, respectively.

Diptera (true flies) were collected in greatest numbers in the grabs in most years at all stations, likely due to the greater efficiency of grabs for sampling the unconsolidated soft substrate that Dipteran larvae often dominate. Oligochaeta (worms), Gastropoda (snails), and Pelecypoda (bivalves) were also numerically important in nearly all Ponar samples. Occasionally, these groups and/or Trichoptera (caddisflies), Turbellaria (flatworms), and Crustacea (scuds, sowbugs, and crayfish) were collected in greatest numbers at one or several stations. This is likely due to the spatial heterogeneity of substrates such as gravel, sand, silt and clay and the specificity of many taxa for these and other substrate types. Diptera were not collected in greatest numbers in the rock baskets in most years as they were in the grab samples. In fact, the identity of the higher taxonomic groups collected in greatest numbers varied greatly from year to year at most stations. This variability is likely due to the microhabitat that the rock baskets were deployed in, for instance whether they were deployed in sand or gravel substrates at a station with diverse microhabitats. Species composition of benthic macroinvertebrates from Station 4 (closest to Vermont Yankee's CWIS, therefore most representative of the population susceptible to entrainment or impingement) is presented in Table 8-2 and Figure 8-3.

Macroinvertebrate community composition, relative species abundance and annual total abundance have remained nearly constant during the annual 1991 to 2004 monitoring programs (Normandeau 2004, 2005). Among the grab samples, only one inter-annual test (Oligochaeta collected by Ponar grab at station 5) was significant, which indicated a negative trend in oligochaete abundance from 1996-2002 (Normandeau 2004). Mann-Kendall correlation analyses on rock basket samples (1996-2004, Normandeau 2005) showed a non-significant but decreasing trend from eight of the twenty analyses conducted, while eleven tests showed non-significant positive trends in catch for certain taxa. The remaining two tests showed no readily discernable overall trends. Therefore, these interannual trend analyses collectively demonstrate that the macroinvertebrate community in the vicinity of Vermont Yankee has remained stable over the observed period (Normandeau 2005).

8.4 FISH COMMUNITY

Vermont Yankee's environmental monitoring programs have collected extensive data on the fish community of the Connecticut River near Vernon, VT annually since 1968. Downey (1990) describes the fish community near Vernon from collections made during 1968-1989 with various gear types both upstream and downstream of Vernon Dam. Yellow perch, white perch, centrarchids, minnows, and white suckers were numerically important components of the fish community. Fish community composition remained stable during the period 1968-1989 with increasing abundance of anadromous fish resulting from restoration efforts.

This section summarizes general trends in the fish community found upstream of Vernon Dam by using the data from the routine sampling performed during 1991 – 2004, as specified in "Part III Environmental Monitoring Studies, Connecticut River – Fish and - Larval Fish" sections of Vermont Yankee's NPDES Permit No. 3-1199 (Normandeau 2004). This fish sampling continued the majority of the monitoring tasks performed since the late 1960s and reviewed in the 1990 §316(a) and §316(b) demonstrations (Downey et al. 1990). The total data set exceeds 30 years and illustrates relative consistency in sampling methods, locations, and effort, providing a sound basis for analysis. Electrofishing and trap net sampling conducted upstream of Vernon Dam is representative of the fish community exposed to impingement on Vermont Yankee's CWIS while fish eggs and larvae samples upstream of Vernon Dam represent the ichthyoplankton community vulnerable to entrainment.

Electrofishing and trap net sampling occurred during May, June, September and October of each year. Electrofishing has been performed throughout the 14-year period, while trap net sampling was discontinued at the direction of VANR and the EAC after 1999. Electrofishing was performed with a boat electroshocker in the evening beginning approximately 0.5 hour after sunset at stations above and below Vernon Dam. Trap nets consisted of a steel frame covered with 1.3-cm square-mesh knotless nylon with a 1 x 2-meter mouth opening, two 8-m long wings and a 30-m center lead. Trap nets were deployed for approximately 48 hours for each monthly sampling event and all fish collected were removed and processed after about 24 hours and at the conclusion of sampling.

Over 19,000 fish were collected upstream of Vernon Dam by electrofishing (Table 8-3) and trap netting (Table 8-4) from 1991-2004. Spatial differences are apparent in the relative abundance of several species with regard to catches obtained upstream versus downstream of Vernon Dam (Normandeau 2004). The River upstream is characterized by relatively slow-moving pool habitat that is more favorable to species typical of lentic (slow-moving) habitats, whereas the habitat downstream in the Vernon Dam tailrace is more riverine and faster flowing (lotic) in character. Trap net and electrofishing samples from the lentic stations upstream of Vernon Dam represent the fish community vulnerable to impingement in Vermont Yankee's CWIS. The most common fishes in electrofishing collections upstream of Vernon Dam were yellow perch (36% of total), bluegill (19%), spottail shiner (9%), pumpkinseed (9%), and largemouth bass (7%, Table 8-5). Species composition upstream of Vernon Dam was similar for the trap net collections which were dominated by yellow perch (45%), pumpkinseed (17%), rock bass (8%), bluegill (7%), and white sucker (5%).

Long-term Community Composition

To provide an indication of the composition and relative abundance of selected species over the 33-year study period during which fish have been sampled in connection with Vermont Yankee, the electrofishing and trap net combined collection results for sampling performed upstream of Vernon Dam for this review period are shown in comparison to collection results summarized in Downey et al. (1990) for the two prior review periods, 1968 – 1980 and 1981 – 1989, in Table 8-6. This table includes sampling results for 18 species, which represent about half of the total number collected over 33 years, and includes all Representative Important Species (RIS). The data confirm a general similarity in community composition upstream of Vernon Dam over the three review periods, although several relatively minor differences are evident, likely as a result of natural cycles of variability in the life history of the various species, the introduction of fishways and changes in sampling methods.

A nonparametric Mann-Kendall test was used to examine the 1991-2002 time series for significant increasing or decreasing trends (Helsel and Hirsch 1991, Chapter 12) in annual total catch per unit of effort (CPUE) for each of the nine RIS as previously described in the benthic macroinvertebrate section (Normandeau 2004). This analysis was initially performed on the 1991-2002 time series for the electrofishing data and for 1991-1999 for trap net data in the 2004 316(a) Demonstration Report (Normandeau 2004). Normandeau (2005) performed the same trend analysis for the electrofishing data with addition of data from 2003 and 2004.

Electrofishing CPUE for all species combined, upstream of Vernon Dam displayed an increasing trend over the 14 year period, although this trend was not statistically significant (Normandeau 2005). No statistically significant trends were observed in annual electrofishing CPUE during the 1991-2004 period for spottail shiner, smallmouth bass, yellow perch, largemouth bass or fallfish. The rare occurrence of Atlantic salmon in the electrofishing or trap netting effort (three salmon smolts collected between 1991-2004, none were collected upstream of the Vernon Dam) precluded any statistical trend analysis.

No statistically significant trend was observed in American shad annual total electrofishing CPUE during the 1991-2004 period downstream of Vernon Dam in the Vernon Dam tailwaters. However, a statistically significant decreasing trend was observed in the time series of annual total electrofishing CPUE upstream of Vernon Dam in lower Vernon Pool which corresponds with lower annual fish passage counts in recent years at the Vernon Dam fishway beginning in about 1997 (Normandeau 2005). A significant, decreasing trend was detected in the annual walleye CPUE from the electrofishing time series (1991-2004) upstream and downstream of Vernon Dam. White sucker has shown significant decrease in annual total electrofishing CPUE throughout the entire permit-required monitoring area of the Connecticut River for the time series from 1991 through 2004.

Impingement

The impingement of fishes on Vermont Yankee's intake screens has been monitored since 1974. Data collected during the period 1974-1984 was summarized by Downey and Haro (1985). From 1974-1984, approximately 36,500 fish were collected in 1,440 impingement samples at Vermont Yankee. Juvenile sunfishes (*Lepomis* spp.) and spottail shiners comprised most of the fish collected. Impingement rates for both circulating water and service water screens were quite low, averaging 25 fish (221 grams), and <1 fish (6 grams) per 24 hour sample, respectively. Impingement rates were highest in April and June and lowest in December-March and July-August. Although some minor variation occurred, inter-annual comparisons were consistent and the impact of impingement on fish populations was assessed to be quite low. Impingement monitoring in Vermont Yankee's service water traveling screens was not required in the 1986 NPDES permit due to low impingement rates. Circulating water impingement monitoring requirements were continued with sampling concentrated on times when anadromous fishes, particularly Atlantic salmon and American shad, might be present.

Impingement monitoring for the period 1985-1989 was summarized by Briggs and Downey (1990). Nearly 3,500 fish were collected in 120, twenty-four hour impingement samples from 1985-1989. More than 80% of these fish were juvenile *Lepomis*, rock bass, minnows (Cyprinidae), or yellow perch, with impinged fish were typically < 100 mm in total length. Daily impingement rates were low, averaging 29 fish (320 grams) per 24 hour sample. Analysis of 16 years of impingement data indicated that impingement of resident and anadromous fish by Vermont Yankee had little effect on the fish community (Downey et al. 1990).

Impingement monitoring has continued from 1991-present when Vermont Yankee was operating in open or hybrid cycle mode. Sampling generally occurred weekly between April 1-June 15; and from August 1-October 31. Prior to the start of each weekly sample, the circulating water screens were backwashed and the debris removed and examined for anadromous fish (Atlantic salmon and American shad). On the following day the screens were backwashed and sorted for impinged fish (all species). Nearly 18,000 fish were collected in impingement samples from 1991-2004 (Table 8.7). Species composition of impinged fish from 1991-2004 was similar to that reported from 1974-1984 (Downey and Haro, 1985) and 1985-1989 (Briggs and Downey, 1990). Over the 14 year period (1991-2004), juvenile bluegill (24.7% of total), yellow perch (16.0%). *Lepomis* sp. (12.4%), and rock bass (10.2%) were numerically dominant in the impingement collections during spring and fall.

Annual species composition in the impingement samples was relatively consistent from 1991-2004 (Figure 8.4).

Ichthyoplankton Entrainment

Ichthyoplankton sampling began in 1974 as part of the evaluation of the Vermont Yankee phase studies. Sampling during 1974-1977 focused on the entrainment of ichthyoplankton by sampling at various depths in the intake structure forebay. Larval fish collected were enumerated and densities reported by Binkerd et al. (1978) were generally <1 fish/m^3. In 1982, an intensive investigation of ichthyoplankton entrainment was undertaken at the intake structure and compared to ichthyoplankton abundance data obtained at various locations upstream and downstream of Vernon Dam (Binkerd et al. 1983). Ichthyoplankton were collected at various depths and at several locations during 1982-1985 as part of Project SAVE (Downey et al. 1990). Since 1986, annual ichthyoplankton sampling has focused on various depths in front of the intake structure from 1 May to 15 July, as part of the 1986 NPDES permit.

Ichthyoplankton sampling from 1982-1989 was summarized by Downey (1990). White perch and minnow larvae represented about 95% of the nearly 37,000 larval fish (14 taxa) collected. White perch usually appeared in mid-May, and were regularly collected through early July (peak from late May-early June); they were most frequently captured in the middle and bottom strata of the water column. Minnow larvae were abundant during most of the summer and were most often encountered near the surface. Minnow larvae were the principal ichthyofauna collected during late June and July. Sunfish, suckers, yellow perch and walleye were collected consistently, but usually in low numbers. Yellow perch and walleye appeared only during a short time period in May and were typically the earliest fish larvae collected in the season. Ichthyoplankton densities were typically < 1 fish/m^3, although densities of minnows during late June and July of 3-5 fish/m^3 were observed. Densities of abundant taxa were relatively low in intake samples and were comparable to densities observed in river samples. Shallow shoreline areas were more productive and contained much higher densities of the abundant taxa than the intake collections. The evaluation of ichthyoplankton near Vernon indicates that the entrainment did not result in appreciable harm to the fish community during Project SAVE (Downey et al. 1990).

Weekly ichthyoplankton sampling in the vicinity of the Vermont Yankee intake structure during the open/hybrid cycle during May through mid-July has continued annually since the 1991 NPDES permit. Samples are taken from surface (0.3 m), mid-depth (1.8m), and near bottom (3.7 m) strata with a 50 cm. diameter, 363 μm mesh plankton net. Sampling is only required when Vermont Yankee was operating its CWIS. From 1991-2004 nearly 12,000 ichthyoplankton specimens were collected (Table 8-8). Cyprinids (minnows and carps), together with white sucker and white perch, were numerically dominant. Cyprinids accounted for about 62% of all larvae collected from 1991-2004.

It is likely that the spottail shiner was the dominant species of the Cyprinidae component in ichthyoplankton collections obtained throughout the 1991-2002 period, since it can be noted in Table 8-6 that no specimens were attributed to the *Notropis* sp. or Cyprinidae category after 1997, while numbers identified as spottail shiner increased coincidentally. This transition occurred due to more detailed identification to the species level of taxonomy. Specimens categorized as Centrarchidae (sunfishes) and *Lepomis* sp. were numerically important in some years. Walleye were collected in most years, but in very low numbers. American shad and largemouth bass rarely entered the ichthyoplankton catch and thus were rarely exposed to entrainment.

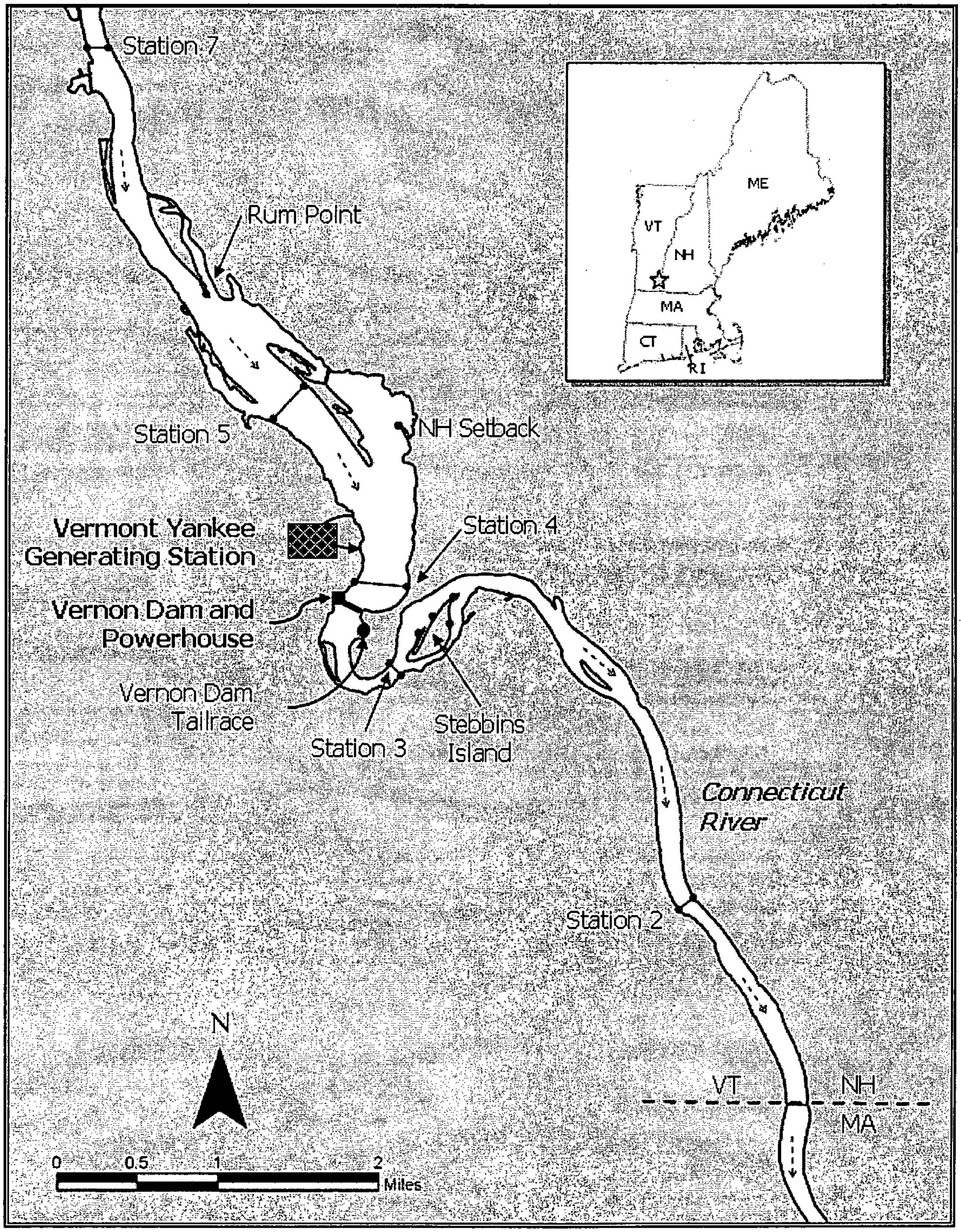


Figure 8-1. Connecticut River in the Vicinity of Vernon Pool.

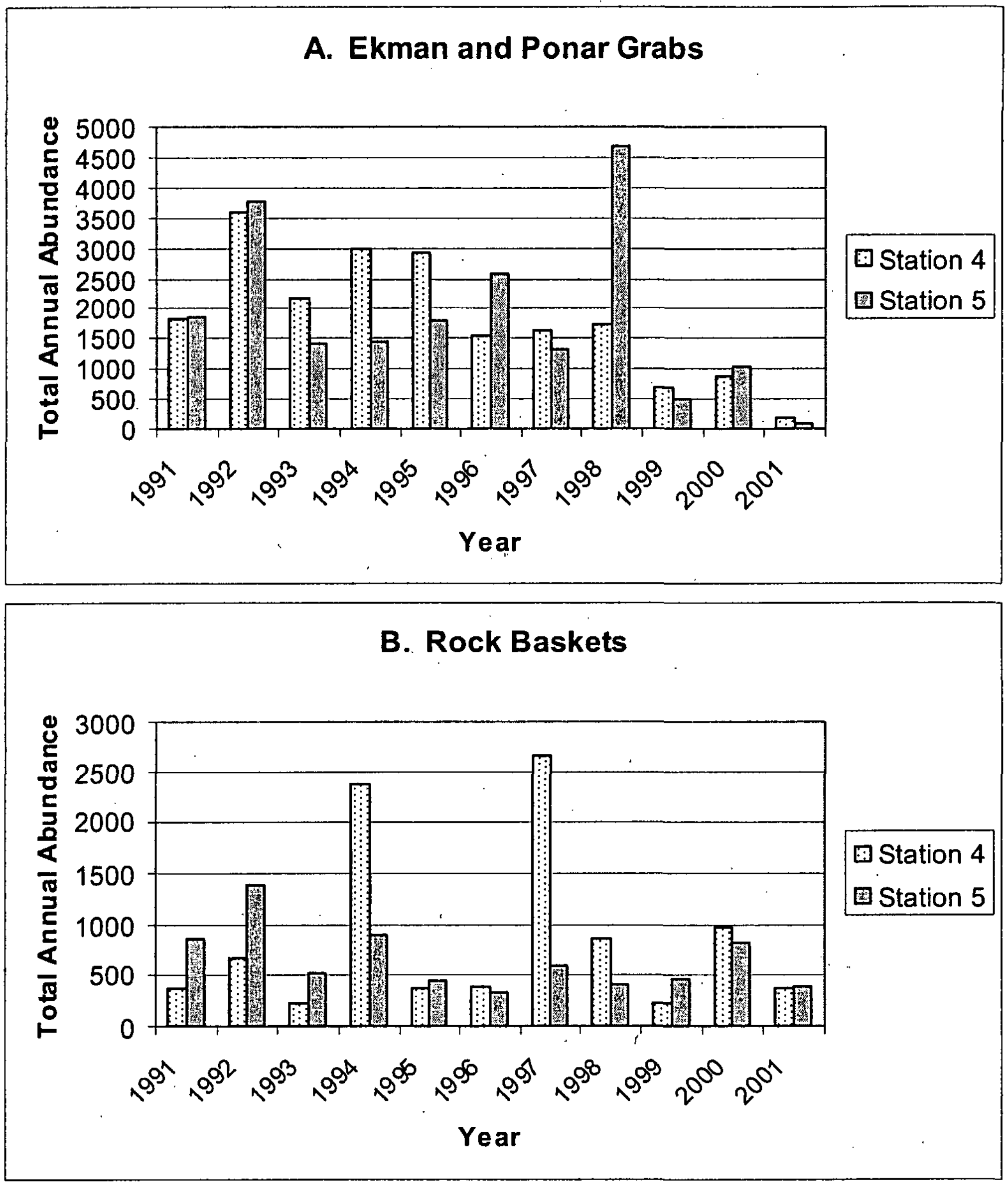


Figure 8-2. Total number of macroinvertebrates collected by (A) Ekman and Ponar grabs (upper panel) and (B) Rock baskets (lower panel) in the Connecticut River upstream (Stations 4,5) of Vernon Dam, 1991 through 2002. Samples were collected in June, August, and October, except in 2001 when they were collected only in June. All grab sampling and upstream rock basket sampling was discontinued in 2002.

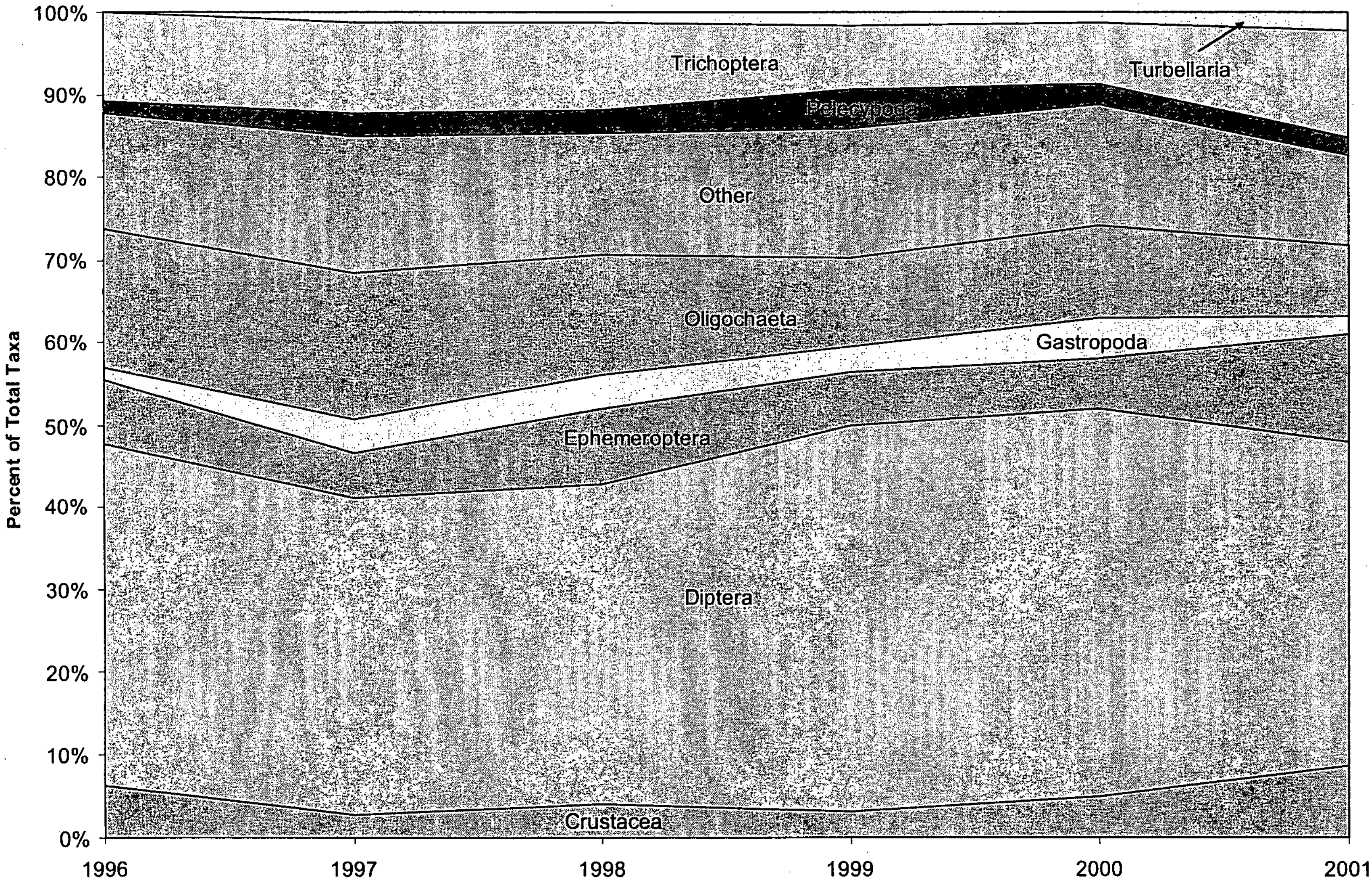


Figure 8-3. Percent of total taxa per year made up by each major taxonomic group identified from rock baskets and grab samples from Station 4 from 1996 to 2001.

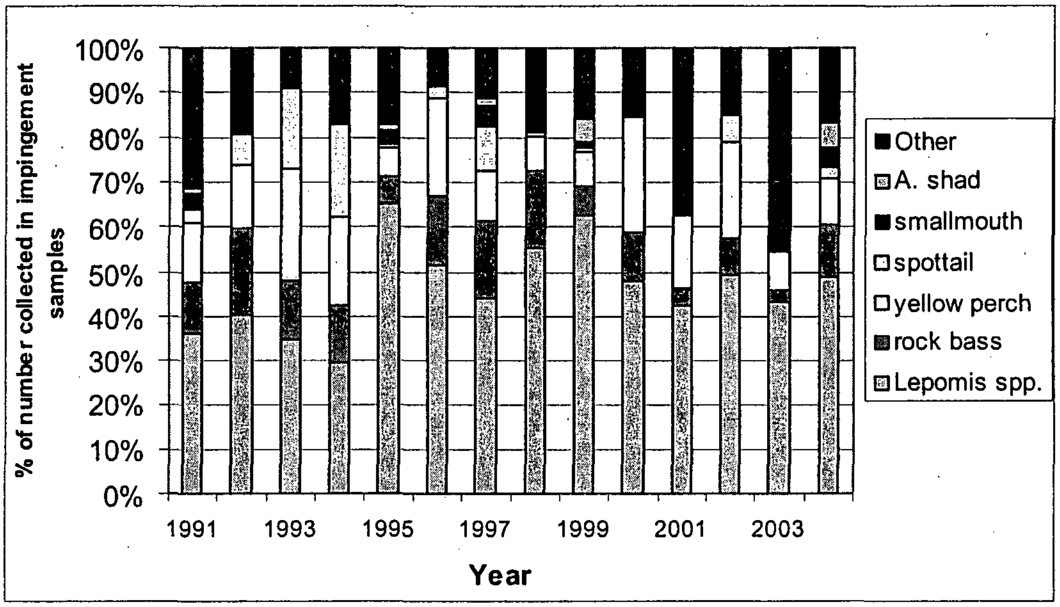


Figure 8-4. Relative species composition (% total) in impingement samples from 1991-2004. Bluegill, pumpkinseed, and unidentified sunfish were pooled and classified as "*Lepomis* spp." to account for the more detailed identification to the species level that occurred from 1996-2004 (Normandeau) compared to 1991-1995 (Aquatec).

Table 8-1. Range of water quality parameters collected from grab samples at NPDES Stations 7, 3, and Vermont Yankee Discharge during 1991-2004.

Parameter (units in mg/L unless otherwise noted)	Location					
	Station 7		Station 3		Discharge	
	min	max	min	max	min	max
Dissolved Oxygen[a]	7.4	15.6	7.6	15.8	6.5	13.8
pH[a]	6.7	7.9	6.6	8.0	6.7	8.3
Alkalinity as $CaCO_3$[a]	16.0	47.1	20.0	46.9	19.5	49.0
Calcium[a]	8.7	19.1				
Magnesium[a]	1.2	2.0				
Total Hardness[a]	24.0	55.5				
Sodium[a]	2.5	8.1	3.2	7.8	3.4	12.5
Chloride[a]	5.3	13.6	4.8	13.0	4.8	14.8
Sulfate[a]	5.0	14.2	5.3	10.0	5.2	11.0
Total Kjeldahl Nitrogen[b]	<.01	1.00				
Ammonia[b]	0.006	0.120				
Nitrate + Nitrite[b]	0.110	0.370				
Total Phosphate[a]	0.001	0.820				
Total solids[a]	37	380	33	182	48	189
Total Suspended Solids[a]	1	210	1	97	1	75
Turbidity (NTU)[a]	0.7	71.0	0.6	53.0	0.8	45.0
Copper[c]	0.001	0.135	0.001	0.748	0.001	0.053
Iron[c]	0.070	117.000[d]	0.088	12.200[d]	0.062	3.720[d]
Zinc[c]	0.002	0.220	0.003	2.890	<.003	2.070

[a] Years included: 1991-1996
[b] Years included: 1991-1992
[c] Years included: 1991-2004
[d] bottom sediments may have contaminated

Table 8-2. Composition of macroinvertebrates collected in Ekman or Ponar grabs and rock baskets at Station 4, 1991-2001 (Grab sampling and rock baskets upstream of Vernon Dam was discontinued in 2002).

Gear	Taxa	% of the Total Catch										
		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Grabs	Crustacea	1.1	2.4	2.3	1.4	0.8	0.2	6.8	0.5	2.7	24.9	6.7
	Diptera	29.7	22.1	38.5	53.4	32.7	68.2	54.7	58.9	56.6	40.8	45.3
	Ephemeroptera	6.4	1.3	3.9	3.8	4.4	0.6	0.4	2.8	1.9	2.6	0.6
	Gastropoda	1.3	0.3	1	1.1	0.5	0	7.1	1	0	12.1	1.7
	Oligochaeta	19.9	35.3	37.6	31.1	41.7	26.4	17.5	30.3	22.7	12.2	36.9
	Other	1.5	0.8	0.7	1.3	0.9	1	4.9	1.7	8.4	2.6	1.7
	Pelecypoda	38.4	35.8	15.2	5.7	16.9	2.1	5.7	2.1	3.8	1.8	1.7
	Trichoptera	1.3	0.7	0.6	2.3	1.4	1.6	2.9	2.6	3.8	3	5.6
	Turbellaria	0.5	1.3	0.1	0	0.7	0	0	0	0	0	0
	Total	100	100	100	100	100	100	100	100	100	100	100
Rock baskets	Crustacea	4.1	19.2	6.9	6	14.4	47.7	75	38.9	37.8	20.9	10.9
	Diptera	39.5	24.7	17.6	26.9	20.1	18.5	7.8	21	8.1	10.4	11.5
	Ephemeroptera	13.1	16.4	49.5	5.5	25.3	15.4	0.9	9.8	8.1	4.9	10.4
	Gastropoda	1.9	1.2	6.5	20	2.3	2.1	0.3	4.4	9	5.1	15.9
	Oligochaeta	0	16.7	1.4	5.5	1.8	6.7	5.2	11.2	12.6	6.5	25
	Other	26.2	15.1	9.3	3.6	11	3.1	3.4	7.9	18	49.5	13
	Pelecypoda	0	0	0	0.5	0	0	0.3	0.5	0	0	0
	Trichoptera	14.2	6.7	7.9	30.1	24.3	6.7	7	6.3	6.3	2.7	13.3
	Turbellaria	1.1	0	0.9	1.8	0.8	0	0	0	0	0	0
	Total	100	100	100	100	100	100	100	100	100	100	100

Table 8-3. Numbers and percent of fish collected by electrofishing upstream of Vernon Dam, 1991-2004.

	1991		1992		1993		1994		1995		1996		1997		1998		1999		2000		2001		2002		2003		2004				No.
Species	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	Total No.	%	Fish/Hr.
Sea lamprey	2	0.1	0	0	1	0.1	0	0	0	0	1	0.1	9	1.4	5	0.6	4	0.5	1	0.1	4	0.3	0	0	4	0.6	0	0	31	0.2	0.4
American eel	7	0.5	2	0.2	8	0.8	4	0.4	2	0.2	0	0	0	0	2	0.2	1	0.1	0	0	0	0	0	0	0	0	1	0.2	27	0.2	0.4
Blueback herring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0
American shad	19	1.3	29	3.3	5	0.5	2	0.2	24	2.4	3	0.3	0	0	0	0	0	0	1	0.1	0	0	0	0	0	0	0	0	83	0.7	1.1
Gizzard shad	0	0	0	0	0	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	<0.1	<0.1
Goldfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0
Common carp	11	0.8	6	0.7	8	0.8	7	0.7	11	1.1	2	0.2	1	0.2	2	0.2	3	0.4	2	0.3	0	0	1	0.2	0	0	4	0.9	58	0.5	0.8
E. silvery minnow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	1.1	5	0.6	0	0	2	0.3	0	0	0	0	16	0.1	0.2
Common shiner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1	0	0	0	0	0	0	1	0.2	0	0	2	<0.1	<0.1
Golden shiner	74	5.2	70	8	16	1.7	41	4	46	4.7	39	3.5	15	2.4	74	8.1	66	7.8	24	3.1	55	4.2	29	5	19	3.0	27	5.8	595	4.8	8.0
Notropis sp.	0	0	1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	<0.1	<0.1
Spottail shiner	104	7.3	73	8.4	46	4.9	85	8.3	23	2.3	249	22.2	146	22.9	39	4.3	76	9	50	6.4	141	10.9	17	2.9	18	2.8	6	1.3	1,073	8.6	14.5
Spotfin shiner	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0
Mimic shiner	6	0.4	0	0	0	0	17	1.7	5	0.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0.2	0.4
Fallfish	1	0.1	0	0	0	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	<0.1	<0.1
White sucker	121	8.5	86	9.9	75	7.9	108	10.6	73	7.4	22	2	11	1.7	8	0.9	13	1.5	11	1.4	21	1.6	18	3.1	8	1.3	4	0.9	579	4.6	7.8
Yellow bullhead	5	0.4	4	0.5	5	0.5	4	0.4	7	0.7	2	0.2	0	0	2	0.2	4	0.5	7	0.9	5	0.4	0	0	3	0.5	4	0.9	52	0.4	0.7
Brown bullhead	19	1.3	19	2.2	29	3.1	8	0.8	20	2	1	0.1	2	0.3	2	0.2	0	0	3	0.4	2	0.2	0	0	3	0.5	1	0.2	109	0.9	1.5
Northern pike	7	0.5	11	1.3	6	0.6	2	0.2	6	0.6	4	0.4	0	0	0	0	0	0	4	0.5	1	0.1	1	0.2	0	0	0	0	42	0.3	0.6
Chain pickerel	17	1.2	29	3.3	5	0.5	4	0.4	5	0.5	12	1.1	14	2.2	20	2.2	9	1.1	12	1.5	11	0.8	5	0.9	8	1.3	2	0.4	153	1.2	2.1
Atlantic salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0
Brook trout	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.0
Banded killifish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1	4	0.3	0	0	0	0	0	0	5	<0.1	0.1
White perch	19	1.3	11	1.3	7	0.7	34	3.3	18	1.8	0	0	1	0.2	0	0	1	0.1	0	0	0	0	3	0.5	2	0.3	0	0	96	0.8	1.3
Rock bass	37	2.6	26	3	10	1.1	5	0.5	18	1.8	41	3.7	9	1.4	17	1.9	18	2.1	24	3.1	21	1.6	5	0.9	9	1.4	3	0.6	243	1.9	3.3
Lepomis sp.	0	0	1	0.1	1	0.1	12	1.2	49	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11	1.7	0	0	74	0.6	1.0
Redbreast sunfish	0	0	0	0	0	0	0	0	0	0	0	0	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	<0.1	<0.1
Pumpkinseed	157	11	94	10.8	144	15.2	97	9.5	68	6.9	109	9.7	11	1.7	71	7.8	23	2.7	70	9	104	8	81	14	75	11.8	48	10.4	1,152	9.2	15.5
Bluegill	128	9	56	6.4	99	10.5	118	11.5	135	13.7	222	19.8	46	7.2	234	25.8	296	35.2	221	28.4	360	27.8	197	34.1	202	31.8	123	26.6	2,437	19.5	32.8
Smallmouth bass	15	1.1	10	1.1	18	1.9	11	1.1	22	2.2	12	1.1	7	1.1	26	2.9	21	2.5	10	1.3	2	0.2	6	1	5	0.8	0	0	165	1.3	2.2
Largemouth bass	151	10.6	83	9.5	99	10.5	58	5.7	69	7	44	3.9	30	4.7	31	3.4	43	5.1	47	6	91	7	31	5.4	27	4.2	33	7.1	837	6.7	11.3
Black crappie	0	0	0	0	0	0	0	0	0	0	5	0.4	3	0.5	7	0.8	10	1.2	12	1.5	9	0.7	4	0.7	13	2	9	1.9	72	0.6	1
Tessellated darter	2	0.1	0	0	0	0	0	0	0	0	0	0	0	0	2	0.2	0	0	0	0	4	0.3	1	0.2	0	0	2	0.4	11	0.1	0.1
Yellow perch	507	35.6	260	29.8	352	37.2	394	38.5	373	37.7	346	30.9	324	50.9	360	39.6	240	28.5	272	34.9	454	35	175	30.3	228	35.8	194	41.9	4,479	35.8	60.4
Walleye	15	1.1	1	0.1	12	1.3	12	1.2	13	1.3	6	0.5	7	1.1	6	0.7	3	0.4	2	0.3	7	0.5	2	0.3	0	0	0	0	86	0.7	1.2
Total Number	1,424	100	872	100	946	100	1,023	100	989	100	1,120	100	637	100	908	100	841	100	779	100	1,296	100	578	100	636	100	463	100	12,510	100	168.6
No. Collections	24		24		24		24		24		20		24		24		24		24		24		24		24		24		332		
Effort (hours)	7.8		8.1		7.9		6.5		8.2		3.5		4		4.3		4		3.9		4		4		4		4		74.2		
No. Fish/Hr.	183		108		120		157		121		323		159		210		210		202		324		143		158.3		115.7		168.6		

Table 8-4. Numbers and percent of fish collected by trap net upstream of Vernon Dam, 1991-1999.

	1991		1992		1993		1994		1995		1996		1997		1998		1999				
Species	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	Total No.	%	No. Fish/ 24 Hrs.
Sea lamprey	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.00
American eel	2	0.3	1	0.2	0	0	1	0.1	1	0.1	1	0.2	1	0.1	0	0	0	0	7	0.1	0.01
Blueback herring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.00
American shad	0	0	0	0	0	0	0	0	3	0.3	0	0	0	0	1	0.1	0	0	4	0.1	0.01
Common carp	10	1.6	8	1.4	9	1.3	5	0.6	2	0.2	1	0.2	1	0.1	3	0.3	1	0.2	40	0.6	0.08
Golden shiner	11	1.7	14	2.5	7	1	36	4.1	17	1.8	18	3.1	18	1.6	9	0.8	10	2.3	140	2.0	0.28
Spottail shiner	2	0.3	11	2	10	1.4	2	0.2	3	0.3	0	0	4	0.4	0	0	0	0	32	0.5	0.06
Fallfish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.00
White sucker	16	2.5	24	4.3	56	8.1	41	4.6	55	5.8	47	8	57	5.2	37	3.5	16	3.6	349	5.0	0.69
Yellow bullhead	0	0	0	0	2	0.3	7	0.8	18	1.9	2	0.3	4	0.4	3	0.3	4	0.9	40	0.6	0.08
Brown bullhead	1	0.2	7	1.2	41	5.9	27	3	24	2.6	35	6	37	3.4	28	2.6	20	4.5	220	3.2	0.44
Northern pike	1	0.2	0	0	0	0	2	0.2	4	0.4	1	0.2	4	0.4	0	0	0	0	12	0.2	0.02
Chain pickerel	9	1.4	15	2.7	23	3.3	28	3.2	19	2	26	4.4	13	1.2	27	2.5	12	2.7	172	2.5	0.34
Atlantic salmon	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	0.00
White perch	25	4	43	7.6	19	2.7	16	1.8	61	6.5	15	2.6	36	3.3	18	1.7	11	2.5	244	3.5	0.48
Rock bass	57	9.1	49	8.7	65	9.4	79	8.9	110	11.7	50	8.5	81	7.4	51	4.8	6	1.4	548	7.9	1.09
Lepomis sp.	1	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	<0.1	<0.01
Redbreast sunfish	0	0	0	0	0	0	0	0	0	0	1	0.2	1	0.1	1	0.1	0	0	3	<0.1	0.01
Pumpkinseed	143	22.7	126	22.3	164	23.7	128	14.4	142	15.1	152	25.9	78	7.1	138	12.9	73	16.4	1,144	16.5	2.27
Bluegill	75	11.9	49	8.7	49	7.1	75	8.5	43	4.6	58	9.9	26	2.4	78	7.3	55	12.4	508	7.3	1.01
Smallmouth bass	19	3	15	2.7	22	3.2	16	1.8	20	2.1	11	1.9	26	2.4	22	2.1	5	1.1	156	2.3	0.31
Largemouth bass	7	1.1	2	0.4	16	2.3	4	0.5	14	1.5	2	0.3	19	1.7	21	2	6	1.4	91	1.3	0.18
Black crappie	0	0	0	0	0	0	0	0	0	0	2	0.3	18	1.6	10	0.9	3	0.7	33	0.5	0.07
Tessellated darter	0	0	0	0	0	0	0	0	0	0	0	0	1	0.1	0	0	0	0	1	<0.1	<0.01
Yellow perch	249	39.6	197	34.9	201	29	410	46.2	393	41.8	156	26.5	660	59.9	608	56.7	217	48.9	3,091	44.7	6.14
Walleye	1	0.2	3	0.5	9	1.3	10	1.1	12	1.3	10	1.7	17	1.5	17	1.6	4	0.9	83	1.2	0.16
Total Number	629	100	564	100	693	100	887	100	941	100	588	100	1102	100	1072	100	444	100	6,920	100	13.75
No. Collections	64		64		64		64		64		45		64		63		60		552		
Effort (hours)	1,256		1,333		1,334		1,378		1,353		1,056		1,511		1,442		1,414		12,076		
No. Fish/24 Hrs.	12		10.2		12.5		15.4		16.7		13.4		17.5		17.8		7.5		13.8		

Table 8-5. Comparison of electrofishing (1991-2004) and trap net (1991-1999) catches upstream of Vernon Dam.

Species	Electrofishing Upstream Total No.	%	No. Fish/Hr.	Trap net Upstream Total No.	%	No. Fish/24Hrs.
Sea lamprey	31	0.2	0.4	0	0.0	0.00
American eel	27	0.2	0.4	7	0.1	0.01
Blueback herring	0	0.0	0.0	0	0.0	0.00
American shad	83	0.7	1.1	4	0.1	0.01
Gizzard shad	1	<0.1	0.0	0	0.0	0.00
Goldfish	0	0.0	0.0	0	0.0	0.00
Common carp	58	0.5	0.8	40	0.6	0.08
E. silvery minnow	16	0.1	0.2	0	0.0	0.00
Common shiner	2	<0.1	0.0	0	0.0	0.00
Golden shiner	595	4.8	8.1	140	2.0	0.28
Notropis sp.	1	<0.1	0.0	0	0.0	0.00
Spottail shiner	1073	8.6	14.7	32	0.5	0.06
Spotfin shiner	0	0.0	0.0	0	0.0	0.00
Mimic shiner	28	0.2	0.4	0	0.0	0.00
Fallfish	2	<0.1	0.0	0	0.0	0.00
White sucker	579	4.6	7.9	349	5.0	0.69
Yellow bullhead	52	0.4	0.7	40	0.6	0.08
Brown bullhead	109	0.9	1.5	220	3.2	0.44
Northern pike	42	0.3	0.6	12	0.2	0.02
Chain pickerel	153	1.2	2.1	172	2.5	0.34
Atlantic salmon	0	0.0	0.0	0	0.0	0.00
Brook trout	0	0.0	0.0	0	0.0	0.00
Banded killifish	5	<0.1	0.1	0	0.0	0.00
White perch	96	0.8	1.3	244	3.5	0.48
Rock bass	243	1.9	3.3	548	7.9	1.09
Lepomis sp.	74	0.6	1.0	1	<0.1	<0.01
Redbreast sunfish	1	<0.1	0.0	3	<0.1	0.01
Pumpkinseed	1152	9.2	15.7	1144	16.5	2.27
Bluegill	2437	19.5	33.3	508	7.3	1.01
Smallmouth bass	165	1.3	2.3	156	2.3	0.31
Largemouth bass	837	6.7	11.4	91	1.3	0.18
Black crappie	72	0.6	1.0	33	0.5	0.07
Tessellated darter	11	0.1	0.2	1	<0.1	<0.01
Yellow perch	4479	35.8	61.2	3091	44.7	6.14
Walleye	86	0.7	1.2	83	1.2	0.16
Total Number	12,510	100.0	170.9	6,920	100.0	13.75
No. Collections	326			552		
Effort (hours)	73.2			12,076		
No. Fish/Hr.	171			0.6		

Table 8-6. Number of specimens of numerically important and other selected species collected upstream of Vernon Dam, 1968 - 2002. Impingement and ichthyoplankton samples are not included.

	1968 - 1980[a]		1981 - 1990[a]		1991 - 2002	
Species	Total No.	%	Total No.	%	Total No.	%
American eel	20	0.1	126	0.3	33	0.2
Blueback herring	0	0.0	253	0.6	0	0.0
American shad	0	0.0	270	0.7	87	0.5
Spottail shiner	1,216	7.4	4,599	11.2	1,081	5.9
Mimic shiner	0	0.0	1,161	2.8	28	0.2
White sucker	1,386	8.4	3,874	9.4	916	5.0
Brown bullhead	52	0.3	123	0.3	325	1.8
Northern pike	0	0.0	14	<0.1	54	0.3
Chain pickerel	11	0.1	31	0.1	315	1.7
Atlantic salmon	1	<0.1	1	<0.1	0	0.0
White perch	2,828	17.1	5,157	12.6	338	1.8
Rock bass	466	2.8	1,684	4.1	779	4.2
Pumpkinseed	1,765	10.7	3,731	9.1	2,173	11.9
Bluegill	375	2.3	1,512	3.7	2,620	14.3
Smallmouth bass	583	3.5	2,259	5.5	316	1.7
Largemouth bass	271	1.6	938	2.3	868	4.7
Yellow perch	2,665	16.1	9,705	23.7	7,148	39.0
Walleye	280	1.7	396	1.0	169	0.9
Others	4,595	27.8	5,192	12.7	1,083	5.9
Total Number	**16,514**	**100.0**	**41,026**	**100.0**	**18,333**	**100.0**

[a] data from 1968 - 1989 reported in Downey et al. (1990)
Note: 1968 - 1980: trap net, gillnet and seine collection methods used regularly.
1981 - 1989: trap net used regularly, gillnet not used after 1983, seine not used after 1985, electrofishing began in 1982.

Table 8-7. Number and weight (g) of fishes collected in impingement samples from Vermont Yankee's circulating water traveling screens, 1991-2004.

	1991		1992		1993		1994		1995		1996		1997		1998		1999		2000		2001		2002		2003		2004		SUM		% Total	
Species	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.	No.	Wt.
Sea lamprey	2	898	2	14	26	121	80	284	4	12	8	40			11	51	3	545	12	29	241	680	69	228	2	4	9	43	469	2,949	2.7	0.92
American shad[a]	94	1,467	26	77	1	3	6	26	210	1,225	10	18	31	179	1	11	278	1,756	7	66	25	303	1	0	13	75	73	783	776	5,989	4.4	1.86
Atlantic salmon[a]	2	72	14	1,190	13	722	21	965	108	4,735	13	291	2	38			3	123	9	238	9	233	13	476	2	6			209	9,089	1.2	2.83
Chain pickerel	1	64			10	822	13	914	2	726	4	277	1	17	1	475	1	620	2	16	3	263	0	0	28	1,093	2	328	68	5,615	0.4	1.75
Golden shiner	17	83	11	150	48	763	44	961	4	144	16	140	7	174			8	112	12	82	15	308	2	104	11	615	1	3	196	3,639	1.1	1.13
Spottail shiner	33	162	49	173	247	1,339	588	2,486	30	158	65	245	22	69	1	3	8	26			2	9	59	272	7	257	5	23	1,116	5,222	6.3	1.62
White sucker	11	4,913	6	1,041	5	47	6	1,066	1	802	8	5,066							1	14	2	7	10	1,214	9	32	1	10	60	14,212	0.3	4.42
Yellow bullhead	33	551	10	71	7	458	48	968	55	615	73	595					42	317							3	27	1	16	272	3,618	1.5	1.12
Brown bullhead	9	389	52	1,394	2	92	58	1,414	54	1,247	103	741	2	12	1	480	5	45	13	240	2	115	22	235			3	398	326	6,802	1.9	2.11
White perch	138	1,615	16	609	1	14	3	1,106	140	2,236	4	26					3	104	28	230			1	5	1	120			335	6,065	1.9	1.89
Rock bass	120	2,714	131	1,642	185	13,695	364	10,714	146	6,314	438	2,168	39	503	20	623	49	1,528	134	3,216	33	1,108	74	1,947	39	285	23	643	1,795	47,100	10.2	14.64
Lepomis sp.	1,844	3,427	17	44	54	87	203	376	72	111	1																		2,191	4,045	12.4	1.26
Pumpkinseed	55	979	57	483	21	1,050	79	2,396	518	2,054	75	1,606	2	79			18	1,189	25	646	12	412	27	1,632	108	5,025	6	197	1,003	17,748	5.7	5.52
Bluegill	197	12,508	167	7,579	125	10,025	186	11,110	1,347	5,795	837	6,157	64	7,034	53	537	428	9,949	269	3,908	201	8,925	254	9,142	162	2,044	67	831	4,357	95,544	24.7	29.70
Smallmouth bass	35	1,674	14	344	9	1,606	106	1,894	68	4,339	10	151	11	270	3	125	11	527	10	653	7	515	9	583	372	11,450	9	235	674	24,366	3.8	7.57
Largemouth bass	16	263	2	14	2	33	5	63	75	546	3	88	1	67	1	2	4	16	20	77	4	144	2	9	27	1,070	3	10	165	2,402	0.9	0.75
Yellow perch	137	2,564	96	913	340	8,513	563	11,688	154	1,928	628	5,490	26	535	9	139	62	1,092	322	3,569	128	3,720	203	3,275	126	873	20	467	2,814	44,766	16.0	13.91
Walleye	55	2,969	1	43	4	94	9	214	19	861	1	17	10	141	1	2	5	612	3	465			4	370	1	140	1	345	114	6,273	0.6	1.95
All other species	39	4,297	11	896	7	179	122	2,167	45	1,902	18	82	4	33	4	33	55	439	91	376	16	251	19	415	231	5,086	12	117	674	16,273	3.8	5.06
TOTAL	2,838	41,609	682	16,677	1,107	39,663	2,504	50,812	3,052	35,750	2,315	23,198	222	9,151	106	2,481	983	19,000	958	13,825	700	16,993	769	19,907	1,142	28,202	236	4,449	17,614	321,717		

[a] American shad and Atlantic salmon counts represent the total number impinged while the plant was in open or hybrid cooling cycle mode. All other species represent counts from 24 hour samples.

Table 8-8. Summary of total number and percent catch of larval fish collected in the Vermont Yankee ichthyoplankton program samples from near the CWIS, 1991 – 2004.

Species	Year	Number Collected	Percent of Catch for Each Year
Common carp	1991	1	0.1
	1992	3	0.3
	1993	6	1.2
	1994	1	0.1
	1996	3	1.0
	1997	1	0.5
	1998	9	2.0
	1999	43	9.6
	2000	2	0.4
	2001	3	0.2
	2002	2	0.1
	2003	27	2.2
	2004	5	0.5
		106	
Notropis sp. or Cyprinidae	1991	516	55.8
	1992	515	59.4
	1993	174	35.4
	1994	1,658	90.5
	1995	272	61.5
	1996	129	43.1
	1997	163	83.6
		3,427	
White perch	1991	174	18.8
	1992	212	24.5
	1993	248	50.5
	1994	109	5.9
	1995	90	20.4
	1996	149	49.8
	1997	15	7.7
	1998	31	6.9
	1999	7	1.6
	2000	141	28.8
	2001	31	1.8
	2002	75	5.4
	2003	178	14.6
	2004	36	3.4
		1,496	

(continued)

Table 8-8. (Continued)

Species	Year	Number Collected	Percent of Catch for Each Year
Lepomis sp.	1991	219	23.7
or Centrarchidae	1992	121	14.0
	1993	56	11.4
	1994	28	1.5
	1995	52	11.8
	1996	7	2.3
	1997	3	1.5
	1998	29	6.5
	1999	201	45.0
	2000	6	1.2
	2001	31	1.8
	2002	7	2.0
	2003	100	8.2
	2004	726	68.7
		1586	
Yellow perch	1991	110	11.9
	1992	11	1.3
	1993	4	0.8
	1994	27	1.5
	1995	25	5.7
	1996	8	2.7
	1997	12	6.2
	1998	84	16.8
	1999	20	4.5
	2000	72	14.7
	2001	2	0.1
	2002	29	2.1
	2003	39	3.2
	2004	5	0.5
		448	
Walleye	1991	4	0.4
	1992	1	0.1
	1994	2	0.1
	1995	1	0.2
	1998	14	3.0
	1999	5	1.1
	2000	2	0.4
	2001	2	0.1
	2003	1	0.1
	2004	2	0.2
		34	
American shad	1992	1	0.1
	1999	1	0.2
		2	

(continued)

Table 8-8. (Continued)

Species	Year	Number Collected	Percent of Catch for Each Year
Spottail shiner	1993	1	0.2
	1994	1	0.1
	1998	183	40.6
	1999	113	25.4
	2000	195	39.8
	2001	978	57.9
	2002	1,236	89.7
	2003	875	71.6
	2004	269	25.4
		3,851	
Bluegill	1996	2	0.7
		2	
Fallfish	1996	1	0.3
	1998	2	0.4
	2002	3	0.2
		6	
White sucker	1997	1	0.5
	1998	90	20.0
	1999	55	12.3
	2000	71	14.5
	2001	640	37.9
	2002	2	0.1
	2003	2	0.2
	2004	11	1.0
		872	
Largemouth bass	1997	1	0.5
	1998	1	0.2
		2	
Tessellated darter	2002	4	0.3
	2004	3	0.3
		7	
Total		**11,839**	

9.0 SUMMARY OF RELEVANT CONSULTATIONS WITH FEDERAL, STATE, AND TRIBAL FISH AND WILDLIFE AGENCIES

As described in the Introduction (Section 1.0 above) of this PIC, Entergy has requested an extended submission schedule for the PIC and CDS for Vermont Yankee in a letter from Ms. Lynn DeWald of Entergy to Ms. Carol Carpenter of the VANR dated 3 June 2005, as is allowed by the Phase II Regulations. This document was filed in response to the April 22, 2005 letter from Mr. Brian Kookier, Chief of the VANR Discharge Permits Section to Ms. Lynn DeWald of Entergy, requesting that Entergy proceed with submitting a PIC for Vermont Yankee. The submission schedule for Vermont Yankee's CDS is to be included in the renewed NPDES permit. Copies of these two letters are included in Appendix 3 of this PIC.

In addition to 35 consecutive Annual Reports describing the results of permit-required monitoring activities and submitted annually to VANR and to Vermont Yankee's Environmental Advisory Committee (EAC), and included by this reference with the PIC, Vermont Yankee has conducted 82 "objective specific" studies through 2005 and presented the results to VANR and to the EAC as the Analytical Bulletins listed in Appendix 2. Entergy reserves its right to supplement Appendix 3 in the event it determines that it inadvertently has not referenced a relevant consultation or listed a relevant document; as noted above, Vermont Yankee has been operating for more than three decades and has many documents in its files relating to plant operations, and it is possible that it has not located or does not have all relevant documents.

Vermont Yankee's 316 Demonstration (Binkerd et al. 1978) submitted to VANR in March 1978 documents in the second paragraph on page 1-1 that "Vermont Yankee was originally designed with a once through circulating water system. This system was to utilize Connecticut River water pumped once through the condenser and returned to the river without prior cooling. During public hearings preceding the licensing and operation of Vermont Yankee, concerns were expressed as to the possible environmental impact of this completely open cycle mode of condenser cooling. In response to these concerns, mechanical draft cooling towers were installed. These towers can dissipate directly to the atmosphere all or part of the heat added to the circulating water from cooling the condenser. Any use of the cooling towers, however, results in an overall loss in the plant's thermodynamic efficiency and to the power requirements of cooling tower fans and pumps."

10.0 SAMPLING PLAN FOR NEW FIELD STUDIES

10.1 QUANTIFY RAW WATER INTAKE FLOWS

Plant operating characteristics such as recirculation during cooling tower use, outages, and winter reductions in intake pump operations all reduce the amount of raw water withdrawn into Vermont Yankee for condenser cooling compared to the baseline capacity of the CWIS. Intake flows cannot be directly determined for the Vermont Yankee CWIS due to design and continually varying operation of the cooling system (recycling directly into the intake forebay) dictated by the NPDES thermal limits. Even so, plant outflow can be accurately calculated and since inflow must equal outflow, inflow can therefore be indirectly, but accurately calculated. An appropriate method will be developed and used to estimate the actual monthly and annual total cooling water flows for Vermont Yankee under representative historical operating conditions and under the expected future conditions of the power uprate and the amended NPDES permit issued 30 March 2006.

The actual plant performance characteristics will be obtained from Vermont Yankee and analyzed to calculate the hourly cooling water intake flows during 12 months of each year, with each year beginning 15 October and continuing through 14 October to align the calculation period with the NPDES permit thermal limit changes that most affect cooling water flow. Furthermore, the time period examined will be selected to obtain plant performance data in three-year blocks of time to provide a symmetrical representation of Vermont Yankee's 18 month outage cycle and therefore will be balanced with respect to the monthly average flows derived. This analysis will be based on an appropriate method of estimating intake flow such as using the thermal compliance equation to solve for discharge flow, or by using the plant heat balance and measured temperatures to estimate recirculation flow and discharge flow.

10.2 IMPINGEMENT

The existing NPDES permit monitoring plan for Vermont Yankee requires the collection of weekly impingement sampling at the Vermont Yankee cooling water intake structure during April, May, June, July, September, and October of each year if the CWIS is operated in those months. These weekly impingement samples consist of one 24-hour impingement collection from which all fish are identified and enumerated, and one 6-day collection from which just anadromous fish are processed (American shad and Atlantic salmon). This permit-required impingement sampling program must be supplemented to determine the annual (12 months) impingement rates for Vermont Yankee that are required to measure compliance with the 316b Phase II rule, because only half of the year is sampled. Therefore, Vermont Yankee will expand the current NPDES permit-required impingement sampling program to obtain 12 months of impingement data for the Vermont Yankee CWIS to determine the annual impingement rate. A secondary goal will be to obtain these impingement samples from known sampling times and link the number of fish impinged with the raw water intake flow for each sample that is estimated as described above (Section 10.1) to allow calculation of impingement rates based on species-specific counts (or weights) per unit of volume withdrawn from the river.

Vermont Yankee will collect and process weekly impingement samples from the CWIS when operated during the six months of the year not already sampled as required by the NPDES permit. One 24-hour impingement sample will be obtained from each week during the months of August

2006, November 2006, December 2006, January 2007, February 2007, and March 2007 if the traveling screens are operable and at least one intake pump is operated during the 24-hour sampling period so that 52 consecutive weeks of impingement samples are collected and processed from the period April 2006 through March 2007. The 6-day anadromous fish impingement samples required by the NPDES permit will not be collected during the supplemental months. Each 24-hour sample collected in each of the 52 weeks of the period will have accurate start and end times recorded so that the sample duration can be linked to Vermont Yankee operating data reporting intake pump status and raw water intake flows.

Impingement collection efficiency will also be determined during one 24-hour sampling period in each month to adjust each 24-hour sample for fish that are lost between the time they are impinged on the operating intake screens and their collection in the sampling pit. A lot of 100 marked (finclipped or dyed) dead fish representative of the species and size range that we have observed in impingement samples during the previous sampling events will be introduced immediately in front of an operating intake screen. The lot of marked fish will be introduced in a water bottle device that can be lowered in the intake forebay to the mid-depth location in front of the ascending face of an operating traveling screen. The collection efficiency fish will be introduced within four hours of the midpoint of the 24-hour sample (i.e. if the 24-hour sample began at 0800, the marked fish will be released some time between 1600 and midnight). The number of marked fish subsequently recovered in the collection device at the end of the sampling period, divided by the number released, represents the impingement collection efficiency for that period. These impingement collection efficiency factors will be applied to other 24-hour impingement collections from the preceding and following two weeks to obtain "collection-efficiency adjusted" impingement rates.

Specific impingement sample collection, data recording, and quality control procedures will follow previously established protocols documented in Section 3.7 of the following document "Entergy Nuclear Vermont Yankee, LLC Environmental Services Quality Program and Standard Operating Procedures for NPDES Permit Monitoring, Revision 2, May 2005".

Vermont Yankee's NPDES permit presently does not allow the return of impinged fish and screenwash debris to the river. Accordingly, impinged fish experience 100% mortality. Vermont Yankee may also consider performing impingement survival studies to simulate the survival of impinged fish if the NPDES permit were modified in the future to allow impinged fish to be returned to the river through a modified fish return system. Monthly fish return survival may be determined coincident with the proposed impingement abundance program under either periodic or continuous screen wash conditions. An impingement survival study plan will be provided to VANR for their review prior to the onset of these studies if Vermont Yankee decides to proceed with this work.

10.3 ENTRAINMENT

Vermont Yankee's existing NPDES permit requires nearfield ichthyoplankton sampling in the Connecticut River at a location just in front of the CWIS in Vernon Pool, but it does not require the direct sampling of entrained organisms. Because the actual water velocity through each CW fixed screen varies throughout the year from 1.0 fps down to 0.0 fps as the operating mode for the plant is changed from open cycle to closed cycle (Section 3.3 above), and because the period of lowest cooling water withdrawal and lowest through-screen velocities are likely to coincide with seasonal periods of high abundance of fish eggs and larvae, Vermont Yankee proposes a one-year entrainment sampling program beginning in April and continuing through September 2006. Vermont Yankee may undertake a second year of entrainment sampling in 2007 to verify the results observed during 2006 if appropriate. The April through September period is expected to encompass the entire season when entrainable-sized ichthyoplankton are exposed to Vermont Yankee's cooling water withdrawal.

The goal of the proposed entrainment program is to estimate the seasonal and annual total abundance of fish eggs and larvae that become drawn into Vermont Yankee's CWIS. The entrainment program will be documented in a project-specific Quality Assurance Plan (QAP) consistent with USEPA protocols (USEPA 2001). The QAP will describe the Standard Operating Procedures to be used for the field, laboratory, and data file preparation activities, and is included with this PIC as Appendix 4.

Entrainment sampling at the Vermont Yankee CWIS is proposed to begin in April 2006 and continuing through September 2006 on the days when the plant is operating the CWIS and not in a closed cycle mode of operation (no raw water intake). Sampling will be scheduled for the same day per week (e.g. Wednesday) for 26 consecutive weeks during 2006. Both day and night entrainment samples will be collected to insure that diel differences in ichthyoplankton abundance are adequately described. Therefore, the total number of entrainment samples for the 2006 entrainment program at the Vermont Yankee CWIS will be 52 (1 depth x 2 diel periods x 26 dates), unless some samples cannot be collected due to plant outages.

The intention is to separate the collection of daytime and nighttime entrainment samples symmetrically within the daytime and nighttime periods of each sampling date. Daytime is defined as occurring between one hour after meteorological sunrise and one hour before meteorological sunset as observed at the plant site. Nighttime is defined as occurring between one hour after meteorological sunset and one hour before meteorological sunrise as observed at the plant site. The daytime sample will be collected at approximately the mid-point of the daylight period (halfway between sunrise and sunset, ± 2 hours), and the nighttime sample will be collected at approximately the mid-point of the night period (halfway between sunset and sunrise, ± 2 hours). The crew will check with the control room operator to determine the CWIS status prior to each scheduled sampling event, and make a decision to sample based on the operational mode of the plant with respect to recirculation flow. Sampling will not occur if the recirculation gates are 45% or more open and the plant is considered to recirculate 100% of the cooling water, thus not withdrawing any river water at the CWIS.

The entrainment sampling net is a 0.5-m diameter, 1.5-m long, 360 micron mesh net equipped with a flume-calibrated, electronic flow meter (General Oceanics, Inc. GO Model 2030R) mounted slightly off-center in the net mouth. Due to the continually varying intake flow, deployment times will be adjusted in the intake forebay to insure that the volume of each sample is within ±10% of 100 m^3 based on the read-out from the electronic flowmeter. All samples will be fixed at the time of collection in 4% buffered formalin and changed over to 80% ethanol within 24 hours. Rose Bengal will be added to stain the fish eggs and larvae and facilitate separating them from other material by sorting in the laboratory. Each sample jar will be labeled with a unique inventory number along with the location, date, time, and depth of collection.

In the laboratory, a total of 52 samples will be processed for the 2006 entrainment program at the Vermont Yankee CWIS, unless some samples cannot be collected due to plant outages. All fish eggs and larvae will be removed (sorted) from the total material collected in each composite sample, identified to the lowest possible taxonomic category (generally genus and species), and enumerated by life stage. Life stages will be defined as egg, yolk sac larvae, post yolk sac larvae, and juvenile.

Samples with extremely high numbers of ichthyoplankton will be subsampled in the lab with Motoda plankton splitters according to established and statistically reliable protocols. In such cases, a minimum of 200 eggs and larvae will be sorted and identified from the subsample. For subsampling due to high detrital load when ichthyoplankton densities are low, high detrital load will be defined as more than 400 milliliters of settled volume of solids in the sample (detritus and plankton). If this occurs, a maximum of one-half of the sample will be sorted. A reference collection will be made for the species and life stages collected.

All laboratory sorting, fish identification, and enumeration will be subject to a standard and appropriate quality assurance/quality control review based on a Military Inspection Standard (MIL-STD inspection plan derived from MIL-STD 1235 Single and Multiple Level Continuous Sampling Procedures and Tables for Inspection by Attributes to achieve a 10% Average Outgoing Quality Limit (AOQL), and a 1% AOQL for all data files, computations and reports. Please note that, for example, an AOQL of 1% means that the final data files will be certified through statistical inspection to document that less than one record (line of data) out of every 100 records will be in error. This level of quality meets or exceeds industry standards for impingement and entrainment studies. Computerized operational data files from Vermont Yankee will be obtained and used to extrapolate entrainment abundance (numbers per 100 m^3) for each taxon and life stage up to diel, daily, weekly, monthly and total annual abundance based on the actual total circulating water flow for each sampling period.

Vermont Yankee may also elect to perform entrainment survival studies monthly to determine the survival of entrained ichthyoplankton that have passed through the CWIS if the entrainment abundance studies suggest that these data may be useful in a cost-benefit evaluation. Entrainment survival collections would be scheduled for one randomly selected day per month on a day already selected for entrainment sampling. The regularly scheduled entrainment sample will be collected and preserved for each daytime or nighttime collection interval as described above, and then a second sample will be collected and observed for entrainment survival. The entrainment survival studies will be staffed continuously during the collection and observation periods, and sufficient volume of water will be filtered through the entrainment collection device to insure that at least 100 fish larvae are available for initial (0-hour) latent (24-hour) survival observations or eight hours of sampling has occurred. An entrainment survival study plan will be provided to VANR for their review prior to the onset of these studies if Vermont Yankee decides to proceed with this work.

10.4 NEARFIELD ICHTHYOPLANKTON SAMPLING IN THE CONNECTICUT RIVER

Vermont Yankee's existing NPDES permit requires nearfield ichthyoplankton sampling in the Connecticut River at a location just in front of the CWIS in Vernon Pool. This sampling is accomplished by towing a fine-mesh plankton net (0.5-m diameter, 1.5-m long, 360 micron mesh) behind a boat in the river immediately in front of the intake structure. The net is equipped with a flume-calibrated flow meter (General Oceanics, Inc. GO Model 2030R) mounted slightly off-center in the net mouth to measure sample volume. The net is towed for about ten minutes at a speed through water of 1 m/s to provide a sample volume of 100 $m^3 \pm 10$ m^3. The permit-required sampling schedule is once per week (three tow depths per event) during daylight hours for 11 consecutive weeks beginning during the first week in May and ending during the middle of July of each year. The total number of samples collected and processed under this permit-required program is 33.
The permit-required sampling period appears to target the seasonal occurrence of American shad eggs and larvae, and begins too late and ends too soon to adequately represent the entrainment season for

all of the representative important fish species exposed to entrainment at Vermont Yankee because some of these fish spawn earlier or later than American shad., Furthermore, this nearfield program does not account for diel (day vs. night) differences in ichthyoplankton abundance in Vernon Pool. Vermont Yankee proposes to add sampling weeks onto the beginning and end of the existing ichthyoplankton program to expand the program to a period that encompasses the entire season when entrainable-sized ichthyoplankton are exposed to Vermont Yankee's cooling water intake withdrawal.

The nearfield data set obtained by expanding the current NPDES permit-required program will complement the in-plant entrainment program described above (Section 10.3) and will be conducted concurrently with the objective of allowing the calculation of a withdrawal ratio by comparing ichthyoplankton abundance in the nearfield Connecticut River net samples to those collected simultaneously and by the same methods in the plant. This withdrawal ratio is calculated by taking the nearfield ichthyoplankton density (number of fish per cubic meter of water) and dividing it by the in-plant density from pairs of samples taken from the same water mass (at the same time). Calculation of an accurate withdrawal ratio requires sampling with the same gear and deployment practices in both locations so that differences in the gear and methods do not contribute a bias to the calculated ratio. This withdrawal ratio may be used to evaluate the entrainment reductions due to the low through-screen intake velocities that are likely to occur during periods of high nearfield ichthyoplankton abundance.

An extra 15 extra weeks of sampling will be added to the existing 11-week nearfield ichthyoplankton program, so that the nearfield ichthyoplankton program at Vermont Yankee will begin during the first week of April 2006 and extend for 26 consecutive weeks through September 2006. Nearfield ichthyoplankton sampling will be scheduled for the same day per week as the in-plant entrainment sampling (e.g. Wednesday), and both daytime and nighttime samples will be collected to insure temporal correspondence (± 2 hours) between the two sampling programs. Therefore, the total number of nearfield ichthyoplankton samples for the 2006 program in the Connecticut River near the Vermont Yankee CWIS will be 156 (3 depths x 2 diel periods x 26 dates). The same deployment practices, gear (363 micron mesh 0.5 m diameter net), and laboratory methods will be used for the expanded 2006 program as is used for the permit-required program. These procedures follow previously established protocols documented in Sections 3.5 (Ichthyoplankton Sampling) and 3.9 (Ichthyoplankton Laboratory) of the following document "Entergy Nuclear Vermont Yankee, LLC Environmental Services Quality Program and Standard Operating Procedures for NPDES Permit Monitoring, Revision 2, May 2005".

In the laboratory, a total of 156 samples will be processed for the 2006 nearfield ichthyoplankton program, unless some samples cannot be collected due to plant outages. The 33 samples collected as required by the NPDES permit (3 depths x 1 diel period x 11 dates) will be individually processed as described by the methods in the preceding paragraph. The remaining 123 samples (3 depths x 1 diel period x 11 dates plus 3 depths x 2 diel periods x 15 dates) will be combined by depth to provide 41 depth-integrated samples. These 41 depth integrated samples will be processed as described by the methods in the preceding paragraph. All fish eggs and larvae will be removed (sorted) from the total material collected in each composite sample, identified to the lowest possible taxonomic category (generally genus and species), and enumerated by life stage. Life stages will be defined as egg, yolk sac larvae, post yolk sac larvae, and juvenile. Samples with extremely high numbers of ichthyoplankton will be subsampled in the lab with Motoda plankton splitters according to established and statistically reliable protocols. In such cases, a minimum of 200 eggs and larvae will be sorted and identified from the subsample. For subsampling due to high detrital load when ichthyoplankton densities are low, high detrital load will be defined as more than 400 milliliters of settled volume of solids in the sample (detritus and plankton). If this occurs, a maximum of one-half of the sample will be sorted. A reference collection will be made for the species and life stages collected.

All laboratory sorting, fish identification and enumeration will be subject to the same quality assurance/quality control review described for the processing of entrainment samples (Section 10.3 above). This level of quality meets or exceeds industry standards for impingement and entrainment studies. Nearfield ichthyoplankton abundance will be calculated as numbers per 100 m^3 for each taxon and life stage and compared to the corresponding entrainment samples (also numbers per 100 m^3) to derive the withdrawal ratios for diel, daily, weekly, monthly and total annual abundance estimates.

11.0 LITERATURE CITED

Binkerd, R.C., W.D. Countryman, R.M. Mason, and D.J. Marx. 1978. 316 Demonstration, Engineering, Hydrological and Biological Information and Environmental Impact Assessment for Vermont Yankee Nuclear Power Corporation. Aquatec, Inc., So. Burlington, VT.

Binkerd, R.C., H.G. Johnston, P.C. Downey, S.C. McAvoy, and H.R. DeYoe. 1983. Operational and biological studies of the Vermont Yankee/Connecticut River system. Aquatec, Inc., South Burlington, Vermont.

Binkerd, R.C. 1985. Temperature patterns near Vernon Dam fish passage during high river discharge. Vermont Yankee/Connecticut River System, Analytical Bulletin 11. Aquatec, Inc.

Briggs, E.C., and P.C. Downey. 1990. Fish impingement on intake screens at Vermont Yankee, 1985-1989. Vermont Yankee/Connecticut River System, Analytical Bulletin 26. Aquatec, Inc.

Downey, P.C., R.C. Binkerd, and D.J. Marx. 1990. 316 Demonstration, Engineering, Hydrological and Biological Information and Environmental Impact Assessment for Vermont Yankee Nuclear Power Corporation. Aquatec, Inc., So. Burlington, VT.

Downey, P.C., and A.J. Haro. 1985. Fish impingement on intake screens at Vermont Yankee, 1974-1984. Vermont Yankee/Connecticut River System, Analytical Bulletin 14. Aquatec, Inc.

Helsel, D.R., and R.M. Hirsh. 1991. Chapter A3: statistical methods in water resources. U.S. Geol. Surv. 510 p.

Luxenberg, R.R. 1990. Thermal history of the Connecticut River, 1984-1989. Vermont Yankee/Connecticut River System Analytical Bulletin 34. Aquatec, Inc., So. Burlington, VT.

Normandeau Associates, Inc. 2004. §316(a) Demonstration in Support of a Request for Increased Discharge Temperature Limits at Vermont Yankee Nuclear Power Station During May through October.

Normandeau Associates, Inc. 2005. Analysis of Inter-annual trends in the abundance of benthic macroinvertebrate taxa and representative important fish species samples by Vermont Yankee's NPDES permit-required monitoring program, 1991-2004.

Shambaugh, A.D. 1987. Temporal and spatial distribution of phytoplankton in Upper Turners Falls Pool. Vermont Yankee/Connecticut River System Analytical Bulletin 18. Aquatec, Inc., So. Burlington, VT.

Shambaugh, A.D., and P.C. Downey. 1990. The occurrence of *Leptodora kindii* in the Connecticut River near Vernon, Vermont during early summer 1988. Vermont Yankee/Connecticut River System Analytical Bulletin 28. Aquatec, Inc., So. Burlington, VT.

Timmons, M.J. 1988. Temporal and spatial distribution of zooplankton in Upper Turners Falls Pool. Vermont Yankee/Connecticut River System Analytical Bulletin 20. Aquatec, Inc., So. Burlington, VT.

U.S. Environmental Protection Agency (USEPA). 1977. Draft interagency 316(a) technical guidance manual for thermal effects sections of nuclear facilities environmental impact statement.

Vermont Yankee Nuclear Power Station, Updated Final Safety Analysis Report (UFSAR), Revision 19.

APPENDIX 1

Vermont Yankee Intake Structure Drawings

APPENDIX 2

Vermont Yankee Analytical Bulletins

Appendix Table 2-1. List of Vermont Yankee Analytical Bulletins 1984 – 2005.

Bulletin	Author(s)	Year	Title
1	Downey, Philip C.	1984	Notes on the health of fishes of the Connecticut River near Vernon, Vermont
2	Johnston, H. Gregory	1984	Thermal experience of the Connecticut River near Vernon, Vermont
3	Binkerd, Roger C.	1984	Synopsis of 1983 Environmental Programs
4	Johnston, H. Gregory and Roger C. Binkerd	1984	Determination of optimal settings of condenser cooling system facilities
5	Downey, Philip C.	1984	Age and growth of walleye (*Stzistedion vitreum vitreum* (Mitchill)) of the Connecticut River near Vernon, Vermont
6	Downey, Philip C.	1985	Growth of 1984 juvenile American shad (*Alosa sapidissima* (Wilson)) of the Connecticut River near Vernon, Vermont
7	Downey, Philip C.	1985	Age and growth of smallmouth bass (*Micropterus dolomieui* Lacepede) of the Connecticut River near Vernon, Vermont
8	Downey, Philip C.	1985	Age and growth of white perch (*Morone americana* (Gmelin)) of the Connecticut River near Vernon, Vermont
9	Downey, Philip C.	1985	Age and growth of yellow perch (*Perca flavescens* (Mitchill)) of the Connecticut River near Vernon, Vermont
10	King, David E.	1985	Vermont Yankee environmental temperature system
11	Binkerd, Roger C.	1985	Temperature patterns near Vernon Dam fish passage during high river discharge
12	Binkerd, Roger C.	1985	Connecticut River water quality near Vernon, Vermont, 1969-1984
13	Luxenberg, Roland R.	1985	Connecticut river temperature increase
14	Downey, Philip C. and Alexander J. Haro	1985	Fish impingement on intake screens at Vermont Yankee, 1974-1984
15	Downey, Philip C.	1986	Growth of 1985 juvenile American shad (*Alosa sapidissima* (Wilson)) of the Connecticut River near Vernon, Vermont
16	Downey, Philip C.	1987	Spatial distribution of 1986 juvenile shad (*Alosa sapidissima* (Wilson)) of the Connecticut River near Vernon, Vermont
17	Luxenberg, Roland R.	1987	Temporal and spatial distribution of water quality parameters in Upper Turners Falls Pool

(continued)

Appendix Table 2-1 (Continued)

Bulletin	Author(s)	Year	Title
18	Shambaugh, Angela D.	1987	Temporal and spatial distribution of phytoplankton in Upper Turners Falls Pool
19	Wood, Susan M.	1988	Temporal and spatial distribution of macroinvertebrates in Upper Turners Falls Pool
20	Timmons, Maria J.	1988	Temporal and spatial distribution of zooplankton in Upper Turners Falls Pool
21	Downey, Philip C.	1988	Age and growth of 1986 juvenile American shad (*Alosa sapidissima* (Wilson)) of the Connecticut River near Vernon, Vermont
22	Downey, Philip C.	1990	Microhabitats of juvenile American shad (*Alosa sapidissima* (Wilson)) of the Connecticut River near Vernon, Vermont
23	Downey, Philip C., Nicholas R. Staats, and Mark B. Biercevicz	1990	Age and growth of juvenile American shad (*Alosa sapidissima* (Wilson)) of the Connecticut River near Vernon, Vermont
24	Staats, Nicholas R.	1990	Age and sex composition of adult American shad (*Alosa sapidissima* (Wilson)) at Vernon Dam fishway, 1989
25	Shambaugh, Angela D., Philip C. Downey, and Nicholas R. Staats	1990	Evaluation of shad otolith aging techniques: scanning electron microscopy and light microscopy
26	Briggs, Errol C. and Philip C. Downey	1990	Fish impingement on intake screens at Vermont Yankee, 1985-1989
27	Shambaugh, Angela D.	1989	Algal growth in the cooling towers and spray pond of Vermont Yankee, late summer 1988
28	Shambaugh, Angela D. and Philip C. Downey	1990	The occurrence of *Leptodora kindii* in the Connecticut River near Vernon, Vermont during early summer 1988
29	Downey, Philip C. Nicholas R. Staats, and Roger C. Binkerd	1990	Downstream movement of Atlantic Salmon (*Salmo salar* Linnaeus) smolts in Vernon pool
30	Binkerd, Roger C., Michael T. Hewlett, and Philip C. Downey	1990	Tag and recapture studies of smallmouth bass (*Micropterus dolomieui,* Lacepede), 1981-1989
31	Downey, Philip C.	1990	Age and growth of selected resident fish of the Connecticut River near Vernon, Vermont
32	Downey, Philip C.	1990	Abundance, density, and composition of ichthyoplankton of the Connecticut River near Vernon, Vermont

(continued)

Appendix Table 2-1 (Continued)

Bulletin	Author(s)	Year	Title
33	Binkerd, Roger C., Roland R. Luxenberg, and Stephen P. Farrington	1990	Thermal plumes in the lower Vernon pool, 1989
34	Luxenberg, Roland R.	1990	Thermal history of the Connecticut River, 1984-1989
35	Downey, Philip C.	1990	Composition of the fish community of the Connecticut River near Vernon, Vermont
36	Downey, Philip C.	1990	Adult American shad (*Alosa sapidissima* (Wilson)) migration in the Connecticut River near Vernon, Vermont
37	Park, Janice H.	1990	Acquisition of biological data and their translation to a computer database
38	King, David E.	1990	The Vermont Yankee environmental data acquisition systems; An update
39	Luxenberg, Roland R.	1990	Analysis of the thermal history of the Connecticut River 1970-1989
40	Downey, Philip C. and Nicholas R. Staats	1990	Composition of the Adult American shad (*Alosa sapidissima* (Wilson)) population at Vernon Dam and Turners Falls Fishways, 1990
41	Downey, Philip C.	1991	Sexual maturity of Adult American Shad at Turners Falls and Vernon Dam Fishways, 1990
42	Downey, Philip C. and Mark P. Biercevicz	1991	Relative density and growth of juvenile American Shad in the Connecticut River Near Vernon, Vermont, 1990.
43	Downey, Philip C. and Mark P. Biercevicz	1994	Composition of Adult American Shad at Turners Falls and Vernon Dam Fishways, 1991
44	Downey, Philip C. and Robert L. Smith	1995	Sexual maturity of Adult American Shad at Turners Falls and Vernon Dam Fishways, 1991
45	Biercevicz, Mark P. and Philip C. Downey	1995	Relative density and growth of Juvenile American Shad in the Connecticut River near Vernon, Vermont, 1991
46	Smith, Robert L., Philip C. Downey, and Gary R. Miles	1995	Composition of Adult American Shad at Turners Falls and Vernon Dam Fishways, 1992
47	Downey, Philip C. and Robert L. Smith	1995	Sexual maturity of Adult American Shad at Turners Falls and Vernon Dam Fishways, 1992

(continued)

Appendix Table 2-1 (Continued)

Bulletin	Author(s)	Year	Title
48	Smith, Robert L. and Philip C. Downey	1995	Relative density and growth of Juvenile American Shad in the Connecticut River near Vernon, Vermont, 1992
49	Smith, Robert L., Philip C. Downey, and Gary R. Miles	1995	Composition of Adult American shad at Turners Falls and Vernon Dam Fishways, 1993
50	Downey, Philip C. and Robert L. Smith	1995	Sexual maturity of Adult American Shad at Turners Falls and Vernon Dam Fishways, 1993
51	Smith, Robert L. and Philip C. Downey	1995	Relative density and growth of Juvenile American Shad in the Connecticut River near Vernon, Vermont, 1993
52	Smith, Robert L. and Philip C. Downey	1995	Composition of Adult American Shad at Turners Falls and Vernon Dam Fishways, 1994
53	Downey, Philip C. and Robert L. Smith	1995	Sexual maturity of Adult American Shad at Turners Falls and Vernon Dam Fishways, 1994
54	Smith, Robert L. and Philip C. Downey	1995	Relative density and growth of Juvenile American Shad in the Connecticut River near Vernon, Vermont, 1994
55	Smith, Robert L. and Philip C. Downey	1995	Evaluation of gross energy content in selected Adult American shad tissue by proximate analysis
56	Finck, Laura L. and Philip C. Downey	1995	Adult American shad (*Alosa sapidissima* (Wilson)) passage efficiency through Vernon fishway, 1981 to 1994
57	Downey, Philip C. and Robert L. Smith	1995	Biology of American shad, 1990 to 1995
58	Finck, Laura L.	1995	Zebra Mussel and asiatic clam monitoring, 1994
59	Finck, Laura L. and Philip C. Downey	1995	Tag and recapture of Smallmouth Bass (*Micropterus dolomieui* Lacepede) in the Connecticut River near Vernon, Vermont, 1990 to 1994
60	Smith, Robert L. and Philip C. Downey	1995	Age and growth of White Perch (*Morone americana* (Gmelin)) in the Connecticut River near Vernon, Vermont 1968-1994
61	Smith, Robert L. and Philip C. Downey	1995	Age and growth of Walleye (*Stzostedion vitreum* (Mitchill)) in the Connecticut River near Vernon, Vermont, 1968 to 1994

(continued)

Appendix Table 2-1 (Continued)

Bulletin	Author(s)	Year	Title
62	Smith, Robert L. and Philip C. Downey	1995	Age and growth of Yellow Perch (*Perca flavescens* (Mitchill)) in the Connecticut River near Vernon, Vermont 1968 to 1994
63	Smith, Robert L. and Philip C. Downey	1995	Age and growth of Smallmouth Bass (*Micropterus dolomieui* Lacepede) in the Connecticut River near Vernon, Vermont, 1968 to 1994
64	Smith, Robert L. and Philip C. Downey	1995	Fish composition at Turners Falls and Vernon Dam, 1968 to 1994
65	Finck, Laura L., Robert L. Smith, and Philip C. Downey	1995	Atlantic Salmon (*Salmo salar*) smolt impingement at Vermont Yankee on the Connecticut River from 1981 to 1995
66	Smith, Robert L. and Philip C. Downey	1995	Phytoplankton and zooplankton entrainment at Vermont Yankee, 1990-1995
67	Smith, Robert L. and Philip C. Downey	1995	Composition of Adult American shad at Turners Falls and Vernon Dam Fishways, 1995
68	Downey, Philip C. and Robert L. Smith	1995	Sexual maturity of Adult American shad at Turners Falls and Vernon Dam Fishways, 1995
69	Smith, Robert L. and Philip C. Downey	1995	Relative density and growth of Juvenile American shad in the Connecticut River near Vernon, Vermont, 1995
70	Normandeau Associates Inc.	1998	Composition of adult American shad at the Vernon Hydroelectric Dam Fishway During Spring 1997
71	Normandeau Associates Inc.	1998	Abundance of juvenile American shad in the Vernon Pool during 1997
72	Normandeau Associates Inc.	1999	Composition of Adult American Shad at the Vernon Hydroelectric Dam Fishway During Spring 1998
73	Normandeau Associates Inc.	1999	Abundance of Juvenile American Shad In the Vernon Pool During 1998
74	Normandeau Associates Inc.	2000	Composition of Adult American at the Vernon Hydroelectric Dam Fishway During Spring 1999
75	Normandeau Associates Inc.	2000	Abundance of Juvenile American Shad In the Vernon Pool During 1999
76	Normandeau Associates Inc.	2001	Abundance of Juvenile American Shad In the Vernon Pool During 2000
77	Normandeau Associates Inc.	2002	Composition of Adult American Shad at the Vernon Hydroelectric Dam Fishway, During Spring 2001
78	Normandeau Associates Inc.	2002	Abundance of Juvenile American Shad in the Vernon Pool During 2001

(continued)

Appendix Table 2-1 (Continued)

Bulletin	Author(s)	Year	Title
79	Normandeau Associates Inc.	2003	Abundance of Juvenile American Shad in the Vernon Pool During 2002
80	Normandeau Associates Inc.	2003	Evaluation of the Macroinvertebrate Community in Lower Vernon Pool During 2002 Using Artificial Multiplate Samplers
81	Normandeau Associates Inc.	2004	Abundance of Juvenile American Shad in the Vernon Pool During 2003
82	Normandeau Associates Inc.	2005	Abundance of Juvenile American Shad in the Vernon Pool During 2004

APPENDIX 3

Reports and Relevant Agency Correspondence Regarding §316(b) at Vermont Yankee

State of Vermont

Department of Fish and Wildlife
Department of Forests, Parks and Recreation
Department of Environmental Conervation
State Geologist
RELAY SERVICES FOR HEARING IMPAIRED
1-800-253-0191 TDD>Voice
1-800-253-0195 Voice>TDD

AGENCY OF NATURAL RESOURCES
Department of Environmental Conservation
Wastewater Management Division
103 South Main Street - Sewing Bldg.
Waterbury, Vermont 05671-0405

Telephone: (802) 241-3822
Fax: (802) 241-2596
www.anr.state.vt.us/dec/ww/wwmd.cfm

RECEIVED
APR 29 2005
By Lynn DeWald

April 22, 2004 2005 LDD 4/29/05

Lynn DeWald
Entergy Nuclear Vermont Yankee, LLC
PO Box 157
Vernon, VT 05354

Re: Clean Water Act § 316(b) - Application Requirements

Dear Ms DeWald:

We have received and reviewed your March 7, 2005 letter requesting specific dates for submittal of information required by the 316(b) regulations. You also indicated your opinion that Vermont must make changes to state regulatory framework with respect to the new federal regulations. We do not believe this is necessary because of the overarching way the permit regulations (Vermont Water Pollution Control Permit Regulations) were written. Specifically, Section 13.4 b, Application of State and Federal Requirements, states:

> "(1) The terms and conditions of each permit shall apply and insure compliance with all of the following, whenever applicable:
> (d) Any more stringent limitation including those…(ii) necessary to meet any other Federal law or regulation".

Since NPDES delegation took place over 30 years ago, the Department has consistently relied on this section of regulation when changes or additions to the federal regulations have occurred. We intend to maintain this reliance with respect to the changes in 316(b).

We recognize that the 316(b) regulations allow an applicant to request dates for submittal of the Proposal for Information Collection (PIC) and the Comprehensive Demonstration Study (CDS) that do not coincide with the application renewal date (in this case September 30, 2005). Although EPA is approving alternate dates via letter to applicants in states where they maintain NPDES permitting authority, Vermont believes that the appropriate process is to include any such dates in the permit itself. Only this process will provide compliance with state and federal public notice requirements. That said, the Department intends to provide dates for submittal of the PIC and the CDS in a draft permit following submittal of Entergy's application due September 30, 2005. The submittal of the PIC and the CDS will not be required to be part of the application package and their omission will not cause the application to be considered incomplete.

As in the past, with respect to the cooling water intake structure, the application will be reviewed and a permit drafted utilizing best professional judgment (BPJ) as allowed under federal regulation. Entergy should submit any new information (i.e. since the previous application for renewal was submitted) about the intake structure including operational changes as well as any impingement and entrainment data collected during the past permit period.

If there are any questions with respect to this letter please contact myself or Carol Carpenter at the above phone number.

Sincerely,

Brian D Kooiker, Chief
Discharge Permits Section

Entergy

Entergy Nuclear Northeast
Entergy Nuclear Operations, Inc.
Vermont Yankee
322 Governor Hunt Rd.
P.O. Box 157
Vernon, VT 05354
Tel 802-257-7711

June 3, 2005

Carol Carpenter
Discharge Permits Section
Vermont Department of Environmental Conservation
Vermont Agency of Natural Resources
Wastewater Management Division
103 South Main Street – Sewing Building
Waterbury, VT 05671-0405

Re: Entergy Nuclear Vermont Yankee, LLC
Vermont Yankee Power Station

Dear Ms. Carpenter:

Entergy Nuclear Vermont Yankee, LLC ("Entergy VY") respectfully submits this request that the Vermont Agency of Natural Resources ("ANR") establish a schedule for submission of Vermont Yankee Power Station's (the "Station") Clean Water Act §316(b) comprehensive demonstration study in a manner consistent with the United States Environmental Protection Agency's ("EPA") final regulations implementing § 316(b) at existing electricity-generating stations (the "Rule"). *See* 69 Fed. Reg. 41576, 41620 (July 9, 2004). In particular, Entergy VY requests that ANR allow it to submit any necessary § 316(b) demonstration required by the Rule on January 7, 2008. Entergy previously requested that ANR provide written confirmation of its requested schedule in a manner consistent with 40 C.F.R. § 125.95 (a)(2)(ii) by countersigning a letter in which Entergy VY proposed a reasonable compliance schedule. ANR rejected that request and proposed to include the schedule in the Permit at the time of its renewal (September 2006) to facilitate an opportunity for public notice.

As you are aware, the Rule requires facilities, including the Station, to comply with the Rule within the next permitting cycle, unless the permittee obtains a written alternative schedule from ANR. *See* 69 Fed. Reg. at 41620, 41631. For stations with permits that terminate in the near future, demonstration of compliance with the Rule may be triggered by the Station's next permit-renewal application, which the Station expects to submit on or about September 30, 2005. As such, absent approval of Entergy's proposed submission

Entergy

schedule in writing from ANR, Entergy VY respectfully requests ANR's confirmation of its requested schedule in a manner consistent with 40 C.F.R. § 125.95 (a)(2)(ii) by incorporating this schedule into the pending NPDES Permit amendment. To that end, the proposed schedule for submission is as follows:

- No later than October 31, 2006, Entergy VY shall submit to ANR its Proposal for Information Collection.
- No later than January 7, 2008, Entergy VY shall submit to ANR its Comprehensive Demonstration Study.

Sincerely,

Lynn DeWald

Entergy Nuclear Vermont Yankee, LLC
Lynn DeWald
Environmental Specialist

cc: Chuck D. Barlow, Assistant General Counsel – Environmental, Entergy Services, Inc.

APPENDIX 4

Vermont Yankee Entrainment Monitoring

Quality Assurance Plan and Standard Operating Procedures

April 2006

ENTERGY NUCLEAR VERMONT YANKEE, LLC QUALITY ASSURANCE PLAN AND STANDARD OPERATING PROCEDURES FOR ENTRAINMENT MONITORING

Revision 0

April 2006

Prepared by

NORMANDEAU ASSOCIATES INC.

25 Nashua Road

Bedford, New Hampshire 03110

20455.001

TABLE OF CONTENTS

1.0 INTRODUCTION

Entergy Nuclear Vermont Yankee LLC ("Vermont Yankee") owns and operates the Vermont Yankee Generating Station located on the western shore of the Connecticut River (River) in Vernon, Vermont. Vermont Yankee withdraws non-contact cooling water from Vernon Pool of the Connecticut River at a location about 0.65 miles upstream from the Vernon Dam and Hydroelectric Station. The primary activity of Vermont Yankee is the generation of electric power. The final regulations implementing §316(b) of the Clean Water Act ("CWA") at existing electricity-generating stations (the "Phase II Regulations"), among other things, establish performance standards for the reduction of entrainment mortality by 80 to 95 percent and, under certain circumstances, for the reduction of entrainment by 60 to 90 percent. See 69 Fed. Reg. 41576 (July 9, 2004). The applicability of these performance standards is determined by several factors, including the type of water body from which a plant withdraws cooling water and the plant's capacity utilization factor. Under the Phase II Regulations, applicable performance standards can be met by design and construction technologies, operational measures, restoration measures, or some combination of these compliance alternatives.

Vermont Yankee's existing NPDES permit requires nearfield ichthyoplankton sampling in the Connecticut River at a location just in front of the CWIS in Vernon Pool, but it does not require the direct sampling of entrained organisms. Because the actual water velocity through each CW fixed screen varies throughout the year from 1.0 fps down to 0.0 fps as the operating mode for the plant is changed from open cycle to closed cycle, and because the period of lowest cooling water withdrawal and lowest through-screen velocities are likely to coincide with seasonal periods of high abundance of fish eggs and larvae, Vermont Yankee proposes a one-year entrainment sampling program beginning in April and continuing through September 2006. Vermont Yankee may undertake a second year of entrainment sampling in 2007 to verify the results observed during 2006 if appropriate. The April through September period is expected to encompass the entire season when entrainable-sized ichthyoplankton are exposed to Vermont Yankee's cooling water withdrawal.

The goal of the proposed entrainment program is to estimate the seasonal and annual total abundance of fish eggs and larvae that become drawn into Vermont Yankee's CWIS. The entrainment program will be documented in a project-specific Quality Assurance Plan (QAP) consistent with USEPA protocols (USEPA 2001). The Phase II Regulations require submission of a Proposal for Information Collection ("PIC") in certain circumstances. The following Standard Operating Procedures (SOP) and Quality Assurance Plan (QAP) comprise Appendix 4 of the PIC that Vermont Yankee is submitting to the Vermont Agency of Natural Resources (VANR). They detail Normandeau's methods for completing the 2006 entrainment and nearfield ichthyoplankton study at Vermont Yankee.

1.1 VERMONT YANKEE SITE AND FOREBAY DESCRIPTION

The cooling water intake structure (CWIS) at Vermont Yankee is located in a reinforced concrete bulkhead near the west shore of the River, in the impoundment area immediately upstream of the Vernon Hydroelectric Station, in the town of Vernon, Windham County, Vermont. The CWIS is located at the north side of the plant at approximately 42 degrees 47 minutes north latitude by 72 degrees 31 minutes west longitude. The CWIS is shared by the Circulating Water (CW) and Service

Water (SW) systems, each within separate and isolated forebays. The CW system provides cooling water as a heat sink to condense the plant's main process steam after it is processed by the main generating turbine. The SW system provides cooling water as a heat sink for smaller heat loads generated by coolers in a variety of pumping equipment and heat exchangers within the plant. The SW portion of the intake structure also provides a suction path for the infrequently used Fire Protection System pumps. The Fire Protection System is used to protect the safety of the plant by providing a source of water for a variety of sprinkler systems throughout the plant, and is normally not operating but is maintained in standby readiness.

2.0 ICHTHYOPLANKTON NET TOW / ENTRAINMENT FIELD STANDARD OPERATING PROCEDURES

2.1 SIMULTANEOUS ENTRAINMENT / ICHYOPLANKTON SAMPLING

The goal of the entrainment and ichthyoplankton sampling is to obtain sufficient in-plant entrainment data to quantify the calculation baseline for compliance with the performance standards of the Phase II Regulations and for comparison with nearfield ichthyoplankton data to calculate a withdrawal ratio. This withdrawal ratio is determined by comparing ichthyoplankton abundance in nearfield towed net samples to those collected simultaneously and by the same methods in the plant. This withdrawal ratio is calculated by taking the nearfield ichthyoplankton density and dividing it by the in-plant density from pairs of samples taken from the same water mass (at the same or similar time). Calculation of an accurate withdrawal ratio requires sampling with the same gear and deployment practices in both locations so that differences in the gear and methods do not contribute a bias to the calculated ratio.

2.2 EQUIPMENT

The following equipment will be necessary to complete entrainment and/or near field ichyoplankton sampling at Vermont Yankee:

2.3 SAMPLING SCHEDULE

Entrainment sampling at the Vermont Yankee CWIS is proposed to begin in April 2006 and continuing through September 2006 on the days when the plant is operating the CWIS and is not in a closed cycle mode of operation (no raw water intake). Sampling will be scheduled for the same day per week (e.g. Wednesday) for 26 consecutive weeks during 2006. Both day and night entrainment samples will be collected to insure that diel differences in ichthyoplankton abundance are adequately described. Therefore, the total number of entrainment samples for the 2006 entrainment program at the Vermont Yankee CWIS will be 52 (1 depth x 2 diel periods x 26 dates), unless some samples cannot be collected due to plant outages. During 1 May to 15 July Vermont Yankee's NPDES permit prescribes daytime near field icthyoplankton collections with sampling methods identical to those described in this SOP. These NPDES samples will be used in lieu of additional 316b samples during the day.

Table 2-2. Equipment Necessary for Entrainment and Ichthyoplankton Sampling.

Equipment	Entrainment	Ichthyoplankton
Copy of SOP and copy of Health & Safety Plan	X	X
Quality control log	X	X
Data sheets, clipboard, and pencils	X	X
Calculator	X	X
Sample jars	X	X
Labels and waterproof markers	X	X
5 gallon buckets	X	X
0.5-m-diameter, 1.5-m-long, 0.363-mm-mesh plankton net	X	X
General Oceanics flowmeter (Model 2030)	X	X
Gloves	X	X
Appropriate clothing, footwear, and personal protective equipment as specified in the Health & Safety Plan	X	X
5% formalin solution	X	X
Vermont Yankee Security Badge	X	
Personal floatation device		X
Temperature, conductivity meter, dissolved oxygen meter		X
First aid kit		X

The intention is to separate the collection of daytime and nighttime entrainment samples symmetrically within the daytime and nighttime periods of each sampling date. Daytime is defined as occurring between one hour after meteorological sunrise and one hour before meteorological sunset as observed at the plant site. Nighttime is defined as occurring between one hour after meteorological sunset and one hour before meteorological sunrise as observed at the plant site. The daytime sample will be collected at approximately the mid-point of the daylight period (halfway between sunrise and sunset, $\pm$ 2 hours), and the nighttime sample will be collected at approximately the mid-point of the night period (halfway between sunset and sunrise, $\pm$ 2 hours). The crew will check with the control room operator to determine the CWIS status prior to each scheduled sampling event, and make a decision to sample based on the operational mode of the plant with respect to recirculation flow. Sampling will not occur if the recirculation gates are 45% or more open and the plant is considered to recirculate 100% of the cooling water, thus not withdrawing any river water at the CWIS.

2.4 ENVIRONMENTAL PARAMETERS

The following environmental parameters will be observed and recorded at the start of each nearfield icthyoplankton collection and recorded on the field data sheet (Appendix A).

Table 2-4. Environmental Parameters, methods and precision

Parameter	Method	Precision
water temperature	YSI model 57 or 58 dissolved oxygen meter	nearest 1° C
dissolved oxygen concentration	YSI model 57 or 58 dissolved oxygen meter	nearest 0.1 mg/L
pH	Oakton pH Tester 2	nearest 0.1pH
weather conditions	Observation	

Parameter	Method	Precision
water temperature	YSI model 57 or 58 dissolved oxygen meter	nearest 1° C
dissolved oxygen concentration	YSI model 57 or 58 dissolved oxygen meter	nearest 0.1 mg/L
pH	Oakton pH Tester 2	nearest 0.1pH
weather conditions	Observation	

2.5 NEARFIELD ICHTHYOPLANKTON SAMPLING PROCEDURES

Samples are collected using a 0.5-m-diameter, 1.5-m-long, 0.363-mm-mesh plankton net towed from a boat. On each sampling date separate samples are collected from three depths: surface (approximately 1 foot), mid-depth (approximately 6 feet), and bottom (approximately 12 feet). The ichthyoplankton net is fished with a standard 30 cm long by 18 cm wide cable depressor deployed from a 1.0 m long cable attached to a swivel at the bridle ring.

The volume of water filtered for each sample should be approximately 100 cubic meters ±10 cubic meters, which is determined using a General Oceanics flowmeter (Model 2030) with a standard "R" type of rotor (white color) mounted in the mouth of the net. Flowmeters for this program are calibrated in a flume monthly during the sampling season. Flowmeter readings are recorded on an ichthyoplankton rough calculation sheet (Appendix A2), where the approximate sample volume is calculated. The net towing velocity used in this calculation is obtained from the observed number of flowmeter counts per second for each tow, using the General Oceanics graph for the model 2030 flowmeter with standard "R" type of rotor (Appendix A3). For the volume calculation, the net radius of 0.25 m must be squared. If the calculated tow volume is not between 90 and 110 cubic meters, the tow is repeated.

Each ichthyoplankton sample is placed into a sample container, preserved with 5% buffered formalin, and labeled with the collection date and time, station location, depth, and collection gear type. These samples are taken to the biological laboratory for sorting and for identification and enumeration of the fish species present. These procedures follow previously established protocols documented in Sections 3.5 (Ichthyoplankton Sampling) of the following document "Entergy Nuclear Vermont Yankee, LLC Environmental Services Quality Program and Standard Operating Procedures for NPDES Permit Monitoring, Revision 2, May 2005". A Chain of Custody form is completed (Appendix A5), the originator retains a copy, and the form accompanies each sample to the laboratory.

2.6 ENTRAINMENT SAMPLING PROCEDURES

Samples are collected using the same 0.5-m-diameter, 1.5-m-long, 0.363-mm-mesh plankton net deployed for nearfield ichthyoplankton sampling (Section 2.5 above), but the net is mounted inside a frame. The frame is raised and lowered by a rope and pulley system along stainless-steel guide wires bolted into the floor of the intake forebay at a location just inside of the middle intake gate.

A skim wall and the position of the intake gates hanging down below the water surface provides a slack-water area in the intake forebay from the water surface down to an elevation of about 212 ft. Between 212 ft and the floor of the intake structure at elevation 190 ft concrete beams at two elevations 11 ft apart in the vertical that provide cross bracing to the intake forebay structure and gate system, one located at elevation 212 ft and the other at elevation 201 ft.

Entrainment samples will be collected at the water column depth exhibiting the greatest observed through net flow. This depth is expected to be found in one of the two depths corresponding to the mid point of the openings between the cross brace beams, and may vary from sample to sample depending on the status of recirculation flow at the CWIS. The mid-depth entrainment net sample is taken with the top of the net opening set at elevation 207 ft, which corresponds to a measured depth below the surface deck of the intake structure of -30 ft. The bottom depth entrainment net sample will be taken with the top of the net opening set at an elevation of 197 ft, which corresponds to a measured depth below the surface deck of the intake structure of -41 ft. The duration time of deployment for the entrainment net to obtain a 100 m^3 sample is contingent upon the amount of recirculation during hybrid cycle operations. Variability of flows in the forebay due to river discharge, currents, debris in front of the intakes and recirc gate setting may result in the prescribed depths having inadequate flow to produce a sample (i.e. slack water). In these instances, the net is moved up or down to a region of adequate flow.

The water flow and volume of water filtered for each sample should be approximately 100 cubic meters ±10 cubic meters, which is determined using an electronic General Oceanics flowmeter (Model 2030) with a standard "R" type of rotor (white color) mounted slightly off-center in the mouth of the net. Flowmeters for this program are calibrated in a flume monthly during sampling season. Flowmeter readings from the electronic readout will be totalized until 100 m^3 is sampled, and then the entrainment sample will be terminated. The beginning and end times will be recorded.

Each entrainment sample is placed into a sample container and labeled with the collection date and time, station location, depth, and collection gear type. The samples are later preserved with 5% buffered formalin outside of Gate 2 at Vermont Yankee. These samples are taken to the biological laboratory for sorting and for identification and enumeration of the fish species present. A Chain of Custody form is completed (Appendix A5), the originator retains a copy, and the form accompanies each sample to the laboratory.

2.7 USE CODE

Use Code 1 ichthyoplankton and entrainment samples are those individual samples collected exactly as specified in the preceding two sections (2.5 & 2.6). The goal of both nearfield ichthyoplankton sampling and entrainment sampling is to complete the required number of samples specified by the study design with use code 1 samples. Examples of use code 2 ichthyoplankton or entrainment samples are those deviating in one or more ways from the procedures described in the preceding two sections, such as clogging of the net, reducing the tow volume or increasing the tow duration, or flowmeter fouling which would result in an inaccurate volume measurement. Use code 5 samples are those where the contents are lost. An explanatory comment is required for all use code 2 and use code 5 samples.

2.8 INSTRUMENT CALIBRATION AND MAINTENANCE

Field instruments will be calibrated prior to each day of use, and service laboratory scales and balances will be calibrated once each year. Daily calibration checks will be performed with each use of a laboratory scale or balance; field scales will be calibrated every six months. Calibration logs will be maintained for all instruments and include the following information:

- instrument number and identification
- date of calibration
- initials of the person(s) calibrating the instrument
- standards used
- results, including instrument accuracy at receipt for calibration, adjustments made, instrument accuracy after calibration.

3.0 ENTRAINMENT FIELD DATA HANDLING

3.1 Entrainment Field Data Sheets and Coding Instructions

A unique sample number is assigned to each diel entrainment abundance collection. The sample number is a four-digit number that is a composite of sample task code (1 for entrainment abundance sample), week number (two digits), and diel period (one digit). Record the sample identification and status, collection times, flow rate, and flow calibration data on the Entrainment Field Data Sheet (Appendix A) according to the instructions below. Use the space for comments at the bottom of the data sheet to explain any problems or unusual circumstances. Use a separate data sheet for each diel period entrainment sample.

VARIABLE	INSTRUCTIONS
TASK CODE	Pre-coded 1 for entrainment abundance sample
Week	Enter week number within year (01-52).
Diel	Enter the code for diel period: 1 = daytime 2 = nighttime
Use Code	Enter use code for status of sample: 1 = valid sample 2 = sample is provisional due to problem with flow 5 = void (no sample)
Comments	If comments are written at the bottom of the data sheet, enter 1; if not, leave it blank

VARIABLE	INSTRUCTIONS
Start Month	Record the month that the **24-hr** sampling event began (should be the same for all samples collected in the 24-hr period)
Start Day	Record the day that the **24-hr** sampling event began (should be the same for all samples collected in the 24-hr period)
Start Hour	Record the hour that the 100-cubic-meter diel sample began, using 24-hr clock (0000-2359 hrs)
Start Minute	Record the minute that the 100-cubic-meter diel sample began, using 24-hr clock (0000-2359 hrs)
End Hour	Record the hour that a 100-cubic-meter diel sample (or a subsample) ended, using 24-hr clock (0000-2359 hrs)
End Minute	Record the minute that a 100-cubic-meter diel sample (or a subsample) ended, using 24-hr clock (0000-2359 hrs)
Volume, end	Record the flowmeter totalizer reading for total cubic meters at the end of the sample
Volume, start	Record the flowmeter totalizer reading for total gallons at the beginning of the sample
Volume, difference	Subtract the starting flowmeter totalizer volume reading from the ending flowmeter totalizer volume reading
Gauge gpm	Record the pumping rate indicated by the flowmeter gauge to the nearest gallon per minute
Start Temp.	Record the temperature to the nearest 0.1°C, at the start of each entrainment sample
End Temp.	Record the temperature to the nearest 0.1°C, at the end of each entrainment sample
Start pH	Record the pH to the nearest 0.1 pH unit at the start of each entrainment sample
End pH	Record the pH to the nearest 0.1 pH unit at the start of each entrainment sample
Start D.O.	Record the dissolved oxygen concentration to the nearest 0.1 mg/l (ppm) at the start of each entrainment sample
End D.O.	Record the dissolved oxygen concentration to the nearest 0.1 mg/l (ppm), at the end of each entrainment sample
Start Air Temp	Record air temperature (°C) at start of each entrainment sample
End Air Temp	Record air temperature (°C) at end of each entrainment sample
Start Cloud Cover	Record the cloud cover at the start of each entrainment sample 0 = 0-9% 1 = 10-19% 2 = 20-29% 3 = 30-39%

VARIABLE	INSTRUCTIONS
	4 = 40-49%
	5 = 50-59%
	6 = 60-69%
	7 = 70-79%
	8 = 80-89%
	9 = 90-100%
End Cloud Cover	Record the cloud cover at the end of each entrainment sample
	0 = 0-9%
	1 = 10-19%
	2 = 20-29%
	3 = 30-39%
	4 = 40-49%
	5 = 50-59%
	6 = 60-69%
	7 = 70-79%
	8 = 80-89%
	9 = 90-100%
Start Precip.	Record the precipitation at the start of each entrainment sample
	0 = None
	1 = Light Rain
	2 = Heavy Rain
	3 = Snow
End Precip.	Record the precipitation at the end of each entrainment sample
	0 = None
	1 = Light Rain
	2 = Heavy Rain
	3 = Snow
Start Wind Dir.	Record the wind direction at the start of each entrainment sample
	0 = No Wind
	1 = North
	2 = South
	3 = East
	4 = West
End Wind Dir.	Record the wind direction at the end of each entrainment sample
	0 = No Wind

VARIABLE	INSTRUCTIONS
	1 = North 2 = South 3 = East 4 = West
Start Wind Speed	Record the estimated wind speed (MPH) at the start of each entrainment sample 1 = Leaves rustle, wind on face 2 = leaves and twigs in constant motion, flag waving 3 = raises dust and loose paper, small branches moving 4 = small trees begin to sway 5 = whole trees in motion
End Wind Speed	Record the wind speed (MPH) at the end of each entrainment sample 1 = Leaves rustle, wind on face 2 = leaves and twigs in constant motion, flag waving 3 = raises dust and loose paper, small branches moving 4 = small trees begin to sway 5 = whole trees in motion

3.2 Storage and Chain of Custody of Data Sheets

Check over all data sheets, to make sure they are completely and correctly filled out, and to be alert to any unusual or unexpected data values. Transport the original data sheets to the Bedford, NH office where they will be submitted to the technical data processing (TDP) center for keypunching and error checking. Document the transfer of each data packet using a data submittal chain of custody form supplied by the TDP. Retain a photocopy of TDP chain of custody form.

3.3 Hazardous Substances Log

Maintain a log of the amounts of formalin preservative brought on site. Include in each log entry the date, the name of person making the log entry, and the volume in gallons of 100% formalin brought on site on that date. Make the log available for inspection as requested by Vermont Yankee's on-site Environmental Coordinator. Provide the log to Vermont Yankee's Environmental Coordinator at the end of the project.

4.0 ENTRAINMENT LABORATORY SOP

The ichthyoplankton in each entrainment and nearfield abundance sample (Section 2.0 above) will be processed to identify individuals to species (lowest distinguishable taxon, generally species) and enumerate them by life stage. Ichthyoplankton will be enumerated into the following life stages: eggs, yolk-sac larvae, post-yolk-sac larvae, and juveniles. The total length to the nearest 0.1 mm will be measured for up to 30 individuals of each ichthyoplankton life stage (except eggs) per sample. If more than 30 ichthyoplankton larvae are present in a sample, a random selection of 30 specimens will be measured. The sorted contents of all entrainment samples will be retained in storage until the Comprehensive Demonstration Study is accepted by the regulatory agencies.

4.1 SAMPLES TO BE ANALYZED

In the laboratory, a total of 52 samples (1 depth x 2 diel periods x 26 dates) will be processed for the 2006 entrainment program at the Vermont Yankee CWIS, unless some samples cannot be collected due to plant outages. A total of 156 samples will be processed for the 2006 nearfield ichthyoplankton program. The 33 nearfield ichthyoplankton samples collected as required by the NPDES permit (3 depths x 1 diel period x 11 dates) will be individually processed as discrete depth samples. The remaining 123 nearfield ichthyoplankton samples (3 depths x 1 diel period x 11 dates plus 3 depths x 2 diel periods x 15 dates) will be combined by depth and processed as 41 depth-integrated samples.

All fish eggs and larvae will be removed (sorted) from the total material collected in each composite sample, identified to the lowest possible taxonomic category (generally genus and species), and enumerated by life stage. Life stages will be defined as egg, yolk sac larvae, post yolk sac larvae, and juvenile. Samples with extremely high numbers of ichthyoplankton will be subsampled in the lab with Motoda plankton splitters according to established and statistically reliable protocols. In such cases, a minimum of 200 eggs and larvae will be sorted and identified from the subsample. For subsampling due to high detrital load when ichthyoplankton densities are low, high detrital load will be defined as more than 400 milliliters of settled volume of solids in the sample (detritus and plankton). If this occurs, a maximum of one-half of the sample will be sorted. A reference collection will be made for the species and life stages collected.

All laboratory sorting, fish identification, and enumeration will be subject to a standard and appropriate quality assurance/quality control review based on a Military Inspection Standard (MIL-STD inspection plan derived from MIL-STD 1235 Single and Multiple Level Continuous Sampling Procedures and Tables for Inspection by Attributes to achieve a 10% Average Outgoing Quality Limit (AOQL), and a 1% AOQL for all data files, computations and reports. Please note that, for example, an AOQL of 1% means that the final data files will be certified through statistical inspection to document that less than one record (line of data) out of every 100 records will be in error. This level of quality meets or exceeds industry standards for impingement and entrainment studies. Computerized operational data files from Vermont Yankee will be obtained and used to extrapolate entrainment abundance (numbers per 100 m^3) for each taxon and life stage up to diel, daily, weekly, monthly and total annual abundance based on the actual total circulating water flow for each sampling period.

4.2 EQUIPMENT

The following items are required for laboratory analysis of ichthyoplankton in entrainment samples:

- Sorting pans
- Lights
- Magnifiers

- Dissecting microscopes
- Motoda plankton splitter
- Sieves
- Rose bengal
- Gridded Petri dishes
- Divided Petri dishes
- Jars, with lids
- Forceps
- Pipettes
- Multitally counters
- Squirt bottles
- Lab data sheets
- Pens
- Vials, with caps
- Vial labels
- Taxonomic literature
- Copy of SOP
- Ocular micrometers
- Millimeter rulers
- Masking tape
- Rubber bands
- Random number table
- Hensen Stempel Pipette
- Folsom Splitter

4.3 LABORATORY PROCEDURES

4.3.1 Subsampling

4.3.1.1 Restrictions and Quotas

Samples with high abundances may be subsampled in the laboratory, with a minimum of 200 fish eggs and larvae to be analyzed. This quota applies to the total count of all species combined, not to individual species.

For each sample with a low ichthyoplankton concentration and a high total volume of detritus and other plankton (more than 400 ml settled volume), sort a maximum of one-half of the sample for eggs and larvae.

4.3.1.2 Sequence

Use the following sequence of procedures in processing a sample that is subsampled by splitting. To eliminate any chance of bias, some steps in the procedure are to be performed by an assistant, as indicated below, so that the sorter has no prior knowledge of which samples are to be subjected to quality control inspection.

This procedure also applies when a previously split sample is further subsampled, such as an "id. split" performed because the fraction sorted was larger than necessary to meet the quota. In this situation the term "sample" in the following procedure refers to the part of the original sample that is to be further subsampled, and the selected fraction(s) are "analyzed" rather than "sorted."

1. Examine the sample to estimate the smallest size fraction that is likely to contain at least 200 fish eggs and larvae.
2. Divide the sample material into two equal parts using the techniques in Section 4.3.1.3.
3. Randomly select one of the two divisions for processing (or for further subsampling, if a smaller fraction is needed). Selection should be done using a random number table or a coin toss, so that each of the two divisions has an equal chance of being selected. The person performing the division must not know which of the two divisions will be analyzed before the division is completed (it is not acceptable to always select the division from the same chamber of the splitter).
4. Set aside the fraction not selected for further processing and label it to identify the sample number and fractional size.
5. If the fraction that was selected for further processing needs to be subsampled further, repeat steps 2-4 as many times as necessary to produce the desired fraction for analysis. When the desired fraction is obtained, label it to show the sample number and fractional size.
6. Sort the subsample by the procedures in Section 4.3.2. Organisms must be sorted from the entire subsample even if the quota is reached before finishing the subsample.

4.3.1.3 Splitting Technique

Perform all sample splitting using a Motoda splitter. The presence of filamentous algae or large items (including large juvenile fish, or older age classes) can interfere with the even distribution of material and organisms between the two chambers of the splitter. Therefore, to insure successful results, observe the following techniques: (1) Adjust sample dilution to be great enough to allow free mixing of the sample but not so great as to promote clumping due to over dilution. (2) Remove large fish and excessive amounts of filamentous algae before splitting, returning any adhering ichthyoplankton to the sample. (3) Pull apart remaining clumps of algae before splitting. (4) Scrutinize detritus and organisms during the splitting process to see that they appear equally distributed before making the final division. (5) Remix and split again if the two resulting portions of a division do not appear equal. If a sample has so much algae that it cannot be satisfactorily split, sort the entire sample, and if numbers of ichthyoplankton are high splitting may be performed after sorting. Large juveniles that are removed from the whole sample before splitting must be kept separate from ichthyoplankton sorted from the sample after splitting, and they must be labeled to show they represent the whole sample.

4.3.2 Sorting

Remove fish eggs, larvae and juveniles, from the samples according to the following procedures:

- Samples may be stained with rose bengal to facilitate sorting.
- Pour the sample contents into a sieve with a mesh equivalent to, or finer than, 300 μm and rinse with water to remove the preservative.
- If the sample contains large numbers of fish eggs and larvae, prepare a subsample following the procedures in Section 4.3.1.
- Carefully wash the sample contents into a container making certain that nothing remains in the sieve. Pour portions of the sample from the container into a pan and examine them under magnification.
- Remove fish eggs, larvae, and juveniles from the sample using forceps, pipettes, and probes. Remove only those fragments that include the head.
- Maintain a combined total count for eggs and larvae that are removed from the sample (i.e., the combined total of eggs, yolk-sac larvae, post yolk-sac larvae, and juveniles).
- When sorting is completed, recheck the sample for organisms. After the sample has been rechecked, label vials containing the sorted organisms and place them in a box designated for sorted samples. Record the sorting results and date completed in a log.
- Carefully wash back the remaining sample contents into the original sample container, appropriately preserved, and return it to the storage area.
- If a sample is not completed by the end of the work day, it may be left unpreserved overnight if adequate precautions are taken to prevent it from drying out. No sample or part of a sample, however, should remain unpreserved for more than 24 hours.

4.3.3 Identification

Identify, stage, count, and measure the sorted ichthyoplankton according to the following procedures:

- Obtain the sample vials containing the sorted organisms from the storage area and sign them out by initialing a status log.
- Rinse specimens free of preservative and submerge them in water in a Petri dish. Use a binocular microscope with an ocular micrometer to examine the specimens, and identify them to the lowest practical taxon (usually species) by referring to the literature, the reference collections, and by consulting with fellow identifiers.
- Determine the life stage of each specimen. Pertinent life stages for all except winter flounder larvae are defined and identified as follows:

  Egg: the embryonic developmental stage, from spawning until hatching (Life Stage = 1). Eggs frequently become damaged during collection and sample processing. Damaged eggs are counted as the number of embryos (without regard to how many egg capsules are present). Do not count non-fertilized eggs if they are present.

Yolk-sac larva: the transition stage from hatching through the development of a complete, functional digestive system (regardless of the degree of yolk and/or oil globule retention). Life Stage = 2.

Post yolk-sac larva: the transition stage from development of a complete, functional digestive system to transformation to juvenile form (regardless of the degree of yolk and/or oil globule retention), including the leptocephalus stage of eels. Life Stage = 3.

Young-of-the year: the stage from completed transformation to Age 1 (i.e., 12 months after hatching). A young-of-the-year has a full complement of fin rays identical to that of an adult. Eels are classified in this stage until Age 2. Life Stage = 4.

Yearling or older: a fish at least one year old. Life Stage = 7.

- Count the specimens of each life stage. Record the counts by species and stage on the lab data sheet (refer to Section 4.5.1 for coding instructions).
- From each entrainment abundance sample, measure a maximum of 30 larvae of each fish taxon and larval life stage to the nearest 0.1 mm (total length) and record the measurements on the lab data sheet. Record total length of juvenile life stages to the nearest 1.0 mm. If more than 30 larvae of a given taxon and life stage are present, randomize the selection of specimens for measuring by the following procedure. Spread them uniformly in a gridded container, select a starting point in the grid by means of a random number table, and then measure the first 30 measurable specimens encountered in a predetermined pattern commencing at the starting point. Every grid space must have an equal probability of being selected as the starting point, so that every specimen will have an equal probability of being included in the subsample.
- All larvae from entrainment survival samples will be measured without subsampling.
- Place identified organisms in vials with an adequate amount of preservative for storage. Specimens may be removed for inclusion in the reference collection. For those removed, list the species, life stage, and numbers on the comments section of the form and note their removal on a tag retained inside the appropriate vial. Label all vials for a single sample, initial them and band them together. Record the number of vials for the sample on the data form. For reference collection procedures refer to Section 4.7.

4.4 SAMPLE HANDLING

4.4.1 Sample Control

Each sample was given a unique sample number at the time of collection. Track each sample by that sample number throughout the laboratory and data processing functions.

4.4.2 Chain of Custody Records

The chain of custody documentation begins with the field staff providing a list with the following information for each sample in a shipment delivered to the laboratory facility in Bedford, New Hampshire: sample collection date, sample collection time, sample identification number, and number of jars. Upon receipt of the samples, a laboratory representative verifies that all jars of all samples on the list are present, then signs and dates the chain of custody document.

After samples have been received in the laboratory, track their location and status during all phases of storage and laboratory analysis by means of sample control logs. The function of this system is to provide a paper trail of who performed each step in the analysis of a sample from collection to storage, when each step occurred, what condition the samples were in and where each step took place.

4.4.3 Preservation and Storage

Retain the original preservative (formalin solution) for reuse in preserving the residue of sorted samples, adding 5% formalin as needed to fill the sample jars. Store processed samples (i.e., detritus and organisms not removed from split samples) until sorting quality control checks are completed. Keep sorted ichthyoplankton in vials in a heated storage area until disposal is authorized (when the Comprehensive Demonstration Study is submitted to VANR, presently scheduled for January 2008). Tape the tops of jars and vials to prevent loss of preservative by evaporation.

4.4.4 Disposal

Disposal of sample residue remaining after sorting (detritus and organisms not removed from split samples) may proceed after sorting quality control has been completed. Disposal of vials of organisms from processed samples may proceed after receiving authorization from Vermont Yankee. Follow all applicable state and federal regulations for hazardous waste disposal.

4.5 DATA HANDLING

4.5.1 Data Sheets and Coding Instructions

Record ichthyoplankton counts and measurements on Entrainment Lab Count Data Sheets and Entrainment Lab Length Data Sheets (Appendix A). The Entrainment Lab Count Data Sheet is for species identifications, life stage determination, and count data for all taxa. The Entrainment Lab Length Data Sheet is for measurements of all fish larvae. Indicate in the upper right-hand corner of each data sheet how many pages there are for the sample (use "1 of 1" for a one-page sample, "1 of 2" and "2 of 2" for a two-page sample, etc.). Also record in the upper right-hand section of the first page the identifier's initials, the date the sample was identified, and the number of vials.

4.5.1.1 Count Data

Record count data in the top ("Card Type L1") section of the data sheet according to the following instructions.

VARIABLE	INSTRUCTIONS
SAMPLE	Record the 4-digit sample number. Sample numbers will be in the range 1011 to 1524 for entrainment abundance samples (but not every number in that range is used).
CONTAINER #	Blank = not a survival sample (first sample number digit is 1)
SURVIVAL PERIOD	Blank = not a survival sample (first sample number digit is 1)
AD	Blank = not a survival sample (first sample number digit is 1)
CATCH_CD	Enter 1 for valid non-empty sample or 2 for valid empty sample (data sheets are not required for void samples)
SPL_FACT	Enter 1.00 if the whole sample is analyzed; if the sample is subsampled record the ratio of the whole sample to the subsample (e.g., 8.00 for a 1/8 split)
TAXON	Enter the TAXON code from the list provided in Appendix B.
STAGE	Enter one of the following life stage codes: 0 = unknown life stage (damaged preventing positive identification) 1 = eggs 2 = yolk-sac larvae 3 = post yolk-sac larvae 4 = young-of-the-year 7 = yearling or older
COUNT	Record the number of organisms of the indicated taxon and life stage in the sample (or subsample)
SPECIES NAME	Record the common name for the taxon

4.5.1.2 Measurement Data

Record measurement data for all fish larvae on one or more Entrainment Lab Length Data Sheets (Appendix A) according to the following instructions.

VARIABLE	INSTRUCTIONS
SAMPLE	Record the sample number
Card Type	Preprinted: L2
SURVIVAL PERIOD	Blank = not a survival sample (first sample number digit is 1)
AD	Blank = not a survival sample (first sample number digit is 1)
Conversion Factor	Record the number of millimeters per division for the optical micrometer used to measure larvae
TAXON	Enter the TAXON code from the list provided in Appendix B.
FISH_ID	Preprinted: 1-30 for each taxon of ichthyoplankton larvae.

VARIABLE	INSTRUCTIONS
STAGE (or "STG.")	Enter the life stage code for each larva measured (2, 3, 4, or 5 for other species). Refer to the life stage code definitions used for count data (Section 4.3.3).
SCALE	Enter 6 if measurements are recorded in optical micrometer units; enter 7 if measurements are recorded directly in millimeters. (If optical micrometer units are recorded for a measurement, the actual length in millimeters will be obtained later by multiplying the measurement by the conversion factor.)
MEASUREMENT	Record the total length of fish larvae to the nearest 0.1 optical micrometer unit or to the nearest 0.1 mm. Measure juvenile fish to nearest 1.0 mm.

4.5.2 Storage and Chain of Custody of Data Sheets

Maintain all completed data sheets in duplicate. Keep photocopies at the site of origin and transfer the originals as needed from the laboratory to the data center, quality control, and a master project file. Track the custody of data sheets by means of data control logs.

4.6 Quality Control

4.6.1 Tasks Subject to Quality Control

The following tasks are subjected to quality control checks consisting of reanalysis of randomly selected samples or measurements:

- sorting
- identification, life stage determination, and enumeration

4.6.2 Inspection Plans

Items 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). 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=8** and **f=1/7**, because the total number of samples analyzed by an individual is less than 500. It is important that QC inspections are performed as soon as possible after the original analysis; work-up of QC samples must not be postponed to be done in batches. 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.

Select items for reanalysis according to the plan using a random number table. The original analyzer should not know whether a sample is to be checked before the analysis of that sample has been completed. Perform all quality control checks "blindly" (i.e., the individual performing the QC inspection should have no knowledge of the original analyst's results).

Apply the QC plan 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. All errors found during the QC check, whether the sample is defective or not, are to be corrected on the data sheets. (A difference between original and QC counts that is within acceptable limits is not considered to be an error). Results of the quality control program are to be presented to all sorters and identifiers and help is to be made available to anyone failing a QC check.

In some cases a QC inspection may be able to determine the taxon or life stage of damaged specimens when the original identifier has recorded them as unknown life stage, unidentified taxon, or a higher level taxon (genus or family). If a more general taxon or life stage used by the original identifier includes the more specific category used by the QC inspector, and that is the only reason for a count discrepancy, then that sample does not fail the QC inspection on the basis of that taxon. For example, damaged specimens recorded as *Lepomis* sp. (sunfish) by the original identifier and as *Lepomis gibbosus* (pumpkinseed sunfish) by the QC inspector are to be considered in agreement because the category *Lepomis* sp. includes pumpkinseed sunfish. In contrast, an original determination of unidentified sunfish (*Lepomis* sp.) would not be acceptable if the QC determination was smallmouth bass (*Micropterus dolomieui*), because smallmouth bass is not included in the genus *Lepomis*. If substantial differences occur between the original and QC counts as a result of identifying or staging to different levels, then the identifier should be provided with additional guidance or training to minimize such differences in future samples.

4.6.3 Acceptance/Rejection Criteria

4.6.3.1 Sorting

A sample is considered defective if the sorter failed 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.

4.6.3.2 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 may be determined in which a third person reanalyzes the sample (resolution value). The error for each species and life stage will then be calculated using the resolution counts as the divisor. This will be done for both identification and QC counts:

% error = 100% x |identifier count – resolution count | / resolution count

% error = 100% x | QC count – resolution count | / resolution count

If the resolution vs. identifier error is <10 percent, the sample passes. If they are not, the sample fails and identifier counts are replaced by QC counts for all cases, provided the QC vs. resolution error is <10 percent. If the resolution vs. identifier and the resolution vs. QC errors are both 10 percent or more, the sample will be thoroughly reviewed by all three people and the identifier's sample processing will not continue until agreement can be reached on the identification of the sample. Subsequent samples will be reanalyzed by the QC person until eight consecutive samples pass. Notify the Laboratory Manager of any identifier exceeding two failed samples.

4.6.4 Quality Control Records

Maintain quality control logs, documenting the samples analyzed, the samples selected for reanalysis according to the QC plan, the results of the QC analysis, and any corrective action performed. All QC logs will be 100% inspected monthly by the Laboratory Supervisors. A summary report of quality control results and follow-up corrective action will be submitted to the client upon request.

4.6.5 Quality Control Personnel

The QC of the sorting process is to be conducted under the direct supervision of the Sorting Supervisor. Only the Sorting Supervisor or individuals with a documented sorting QC record of superior performance may provide sort QC.

Regarding identification QC, only the Identification Supervisors will be performing the QC on ichthyoplankton identification.

4.7 REFERENCE COLLECTION

Make sure that each taxon and life stage identified in the entrainment program is represented in a project-specific reference collection at Normandeau's biology laboratory. Add to that reference collection as needed by removing specimens from Vermont Yankee entrainment samples and storing them in vials in a designated area. If available, include several (e.g., 10) specimens per taxon per stage, displaying a variety of sizes. Label the vials with the scientific name, date of capture, capture location, and a reference collection catalog number. The catalog number identifies a card containing more detailed sampling information, identifier, comments, etc. File the cards alphabetically by family, genus, and species.

4.8 Instrument Calibration

Calibrate each ocular micrometer periodically (at least weekly) using a stage micrometer. After calibration of ocular micrometers on zoom microscopes, place a calibration mark on the microscope so that measurement accuracy is maintained. Ocular micrometers on microscopes that have been adjusted or moved must be recalibrated before use. Document the calibrations in a log showing the dates and results of the calibrations.

5.0 Data Processing

5.1 Data Entry Verification

A submittal form will be provided with each batch of data sheets submitted to the Technical Data Processing (TDP) department in the Bedford office for data entry. Information on the submittal form should include names of sender and recipient, date sent, and dates of impingement collections included in the batch.

All data will be keyed twice, resolving discrepancies between the two versions as they are flagged by the data verification program.

5.2 Systematic Error Checks

Keyed data will be subjected to a series of systematic error checking programs developed specifically for this project. These consist of univariate, bivariate, and multivariate checks specified by project personnel. Univariate range checks identify records for which one or more variables have values outside their valid or expected ranges. Bivariate and multivariate checks compare values of related variables. Additional checks scan the data for duplicate or missing observations. All records flagged by these programs will be resolved, and corrections to both the data files and the data sheets will be made as necessary. After error checking is complete, data files will be subjected to quality control inspection (refer to Section 5.4).

5.3 Data File Format

Error checked data files will be assembled into a computerized database.

5.4 Quality Control of Data Files

Data files that have completed the systematic error checking process will undergo a QC inspection to assure a 1% AOQL (Average Outgoing Quality Limit) according to a lot sampling plan (American Society for Quality Control. 1993. Sampling procedures and tables for inspection by attributes. ANSI/ASQC Z1.4-1993). This procedure insures that ≥99% of the observations in a data file agree with the original data sheets. The number of observations to be checked, and the number of those that must be within tolerance are shown below. If more than the acceptable number of failures is found, then the data set must be inspected 100%.

Lot Sampling Plan for QC Inspection at Less Than 1% AOQL.

		Number of Failures	
Lot Size	**Sample Size**	**Accept If ≤**	**Reject If ≥**
1-32	ALL	0	1
33-500	32	0	1
501-3,200	125	1	2
3,201-10,000	200	2	3
10,001-35,000	315	3	4
35,001-150,000	500	5	6
150,001-500,000	800	7	8
500,001 and over	1,250	10	11

6.0 TRAINING

In order to assure the standardization of field, laboratory, and data processing procedures, Normandeau has developed a two-level system for training technicians: the first level being documented standard operating procedures; the second level being a training program for all new project personnel. At a minimum, this training program consists of the following steps:

- A complete reading and explanation of the project SOP and QA manual. This is documented by a sign-off sheet which is filed in the program file.
- Observation by the Program Manager, Field Site Supervisor or Laboratory Manager of the first two or more times a new procedure is performed. This is documented with a signed checklist.
- Direct supervision by an experienced technician of personnel assigned to unfamiliar tasks for their first two or more attempts.
- 100% quality control checks for at least the first five samples analyzed.
- On tasks requiring identification of fish and ichthyoplankton, the Program Manager will have final approval as to who is qualified to make these identifications. In some cases special training will be required to participate in tasks, as set forth by the Program Manager.

7.0 QUALITY ASSURANCE PLAN

Normandeau's Program Manager is Dr. Mark Mattson. The program Technical Director is Ms. Jennifer Griffin. Dr. Mattson is expected to be the principle report reviewer and co-author. Normandeau's Quality Assurance Director is Mr. Robert Hasevlat, who is independent of the project and reports directly to the company's President, Ms. Pamela Hall. The Field Supervisor is Mr. John Pierce, who will also contribute as a report author and data analyst along with Mr. Paul Lindsay or Mr. Jason Wyda. Field crew members include Mr. Brian Hanson, Ms. Aimee Varady, and Mr. Bradley Houseworthy. Normandeau's principle laboratory fish taxonomist is Mr. Joseph Strube. Normandeau's technical information processing services will be provided by Mr. Chris Gushin and Mr. Eric Nestler.

7.1 IMPORTANCE OF QUALITY ASSURANCE

The analytical study will provide qualitative and quantitative data for use in decision making. To be valuable, the data must accurately describe the characteristics and concentrations of constituents in the sample analyzed. In many cases, because they lead to faulty interpretations, approximate or incorrect results are worse than no results at all. Decisions on process changes, plant modifications or the construction of new facilities may be based upon the results of field and laboratory analysis. The financial implications of such decisions make it imperative that extreme care be taken in analysis. The analyst should realize not only that he/she has considerable responsibility for providing reliable descriptions of the samples at issue, but also that his/her professional competence, the validity of the procedures used, and the resulting values reported may be challenged (perhaps in court). For the analyst to meet such challenges, he/she should support the data with an adequate documentation program that provides valid records of the control measures applied to all factors bearing on the final results of investigations. Although all analysts practice quality control (QC) in amounts depending upon their training, professional pride, and the importance of their particular projects, under actual working conditions sufficiently detailed QC may be neglected. An established, routine, quality assurance program applied to each analytical test will provide the detailed QC necessary to insure the validity and reliability of the data.

7.2 QUALITY ASSURANCE

A Quality Assurance (QA) Program will be implemented that will provide a 10% Average Outgoing Quality Limit (AOQL) (i.e., 10% or less non-conforming product) for all field or laboratory measurement parameters and a 1% AOQL (i.e., 1% or less non-conforming product) for all data calculations and data tables. This Quality Assurance Program is designed to meet or exceed the USEPA's guidance criteria and be consistent with the intent of Federal regulations (10 CFR 50) which require that quality assurance be separated from operational and budgetary concerns. Normandeau has a full time Quality Assurance Director who supervises the implementation and documentation of the QA Program and reports directly to the President of the Company.

Normandeau's Quality Assurance Program will comprise two systems: a quality control (QC) system and a quality assurance (QA) system. The principal strengths of the QA Program are the functional independence of the systems and the common collection and interpretation point for quality related information, the Quality Assurance Director. The QC system is managed by the Program Manager and conducted by operational personnel. The QA system is managed by Normandeau's Quality Assurance Director and utilizes project-independent technical personnel during performance and system audits.

7.3 QUALITY CONTROL

The function of the QC system is to continually monitor the reliability and validity (accuracy, precision, and completeness) of data produced on a daily basis. The QC system is approved by the QA Director and incorporated into the project Standard Operating Procedures (SOP); any changes to the SOP must be coordinated through Normandeau's QA Department and approved by a client representative. The project SOP will describe and document the following tasks:

- technical requirements, methods, and procedures,
- Quality Control program,
- instrument maintenance and calibration,
- document control and documentation of the resulting from sample analysis, instrument maintenance and calibration and data processing,
- sample control procedures, and
- training of technicians.

Tasks subject to 10% AOQL quality control inspection will be specified in the project SOP. Quality assurance audits of field and laboratory activities will be performed at least once per year to verify that procedures are carried out as specified in the SOP and to verify the effectiveness of the quality control system. Computer entry of data from data sheets will be subjected to double entry verification. Computer files will be subjected to a rigorous set of univariate, bivariate, and multivariate systematic error checks. Analytical files will then be subjected to a 1% AOQL quality control inspection to verify that values have correctly been correctly transferred from data sheets to the analytical files. Representative data values in tables and graphs will be verified by recalculating them from the original data.

7.4 NONCONFORMANCE REPORTS AND CORRECTIVE ACTION

Documentation of problems or unusual events occurring during a program will be accomplished using Extraordinary Event/Nonconformity (EENC) forms. The EENC form (Appendix A) is designed to dispense information to the Program Manager and Quality Assurance department and to obtain necessary action on items that are critical to technical operations and management of programs. The report results from observations such as these:

- deviations from standard operating procedures
- losing a sample
- finding an endangered species in a sample
- noting samples that are grossly different from expected (content, preservation, labels)
- noting a phenomenon that may deserve continued monitoring in the interest of the client and therefore may require a change in the scope of work

- quality control samples that exceed acceptable limits
- unusually high organism counts.

Items, samples, data, or information not in conformity with specifications or which do not meet preconditions for the next step in processing or use, will be set aside until the problem is resolved and documented via the EENC report procedure.

The EENC report is designed for use by any person who identifies a problem or discovers information that is germane to a program scope of work or the improvement or change of contract performance. The originator describes the problem and may make recommendations for its resolution. Two temporary copies are made, and the original is sent to the Program Manager. One of the copies is kept by the originator in a file for "open" EENC reports (corrective action in progress), and the other is sent to the Quality Assurance Supervisor, who periodically checks on the progress of corrective action.

The Program Manager confers with appropriate parties and decides what corrective action will be required. Instructions to the Action Addressee (the person responsible for carrying out the corrective action) are written on the original EENC report. The Program Manger retains the original and sends a copy to the Action Addressee.

The Action Addressee resolves the problem as directed and then signs the EENC copy and returns it to the Program Manager to signify that the corrective action has been completed.

The Program Manager files the signed copy from each Action Addressee (there may be more than one), and when all corrective action is complete signs the original EENC report, keeps a temporary copy, and forwards the original to the QA Supervisor.

The QA Supervisor reviews the EENC report, and signifies acceptance of the resolution by signing and dating the report to "close" it. A copy of the closed EENC report is retained in QA files, the temporary copy received earlier from the originator is discarded, and the original is returned to the Program Manager.

The Program Manager discards the temporary copy and keeps the original on file. A copy of the closed EENC report is sent to the originator, and additional copies are sent to any other affected parties. The originator discards the temporary copy in the file of open EENC reports and files the copy of the closed EENC report.

7.5 QA AUDITS

It is the responsibility of the Quality Assurance organization to verify the achievement of quality through all phases of the project. Once the proposal, program design, and work development phases are complete, these responsibilities will be accomplished primarily by audits, tests, and surveys which will provide objective evidence that the quality control program and technical requirements, methods, and procedures as outlined in the study QA manual are being implemented. All field, laboratory, and data processing tasks will be subject to at least one audit. These audits will be conducted by an audit team of technically qualified personnel familiar with, but independent of and not responsible for, the work or activities under evaluation. The audit team will review the operations, specifications, QC systems, plans, and project objectives and examine the acquisition and transfer of data from field to report.

Observations of nonconformities and program deficiencies will be classified into three categories:

A. Deficiencies that affect the data adversely;

B. Deficiencies that might affect the data adversely; and

C. Deficiencies or procedural changes that cannot affect the data adversely.

Class A deficiencies will be resolved before that portion of the program can proceed. Class B deficiencies must have a determination as to whether they should be changed to Class A or C deficiencies and whether or not corrective action is necessary. If corrective action is necessary, it will be performed within a reasonable time frame agreed to by the program management, the Quality Assurance Department, and Vermont Yankee. Operations with Class A or B deficiencies will be subject to re-audit to determine the effectiveness of corrective action. Class C deficiencies must have corrective action accomplished before the next scheduled audit or end of the project, whichever comes first.

Audit results will be presented orally to the appropriate project or facility management by the audit team after the audit has been completed. At this time, specific findings will be presented and recommended courses of corrective action developed. Subsequently, the audit results will be documented in a written audit report and reviewed by management having responsibility in the areas audited. These reports will include a summary of audit results, observations made with a listing of nonconformities, recommendations and corrective action taken.

The quality assurance director will maintain a file of all project and facility audits. This file will include copies of the audit checklists, audit reports, written replies, the record of completion of corrective action and follow-up action. Further copies of the audit reports, written responses and records of completion of corrective actions will be sent to Ms. Pamela S. Hall, Normandeau's President.

APPENDIX A

Forms

VERMONT YANKEE, 2006
Entrainment Field Data Sheet

Task Code	Week	Diel	Use Code	Comments
1				

DATE & TIME

	month *	day *		hour	min
			start		
			end		

*** Month and day refer to when the 24 hours sample began**

CALIBRATION

Gallons*		Calibration seconds		time for sampling pump to fill calibration tank
start		Calibration gallons		calibration tank volume (210 gal)
end		Calibration gpm		= cal tank vol / (cal. Seconds / 60)
difference		Sampling time		= 26,420 gal / cal. Gpm

* flowmeter totalizer reading

% Error		= 100 x (gauge gpm - calibration gpm) / calibration gpm
Average % Error		if % error greater than 3%, conduct 3 trials and average

WATER QUALITY

	Start	End
temp.		
pH		
D.O.		

ENVIRONMENT

	Air Temp (°C)	Cloud Cover	Precip.	Wind Dir.	Wind Speed (Mph)
Start	.				
End	.				

COMMENTS

CODES

Week:	number within year (01-52)	Cloud Cover:	0=1-9%	Wind Dir.	0=No Wind
Diel:	1 = day		1=10-19%		1=North
	2 = night		2=20-29%		2=South
			3=30-39%		3=East
			4=40-49%		4=West
Use Code:	1=valid sample		5=50-59%	Wind Speed	1=Leaves rustle, wind on face
	2=fish collected, problems with flow		6=60-69%		2=leaves and twigs in constant mtn, flag waves
	3=void(no sample)		7=70-79%		3=raises dust/loose paper, flag in motion
Comments:	1=yes		8=80-89%		4=small trees begin to sway
	2=no		9=90-100%		5=whole trees in motion
		Precip.	0=None		
			1=Light Rain		
			2=Heavy Rain		
			3=Snow		

VERMONT YANKEE, 2006

Entrainment Lab Count Data Sheet

Sample	Card	Container #	Period	AD	Catch_CD
	L1				

Analyzed By: ______

Date: ______

No. Vials: ______

SPL_FACT	TAXON	STAGE	COUNT	SPECIES NAME

Stage Codes

0 = unknown
1 =egg
2 = yolk-sac larvae
3 = post yolk sac larvae
4 = young of year
7 = yearling or older

Sample [ ] Card Type [L2] Conversion Factor [ ] Taxon [ ]

	Stg.	Scale	Msrmnt		Stg.	Scale	Msrmnt		Stg.	Scale	Msrmnt		Stg.	Scale	Msrmnt		Stg.	Scale	Msrmnt
1			.	11			.	21			.	31			.	41			.
2			.	12			.	22			.	32			.	42			.
3			.	13			.	23			.	33			.	43			.
4			.	14			.	24			.	34			.	44			.
5			.	15			.	25			.	35			.	45			.
6			.	16			.	26			.	36			.	46			.
7			.	17			.	27			.	37			.	47			.
8			.	18			.	28			.	38			.	48			.
9			.	19			.	29			.	39			.	49			.
10			.	20			.	30			.	40			.	50			.

PAGE ___ of ___

VERMONT YANKEE, 2006

Entrainment Lab Length Data Sheet

Sample [| | |] **Card** [L2]

Stage Codes: 0 = unknown
2 = yolk sac larvae
3 = post yolk sac larvae
4 = post yolk sac larvae
7 = yearling or older

Page__ of __

TAXON [ ] **STAGE** [ ] **TAXON** [ ] **STAGE** [ ] **TAXON** [ ] **STAGE** [ ]

	Scale	Measurement		Scale	Measurement
1		.	16		.
2		.	17		.
3		.	18		.
4		.	19		.
5		.	20		.
6		.	21		.
7		.	22		.
8		.	23		.
9		.	24		.
10		.	25		.
11		.	26		.
12		.	27		.
13		.	28		.
14		.	29		.
15		.	30		.

	Scale	Measurement		Scale	Measurement
1		.	16		.
2		.	17		.
3		.	18		.
4		.	19		.
5		.	20		.
6		.	21		.
7		.	22		.
8		.	23		.
9		.	24		.
10		.	25		.
11		.	26		.
12		.	27		.
13		.	28		.
14		.	29		.
15		.	30		.

	Scale	Measurement		Scale	Measurement
1		.	16		.
2		.	17		.
3		.	18		.
4		.	19		.
5		.	20		.
6		.	21		.
7		.	22		.
8		.	23		.
9		.	24		.
10		.	25		.
11		.	26		.
12		.	27		.
13		.	28		.
14		.	29		.
15		.	30		.

TAXON [ ] **STAGE** [ ] **TAXON** [ ] **STAGE** [ ] **TAXON** [ ] **STAGE** [ ]

	Scale	Measurement		Scale	Measurement
1		.	16		.
2		.	17		.
3		.	18		.
4		.	19		.
5		.	20		.
6		.	21		.
7		.	22		.
8		.	23		.
9		.	24		.
10		.	25		.
11		.	26		.
12		.	27		.
13		.	28		.
14		.	29		.
15		.	30		.

	Scale	Measurement		Scale	Measurement
1		.	16		.
2		.	17		.
3		.	18		.
4		.	19		.
5		.	20		.
6		.	21		.
7		.	22		.
8		.	23		.
9		.	24		.
10		.	25		.
11		.	26		.
12		.	27		.
13		.	28		.
14		.	29		.
15		.	30		.

	Scale	Measurement		Scale	Measurement
1		.	16		.
2		.	17		.
3		.	18		.
4		.	19		.
5		.	20		.
6		.	21		.
7		.	22		.
8		.	23		.
9		.	24		.
10		.	25		.
11		.	26		.
12		.	27		.
13		.	28		.
14		.	29		.
15		.	30		.

EXTRAORDINARY EVENT/NONCONFORMITY REPORT

EE/NC Report Number: FIELD(number) Date:________________ From:________________

Respond by (date): ____________ Project No.: ____________ Title:________________

Date closed: ____________

ADDRESSEES:
QA: __√__ Project Mgr.: _____ Field Mgr.: _____ Lab Mgr.: _____ Technical Mgr.: _____ Others: _____

PROBLEM DEFINITION (e.g.. Sample ID, Activity, Data, Standard, etc. Not in Conformity) :

RECOMMENDATIONS FOR or CORRECTIVE ACTION TAKEN:

Signed:

ACTION ADDRESSEE RESPONSE:

CORRECTIVE ACTION COMPLETED: Date: ____________ Signed:________________

Distribution: ORIGINAL:QA, COPIES OF ORIGINAL: Originator, Addressees
RESPONSES: QA (responses are to be made on copies)

APPENDIX B

Taxon Identification Codes

Appendix Table B-1. Taxon codes for Vermont Yankee NPDES fish species.

Taxon	Common Name	Scientific Name	Print Order
0	No species caught	No species caught	
1	American eel	*Anguilla rostrata*	3
10	Clupeidae	Clupeidae	
14	American shad	*Alosa sapidissima*	4
15	Gizzard shad	*Dorosoma cepedianum*	5
22	Blueback herring	*Alosa aestivalis*	
32	Brown trout	*Salmo trutta*	7
33	Brook trout	*Salvelinus fontinalis*	8
35	Atlantic salmon	*Salmo salar*	6
36	Rainbow smelt	*Osmerus mordax*	8
41	Chain pickerel	*Esox niger*	10
42	Northern pike	*Esox lucius*	9
50	Carps and Minnows	Cyprinidae	0
52	Goldfish	*Carassius auratus*	11
54	Common carp	*Cyprinus carpio*	12
57	Golden shiner	*Notemigonus crysoleucas*	15
59	Common shiner	*Luxilus cornutus*	14
60	Spottail shiner	*Notropis hudsonius*	16
63	Spotfin shiner	*Notropis spilopterus*	17
67	Longnose dace	*Rhinichthys cataractae*	19
69	Fallfish	*Semotilus corporalis*	20
72	Notropis sp.	*Notropis sp.*	18
75	Silvery mimmow	*Hybognathus regius*	13
82	White sucker	*Catostomus commersoni*	21
92	Yellow bullhead	*Ameiurus natalis*	22
93	Brown bullhead	*Ameiurus nebulosus*	23
101	Banded killifish	*Fundulus diaphanus*	0
111	White perch	*Morone americana*	24
120	Centrarchidae	Centrarchidae	0
121	Rock bass	*Ambloplites rupestris*	25
122	Redbreast sunfish	*Lepomis auritus*	26
124	Pumpkinseed	*Lepomis gibbosus*	27
125	Bluegill	*Lepomis macrochirus*	28
126	Smallmouth bass	*Micropterus dolomieu*	30
127	Largemouth bass	*Micropterus salmoides*	31

129	Black crappie	*Pomoxis nigromaculatus*	32
130	Lepomis sp.	*Lepomis sp.*	29
141	Tesselated darter	*Etheostoma olmstedi*	33
142	Yellow perch	*Perca flavescens*	35
145	Walleye	*Sander vitreus*	36
148	Etheostoma sp.	*Etheostoma sp.*	34
160	Lampreys	Petromyzontidae	2
161	Sea lamprey	*Petromyzon marinus*	1
901	Unidentifiable	Unidentifiable	1000

Note: Check with the project Technical Director if taxon is not found in this list

APPENDIX C

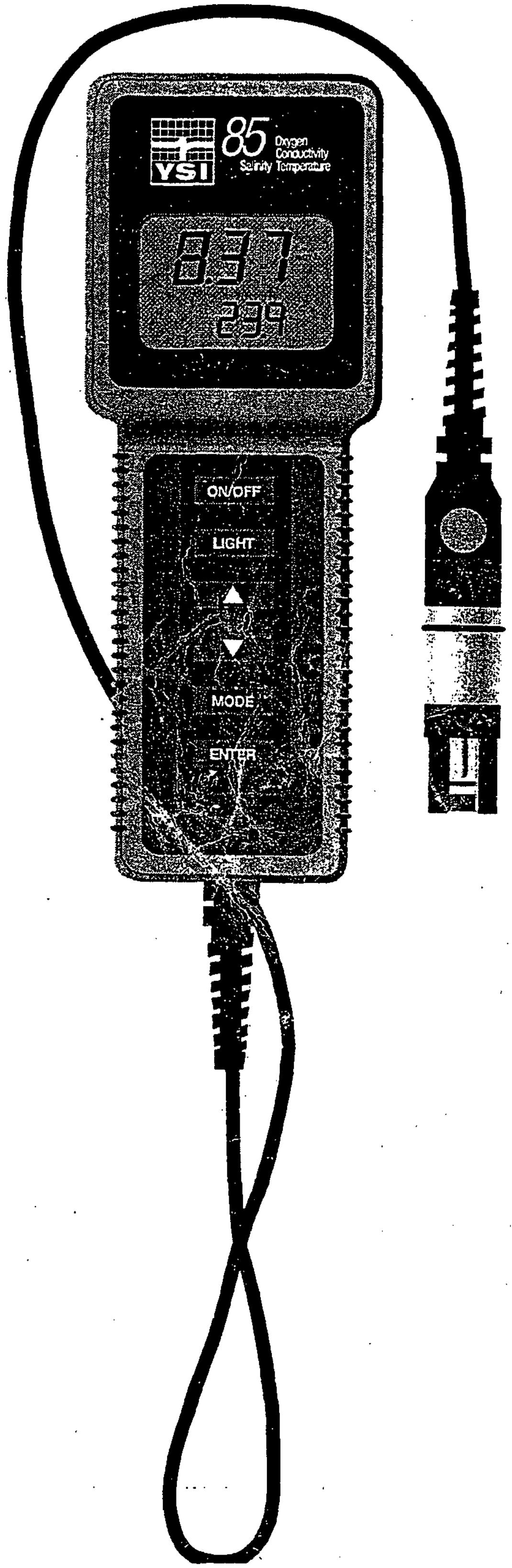
YSI Model 85 Temperature, Conductivity, and Dissolved Oxygen Meter

YSI *incorporated*

YSI Model 85

Handheld Oxygen, Conductivity, Salinity, and Temperature System

Operations Manual



CONTENTS

SECTION 1 INTRODUCTION

The YSI Model 85 Handheld Dissolved Oxygen, Conductivity, Salinity and Temperature System is a rugged, micro-processor based, digital meter with an attached YSI combination conductivity and dissolved oxygen probe.

The YSI Model 85 is designed for use in field, lab, and process control applications as well as for environmental, aquaculture, and industrial uses. The Model 85 is available with cable lengths of either 10, 25, 50 or 100 feet. The body of the probe has been manufactured with stainless steel to add rugged durability and sinking weight. The probe also utilizes our easy to install cap membranes for measuring dissolved oxygen.

The YSI Model 85 probe is a non-detachable, combination sensor designed specifically for the YSI Model 85 Handheld System. The conductivity portion is a four-electrode cell with a cell constant of 5.0/cm ±4%. The dissolved oxygen portion is a polargraphic Clark type sensor.

The Model 85's microprocessor allows the system to be easily calibrated for dissolved oxygen or conductivity with the press of a few buttons. Additionally, the microprocessor performs a self-diagnostic routine each time the instrument is turned on. The self-diagnostic routine provides you with useful information about the conductivity cell constant and function of the instrument circuitry.

The system simultaneously displays temperature (in °C), along with one of the following parameters: dissolved oxygen in either mg/L (milligrams per liter) or % air saturation; conductivity; temperature compensated conductivity; (in µS/cm or mS/cm), and salinity (in parts per thousand {ppt}).

The system requires only a single calibration regardless of which dissolved oxygen display you use. The calibration of conductivity is not required but is available. A single calibration will adjust the instrument, regardless if you are reading conductivity or temperature compensated conductivity. You can switch between all of these parameters with the push of a single key.

A calibration\storage chamber is built into the instrument case. A small sponge in the chamber can be moistened to provide a water saturated air environment that is ideal for air calibration of the dissolved oxygen probe. This chamber also provides a convenient place to store the probe when the system is not in use, and provides protection for the electrodes within the conductivity probe. The Model 85 case is also waterproof (rated to IP65). You can operate your Model 85 in the rain without damage to the instrument.

Six AA-size alkaline batteries power the instrument. A new set of alkaline batteries will provide approximately 100 hours of continuous operation. When batteries need to be replaced, the LCD will display a **"LO BAT"** message.

SECTION 2 PREPARING THE METER

2.1 UNPACKING

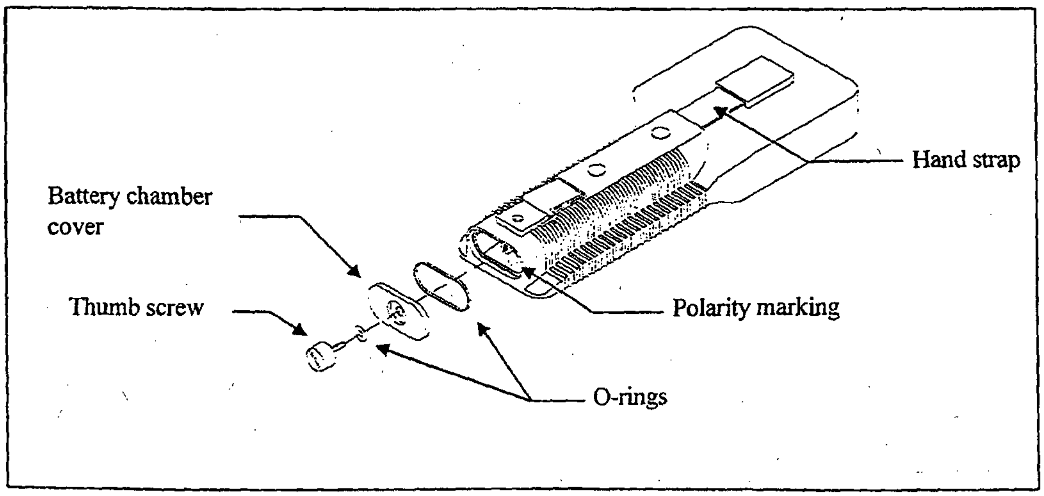
When you unpack your new YSI Model 85 Handheld Dissolved Oxygen, Conductivity, Salinity and Temperature System for the first time, check the packing list to make sure you have received everything you should have. If there is anything missing or damaged, call the dealer from whom you purchased the Model 85. If you do not know which of our authorized dealers sold the system to you, call YSI Customer Service at 800-765-4974 or 937-767-7241, and we'll be happy to help you.

2.2 WARRANTY CARD

Before you do anything else, please complete the Warranty Card and return it to YSI. This will record your purchase of this quality instrument in our computer system. Once your purchase is recorded, you will receive prompt, efficient service in the event any part of your YSI Model 85 should ever need repair and we will be able to quickly verify the warranty period.

2.3 BATTERIES

There are a few things you must do to prepare your YSI Model 85 for use. First, locate the six AA-size alkaline batteries that were included in your purchase. Use a screwdriver or a small coin to remove the thumbscrew on the bottom of the instrument. This thumbscrew holds the battery-chamber cover in place. The battery-chamber cover is marked with the words "OPEN" and "CLOSE."



NOTE: On some models, the battery cover thumbscrew may be unscrewed by hand (a screwdriver may not be required).

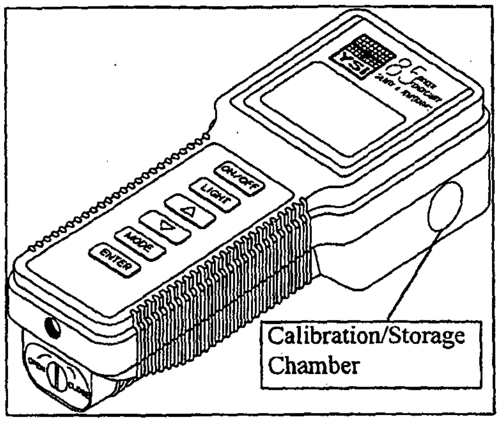
There is a small label inside each of the two battery-chamber sleeves. These labels illustrate the correct way to install the batteries into each sleeve of the battery-chamber.

NOTE: It is very important that the batteries be installed ONLY as illustrated. The instrument will not function and may be damaged if the batteries are installed incorrectly.

Turn the instrument on by pressing and releasing the **ON/OFF** button on the front of the instrument. The liquid crystal display (LCD) should come on. Allow a few seconds for the instrument to complete its diagnostic routine. Notice that the instrument will display the specific cell constant of the conductivity probe during this diagnostic routine. If the instrument does not operate, consult the section entitled Troubleshooting.

You may also want to take the instrument into a dark room and with the instrument ON, hold down the **LIGHT** button. The instrument backlight should illuminate the LCD so that the display can be easily read.

2.4 CALIBRATION/STORAGE CHAMBER



The Model 85 has a convenient calibration storage chamber built into the instruments' side. This chamber provides an ideal storage area for the probe during transport and extended non-use. If you look into the chamber you should notice a small round sponge in the bottom of the chamber. Carefully put 3 to 6 drops of clean water into the sponge. Turn the instrument over and allow any excess water to drain out of the chamber. The wet sponge creates a 100% water saturated air environment for the probe, which is ideal for dissolved oxygen calibration.

2.5 HAND STRAP

The hand strap is designed to allow comfortable operation of the Model 85 with minimum effort. If the hand strap is adjusted correctly, it is unlikely that the instrument will be easily dropped or bumped from your hand. See figure on previous page.

To adjust the hand strap on the back of the meter, unsnap the vinyl cover and pull the two Velcro strips apart. Place your hand between the meter and the strap and adjust the strap length so that your hand is snugly held in place. Press the two Velcro strips back together and snap the vinyl cover back into place.

2.6 THE METER CASE

The meter case is sealed at the factory and is not intended to be opened, except by authorized service technicians. Do not attempt to separate the two halves of the meter case as this may damage the instrument, break the waterproof seal, and will void the manufacturer's warranty.

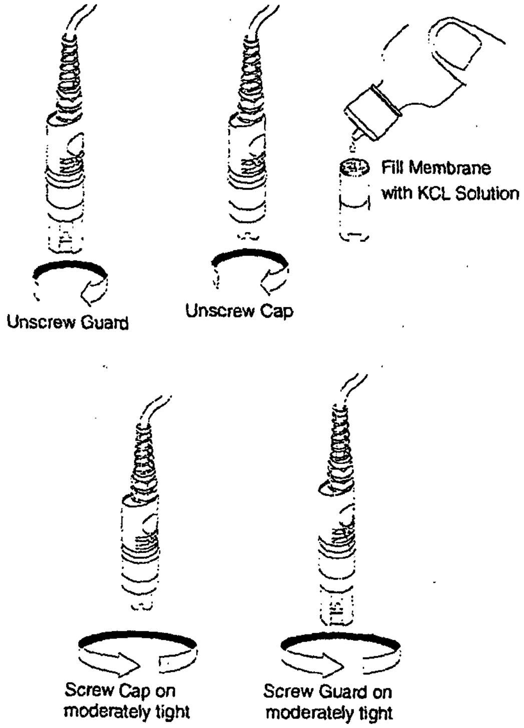
SECTION 3 PREPARING THE PROBE

The YSI Model 85 dissolved oxygen probe is shipped dry. The protective membrane cap on the probe tip must be removed and replaced with KCl solution and a new membrane cap before using the probe. Follow the instructions below to install KCl solution and the new membrane cap.

3.1 MEMBRANE CAP INSTALLATION

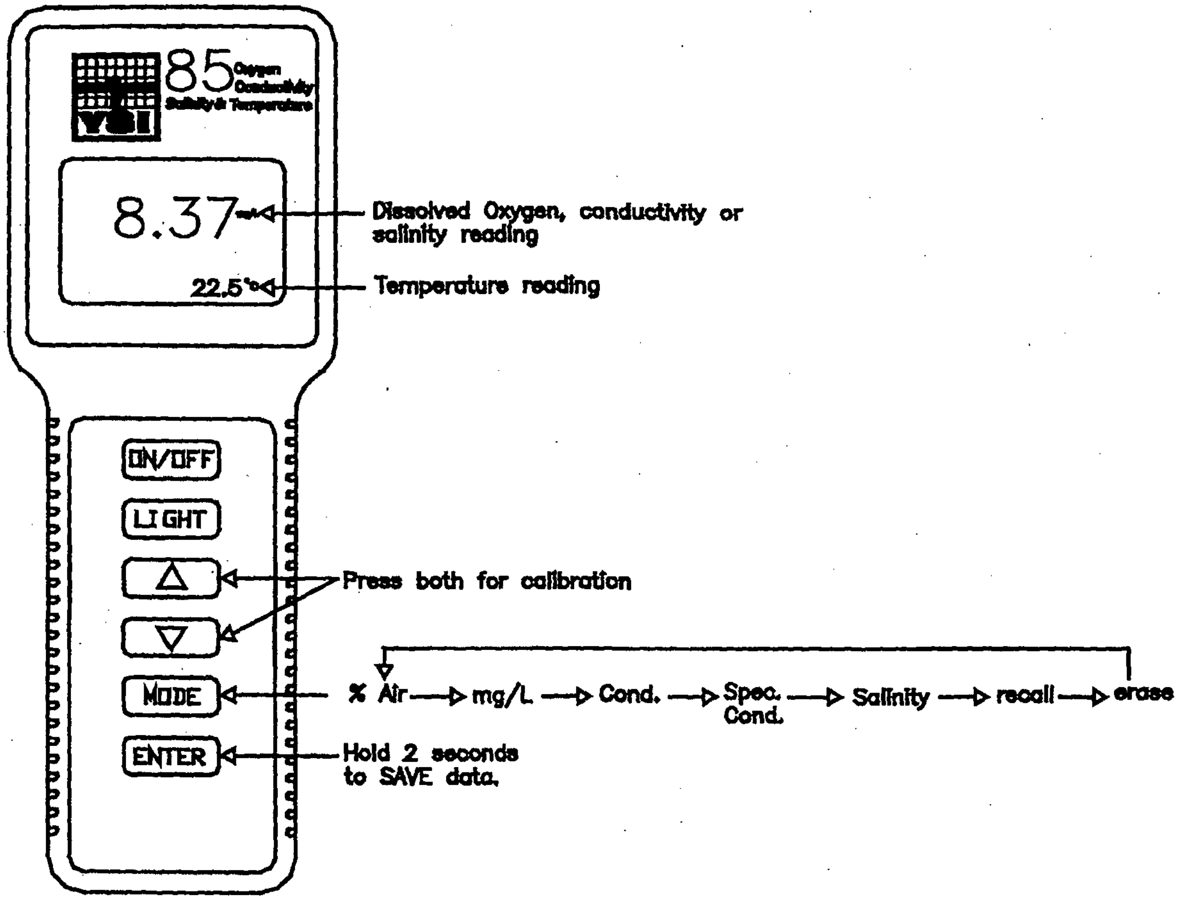
To install a new membrane on your YSI Model 85 dissolved oxygen probe:

1. Unscrew and remove the probe sensor guard.
2. Unscrew and remove the old membrane cap.
3. Thoroughly rinse the sensor tip with distilled water.
4. Prepare the electrolyte according to the directions on the KCl solution bottle.
5. Hold the membrane cap and fill it at least 1/2 full with the electrolyte solution.
6. Screw the membrane cap onto the probe moderately tight. A small amount of electrolyte should overflow.
7. Screw the probe sensor guard on moderately tight.



SECTION 4 OVERVIEW OF OPERATION

The following diagram is an overview of the operation of the Model 85. See the following sections for details of operation.

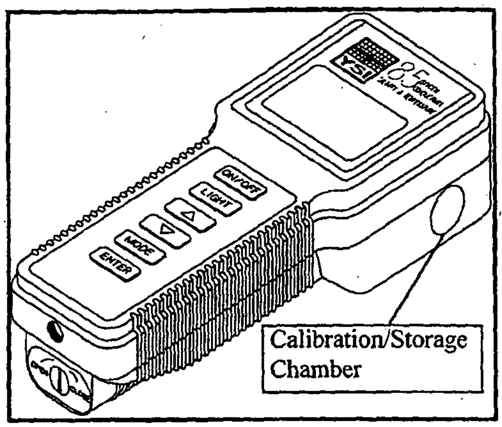


SECTION 5 CALIBRATION

5.1 CALIBRATION OF DISSOLVED OXYGEN

To accurately calibrate the YSI Model 85 you will need to know the approximate altitude of the region in which you are located.

1. Ensure that the sponge inside the instrument's calibration chamber is wet. Insert the probe into the calibration chamber.



2. Turn the instrument on by pressing the **ON/OFF** button on the front of the instrument. Press the **MODE** button until dissolved oxygen is displayed in mg/L or %. Wait for the dissolved oxygen and temperature readings to stabilize (usually 15 minutes is required).

3. Use two fingers to press and release both the **UP ARROW** and **DOWN ARROW** buttons at the same time.

4. The LCD will prompt you to enter the local altitude in hundreds of feet. Use the arrow keys to increase or decrease the altitude. When the proper altitude appears on the LCD, press the **ENTER** button once.

EXAMPLE: Entering the number 12 here indicates 1200 feet.

5. The Model 85 should now display **CAL** in the lower left of the display, the calibration value should be displayed in the lower right of the display and the current % reading (before calibration) should be on the main display. Make sure that the current % reading (large display) is stable, then press the **ENTER** button. The display should read **SAVE** then should return to the Normal Operation Mode.

Each time the Model 85 is turned off, it may be necessary to re-calibrate before taking measurements. All calibrations should be completed at a temperature which is as close as possible to the sample temperature. Dissolved oxygen readings are only as good as the calibration.

5.2 CALIBRATION OF CONDUCTIVITY

IMPORTANT: System calibration is rarely required because of the factory calibration of the YSI Model 85. However, from time to time it is wise to check the system calibration and make adjustments when necessary.

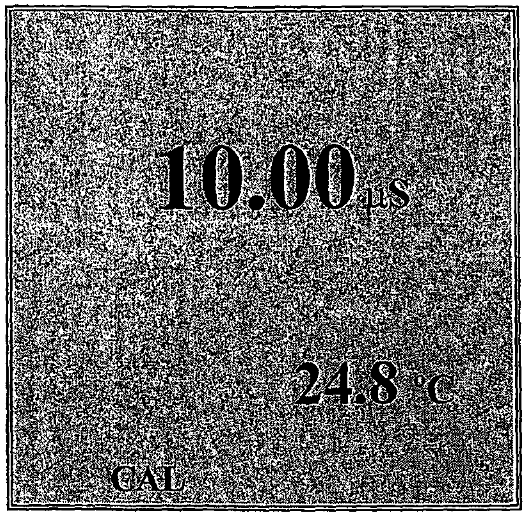
Prior to calibration of the YSI Model 85, it is important to remember the following:

1. Always use clean, properly stored, NIST traceable calibration solutions (see Accessories and Replacement Parts). When filling a calibration container prior to performing the calibration procedures, make certain that the level of calibrant buffers is high enough in the container to cover the entire probe. Gently agitate the probe to remove any bubbles in the conductivity cell.
2. Rinse the probe with distilled water (and wipe dry) between changes of calibration solutions.
3. During calibration, allow the probe time to stabilize with regard to temperature (approximately 60 seconds) before proceeding with the calibration process. The readings after calibration are only as good as the calibration itself.
4. Perform sensor calibration at a temperature as close to 25°C as possible. This will minimize any temperature compensation error.

Follow these steps to perform an accurate calibration of the YSI Model 85:

1. Turn the instrument on and allow it to complete its self-test procedure.
2. Select a calibration solution that is most similar to the sample you will be measuring.
   - For sea water choose a 50 mS/cm conductivity standard (YSI Catalog# 3169)
   - For fresh water choose a 1 mS/cm conductivity standard (YSI Catalog# 3167)
   - For brackish water choose a 10 mS/cm conductivity standard (YSI Catalog # 3168)
3. Place at least 3 inches of solution in a clean glass beaker.
4. Use the **MODE** button to advance the instrument to display conductivity.
5. Insert the probe into the beaker deep enough so that the oval-shaped hole on the side of the probe is completely covered. Do not rest the probe on the bottom of the container -- suspend it above the bottom at least 1/4 inch.
6. Allow at least 60 seconds for the temperature reading to become stable.
7. Move the probe vigorously from side to side to dislodge any air bubbles from the electrodes.
8. Press and release the **UP ARROW** and **DOWN ARROW** buttons at the same time.

The **CAL** symbol will appear at the bottom left of the display to indicate that the instrument is now in Calibration mode.



9. Use the **UP ARROW** or **DOWN ARROW** button to adjust the reading on the display until it matches the value of the calibration solution you are using.
10. Once the display reads the exact value of the calibration solution being used (the instrument will make the appropriate compensation for temperature variation from 25°C), press the **ENTER** button once. The word "**SAVE**" will flash across the display for a second indicating that the calibration has been accepted.

The YSI Model 85 is designed to retain its last conductivity calibration permanently. Therefore, there is no need to calibrate the instrument after battery changes or power down.

SECTION 6 ADVANCED CONDUCTIVITY SETUP

The default settings of the YSI Model 85 are appropriate for the vast majority of measurement applications. However, some measurement applications require very specific measurement criteria. For that reason, we have made the YSI Model 85 flexible to accommodate these "advanced users."

If, for example, you are using the YSI Model 85 for a process control application that requires that the conductivity readings be compensated to 20 °C instead of 25 °C -- this is the section to read. Or, if your application for the YSI Model 85 involves the measurement of a very specific saline solution, the default temperature coefficient may need to be changed to get the very best measurement of that specific salt.

IMPORTANT: There is never a need to enter Advanced Setup Mode unless your special measurement application calls for a change in reference temperature and or temperature coefficient. Therefore, unless you are certain that your application requires a change to one or both of these criteria, do not modify the default reference temperature (25°C) or the default temperature coefficient (1.91%).

6.1 CHANGING THE TEMPERATURE COEFFICIENT

Follow these steps to modify the temperature coefficient of the Model 85.

1. Turn the instrument on and wait for it to complete its self-test procedure.
2. Use the **MODE** button to advance the instrument to display conductivity.
3. Press and release both the **DOWN ARROW** and the **MODE** buttons at the same time.

The **CAL** symbol will appear at the bottom left of the display. The large portion of the display will show **1.91 %** (or a value set previously using Advanced Setup).

4. Use the **UP ARROW** or **DOWN ARROW** button to change the value to the desired new temperature coefficient.
5. Press the **ENTER** button. The word "**SAVE**" will flash across the display for a second to indicate that your change has been accepted.
6. Press the **MODE** button to return to normal operation; the CAL symbol will disappear from the display.

6.2 CHANGING THE REFERENCE TEMPERATURE

Follow these steps to modify the reference temperature of the Model 85.

1. Turn the instrument on and wait for it to complete its self-test procedure.
2. Use the **MODE** button to advance the instrument to display conductivity.
3. Press and release both the **DOWN ARROW** and the **MODE** buttons at the same time.

The **CAL** symbol will appear at the bottom left of the display. The large portion of the display will show **1.91 %** (or a value set previously using Advanced Setup).

4. Press and release the **MODE** button; the large portion of the display will show **25.0C** (or a value set previously using Advanced Setup).
5. Use the **UP ARROW** or **DOWN ARROW** button to change the value to the desired new reference temperature (any value between 15 °C and 25 °C is acceptable).
6. Press the **ENTER** button. The word "**SAVE**" will flash across the display for a second to indicate that your change has been accepted.
7. The instrument will automatically return to normal operation mode.

6.3 CHANGING FROM AUTORANGING TO MANUAL RANGING

If your application is easier to perform using a manual range that you select, the YSI Model 85 allows you to turn off the default autoranging feature. While you are making conductivity or temperature compensated conductivity measurements, simply press and release the **UP ARROW** button. Each additional press of the **UP ARROW** button will cycle the Model 85 to a different manual range until you return again to autoranging. Five pushes of the **UP ARROW** button will cycle the Model 85 through the four manual ranges and return the instrument to autoranging.

NOTE: You may see an error message in some manual ranges if the manual range selected is not adequate for the sample you are measuring. If this happens, simply press and release the **UP ARROW** button again until a range is selected which is suitable for your sample. If you get lost and don't know if you're in a manual range or autoranging, simply turn the instrument off and back on. Also note that the conductivity units will flash while you are in manual range. The instrument will always default to autoranging when first turned on.

The four ranges of the YSI Model 85 are:

Range 1	Range 2	Range 3	Range 4
0 to 499.9 μS/cm	0 to 4999 μS/cm	0 to 49.99 mS/cm	0 to 200.0 mS/cm

SECTION 7 MAKING MEASUREMENTS

7.1 TURNING THE INSTRUMENT ON

Once the batteries are installed correctly, press the **ON/OFF** button. The instrument will activate all segments of the display for a few seconds, which will be followed by a self-test procedure that will last for several more seconds. During this power on self-test sequence, the instrument's microprocessor is verifying that the instrument is working properly. The Model 85 will display the cell constant of the conductivity probe when the self-test is complete. If the instrument were to detect an internal problem, the display would show a **continuous** error message. See the section entitled Troubleshooting for a list of these error messages.

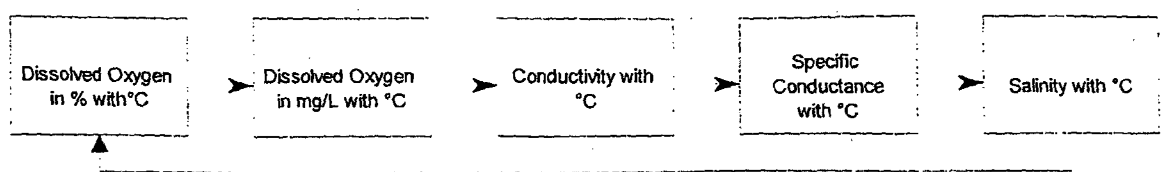
7.2 THE MEASUREMENT MODES OF THE MODEL 85

The Model 85 is designed to provide six distinct measurements:

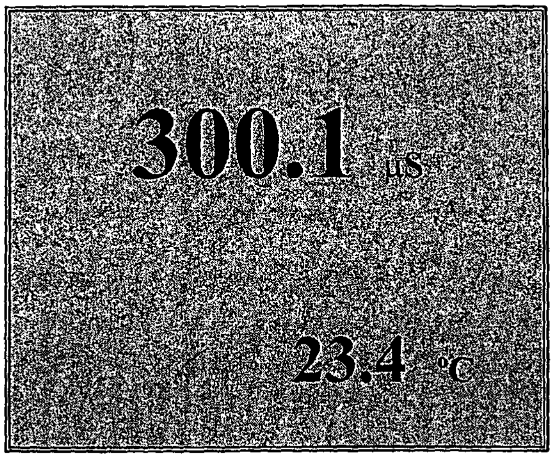
- **Dissolved Oxygen %** -- A measurement of oxygen in percent of saturation.
- **Dissolved Oxygen mg/L** -- A measurement of oxygen in mg/L
- **Conductivity** -- A measurement of the conductive material in the liquid sample without regard to temperature
- **Specific Conductance** -- Also known as temperature compensated conductivity which automatically adjusts the reading to a calculated value which would have been read if the sample had been at 25° C (or some other reference temperature which you choose). See Advanced Setup.
- **Temperature** -- which is always displayed.
- **Salinity** -- A calculation done by the instrument electronics, based upon the conductivity and temperature readings.

NOTE: When you turn the Model 85 off, it will "remember" which mode you used last and will return to that mode the next time the instrument is turned on.

To choose one of the measurement modes above (temperature is always displayed) simply press and release the **MODE** button. Carefully observe the small legends at the far right side of the LCD.



If the instrument is reading **Specific Conductance** the large numbers on the display will be followed by either a µS or an **mS.** Additionally the small portion of the display will show the ° C flashing on and off.



If the instrument is reading **Conductivity** (not temperature compensated) the large numbers on the display will be followed by either a µS or an **mS.** Additionally the small portion of the display will show the ° **C** **NOT** flashing.

If the instrument is reading **Dissolved Oxygen** the large numbers on the display will be followed by either a mg/L or %. It is important to remember that the dissolved oxygen probe is stirring dependent. This is due to the consumption of oxygen at the sensor tip during measurement. When taking dissolved oxygen measurements the probe must be moved through the sample at a rate of 1 foot per second to provide adequate stirring.

If the instrument is reading **Salinity** the large numbers on the display will be followed by a **ppt.**

7.3 AUTORANGING & RANGE SEARCHING

The YSI Model 85 is an autoranging instrument. This means that regardless of the conductivity or salinity of the solution (within the specifications of the instrument) all you need to do to get the most accurate reading is to put the probe in the sample. This feature makes the Model 85 as simple as possible to operate.

When you first place the Model 85 probe into a sample or calibration solution, and again when you first remove the probe the instrument will go into a range search mode that may take as long as 5 seconds. During some range searches the instrument display will flash **rANG** to indicate its movement from one range to another. The length of the range search depends on the number of ranges that must be searched in order to find the correct range for the sample. During the range search, the instrument will appear to freeze on a given reading for a few seconds then, once the range is located, will pinpoint the exact reading on the display. The display may also switch to **00.0** for a second or two during a range search before it selects the proper range.

7.4 THE BACKLIGHT

At times it may be necessary to take measurements with the Model 85 in dark or poorly lit areas. To help in this situation, the Model 85 comes equipped with a backlight that will illuminate the display so that it can be easily read. To activate the backlight, press and hold the **LIGHT** button.

The display will remain lit as long as the button is depressed. When you release it, the light goes out to preserve battery life.

SECTION 12 TROUBLESHOOTING

SYMPTOM	POSSIBLE CAUSE	ACTION
1. Instrument will not turn on	A. Low battery voltage B. Batteries installed wrong C. Meter requires service	A. Replace batteries B. Check battery polarity. C. Return system for service
2. Instrument will not calibrate (Dissolved Oxygen)	A. Membrane is fouled or damaged B. Probe anode is fouled or dark C. Probe cathode is tarnished D. System requires service	A. Replace membrane & KCl B. Clean anode C. Clean cathode D. Return system for service
3. Instrument will not calibrate (Conductivity)	A. Cell is contaminated	A. See "Maintenance" Section
4. Instrument "locks up"	A. Instrument has rec'd a shock B. Batteries are low or damaged C. System requires service	A & B. Remove battery lid, wait 15 seconds for reset, replace lid. C. Return system for service
5. Instrument readings are inaccurate (Dissolved Oxygen)	A. Cal altitude is incorrect B. Probe not in 100% O_2 saturated air during Cal procedure C. Membrane fouled or damaged D. Probe anode is fouled or dark E. Probe cathode is tarnished F. System requires service	A. Recalibrate w/correct value B. Moisten sponge & place in Cal chamber w/ probe & Recal C. Replace membrane D. Clean anode E. Clean cathode F. Return system for service
6. Instrument readings are inaccurate (Conductivity)	A. Calibration is required B. Cell is contaminated C. Tempco is set incorrectly D. Reference temperature incorrect E. Readings are or are not temperature compensated.	A. See "Calibration" Section B. See "Maintenance" Section C. See "Advanced Setup" Section D. See "Advanced Setup" Section E. See "Making Measurements" Section
7..LCD displays "LO BAT" Main display flashes "off"	A. Batteries are low or damaged	A. Replace batteries
8. Main Display reads "OVEr" (Secondary display reads "ovr") (Secondary display reads "udr")	A. Conductivity reading is >200 mS B. Temperature reading is >65°C C. Temperature reading is <-5°C D. Salinity reading is >80 ppt E. User cell constant cal K is >5.25 F. DO temperature is >46°C G. DO % saturation is >200% H. DO concentration is >20 mg/L	In all cases, check calibration values and procedures; check advanced setup settings. If each of these are set correctly, return instrument for service.
9. Main display reads "Undr"	A. User cell constant cal K is <4.9 B. DO current too low to calibrate	A. Recalibrate instrument using known good conductivity standard. Follow cell cleaning procedure in the Maintenance section. B. Replace membrane, clean probe
10. Main display reads "rErr"	A. Reading exceeds user selected manual range.	A. Use the mode key to select a higher or lower manual range, or set system to autoranging.
11. Main display reads "PErr"	A. User cell constant cal K is 0.0 B. Incorrect sequence of keystrokes.	A. See "Advanced Setup" section. B. Refer to manual section for step by step instruction for the function you are

STATE OF VERMONT

ENVIRONMENTAL COURT
DOCKET NO. 89-4-06 Vtec

In Re: Entergy Nuclear Vermont Yankee's Amended Discharge Permit Permit Number: 3-1199	)))))))

Statement of Questions

The Connecticut River Watershed Council, Trout Unlimited (Deerfield/Millers 349 Chapter), and Citizens Awareness Network (Massachusetts Chapter) hereby provide the following statement of questions pertaining to the above-referenced *de novo* appeal:

1. Can Entergy Nuclear Vermont Yankee, LLC (hereinafter "Vermont Yankee") meet its burden to prove to the Vermont Environmental Court (hereinafter "the Court") that the existing thermal effluent limitation is "more stringent than necessary to assure the protection and propagation of a balanced indigenous population of shellfish, fish and wildlife" (hereinafter "biological community") in and on the Connecticut River, as required by § 316(a) of the Clean Water Act, 33 U.S.C. § 1326(a), and Environmental Protection Agency regulations, 40 C.F.R. Part 125?

2. Can Vermont Yankee meet its burden to prove to the Court that there has been "no prior appreciable harm" to the biological community in and on the Connecticut River as a result of the existing thermal discharge as required by 40 C.F.R. § 125.73(c)(1)?

3. Can Vermont Yankee meet its burden to prove to the Court that, "taking into account the interaction of such thermal component with other pollutants and the additive effect of other thermal sources," Vermont Yankee's existing thermal discharge has not resulted in appreciable harm to the biological community in and on the Connecticut River as required by 40 C.F.R. § 125.73(c)(1)(i)?

4. Can Vermont Yankee meet its burden to prove to the Court that "despite the occurrence of such previous harm," the revised alternative effluent limitation will "assure" the protection and propagation of the biological community in and on the Connecticut River as required by 40 C.F.R. § 125.73(c)(1)(ii)?

5. Which Representative Important Species as defined in 40 C.F.R. § 125.71(b) are required to support the Section 316(a) Demonstration pursuant to 40 C.F.R. § 125.72(b)?

6. Whether granting the alternative effluent limitations in Vermont Yankee's application for a permit amendment would violate the Anti-Degradation Policy in Section 1-03 of the Vermont Water Quality Standards (hereinafter "WQS") by impairing existing and designated uses in the Connecticut River?

7. Whether granting the alternative effluent limitations in Vermont Yankee's application for a permit amendment would violate the Mixing Zone requirements in WQS Section 2-04 and the Water Quality Criteria for Temperature in WQS Section 3-01(B)(1), where Vermont Yankee cannot

make the required showing that the alternative effluent limitations will satisfy the criteria in WQS Section 3-01(B)(1)(d) for mixing zones greater than two hundred feet from the point of discharge?

8. Whether Vermont Yankee's application for a permit amendment can be granted in the absence of the opportunity for public review and comment upon information and documents serving as the basis for the decision to approve the alternative effluent limitations for Vermont Yankee's thermal discharge as required by Section 13.3 of the Vermont Water Pollution Control Permit Regulations, such as any input from the Environmental Advisory Committee and documents serving as the basis for a thermal mixing zone determination or the conditions for operation of the water intake structure?

9. Whether Vermont Yankee can meet its burden in its application for a permit amendment to satisfy all applicable substantive and procedural requirements of state and federal law including the Vermont Water Pollution Control Act, 10 V.S.A. §§ 1250 et. seq., and the federal Clean Water Act, 33 U.S.C. §§ 1251 et. seq.?

Signed and dated in South Royalton, Vermont this 31st day of May, 2006.

BY: ______________________________

Patrick Parenteau, Esq.
David K. Mears, Esq.
Environmental and Natural Resources Law Clinic
Vermont Law School

Counsel for:
Connecticut River Watershed Council
Trout Unlimited (Deerfield/Millers 349 Chapter)
Citizen's Awareness Network (Massachusetts Chapter)

10/13/06 LR Disc

Entergy

Entergy Nuclear Northeast
Entergy Nuclear Operations, Inc.
Vermont Yankee
322 Governor Hunt Rd.
P.O. Box 157
Vernon, VT 05354
Tel 802-257-7711

COPY

17 February 2003

Hand Delivered 18 February 2003

Carol Carpenter
Vermont Department of Environmental Conservation
Wastewater Management Division
103 South Main Street – Sewing Building
Waterbury, VT 05671-0405

Reference: NPDES Permit No. VT 0000264, VT DEC Permit No. 3-1199

Subject: Permit Amendment application for small change in summer thermal discharge limits

Dear Carol,

Enclosed is Entergy Nuclear Vermont Yankee, LLC's (VY) NPDES Permit amendment application paperwork and the administrative processing and application review fees, all in support of our request to allow a slight increase in the Station's summer (annually between May 16 and October 14) thermal discharge temperature limits. Per our agreement, I have completed and enclosed form WR-82 and one Schedule B for discharge point SN 001 (Main Condenser Cooling Water), the sole discharge point in the current NPDES Permit to which this request applies. As previously stated, this request will:

* Facilitate increased power generation, adding valuable electricity to Vermont's power grid during summer time peak-load periods that otherwise would be lost through excessive cooling tower use.

* Improve the Station's operational flexibility by reducing the need for Station personnel to react to unexpected temporary reductions in River flow that are outside of Vermont Yankee's control, but require rapid response.

* Increase Station operational efficiency by reducing cooling tower use, which allows Station equipment to operate more efficiently. This also reduces general wear on Station equipment associated with closed and hybrid cycle operation.

* Reduce evaporative losses attributable to cooling tower use, thereby returning more water, originally drawn from the Connecticut River, back to the Connecticut River (up to 5,000 gallons per minute).

Consistent with our prior discussions, we also are beginning consideration of a winter analysis and may submit a supplemental amendment under the current application, depending upon the

Entergy

outcome of our internal review. At this time, the winter modifications, as requested in June 2002, are not part of the current summer request which Vermont Yankee is pursuing on an expedited basis.

We look forward to working with your office and Versar on this request. Of course, please do not hesitate to call if you have questions or concerns with this information.

Sincerely,

Lynn DeWald
Environmental Specialist
Entergy Nuclear Vermont Yankee, LLC

Samuel A. Wender IV
Chemistry Superintendent
Entergy Nuclear Vermont Yankee, LLC

STATE OF VERMONT
AGENCY OF NATURAL RESOURCES
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WASTEWATER MANAGEMENT DIVISION
10 V.S.A. Chapter 47 Permit Application Form WR-82

Application For: (Check ( ) one)	**with Schedule**:	**Action Requested**: (Check ( ) one)
√ Municipal/Industrial Discharge Permit	A or B	___ Original Permit
___ Emergency Pollution Permit	E	___ Renewal
___ Indirect Discharge Permit	I	√ Amendment
___ Pretreatment Discharge Permit	B	___ Transfer
___ Stormwater Discharge Permit	D or F	Permit # 3-1199
___ UIC (non-stormwater) Permit	Special Form	
Status of Discharge: (Check ( ) one)		**Nature of Waste:** (Check ( ) one)
___ Proposed		___ Sanitary (domestic sewage only)
√ Existing		√ Non-Sewage/Industrial
		___ Stormwater (surface or subsurface disp.)

For DEC Use: PIN ______________ Reviewer: __________ Check #:______________ Title 3: Y N

1. **Applicant:** Entergy Nuclear Vermont Yankee

2. **Legal Entity:** Limited Liability Company
(Individual, corporation, partnership, firm, state agency, municipality, etc.)

3. **Mailing Address:** 320 Governor Hunt Road Vernon, VT 05354

4. **Contact:** Lynn DeWald Telephone: *(802) 258-5526*
(Person to contact regarding this application) Fax (optional): *(802) 258-5509*

4. **Name of Activity:** Vermont Yankee Nuclear Power Station
(John Doe residence, SYZ Corp., Clark Lake State Park, Green Motel, etc.)

5. **Type of Activity:** Steam-Electric Generation
(Residential subdivision, paper mill, state park, motel, etc.)

6. **Description of Waste:** See each serial number listed below

7. **Name of Landowner:** Entergy Nuclear Vermont Yankee, LLC

8. **Location:** 320 Governor Hunt Road Town: *Vernon*
(Number and Street/Road Name)

9. If this application is for a permit renewal, is the original application still valid in all respects? N/A

10. If not, document changes on a separate attachment.

10. **Receiving Water for Indirect Discharges:** Connecticut River

11. **ALL other Pretreatment and Direct Discharges:** Using a separate serial number (SIN), identify each independent discharge which will result from the activity described above. Attach a separate schedule for each discharge identified below.

Discharge	Receiving Water	Latitude/Longitude (optional)
S/N 001 **Main Condenser Cooling & Service Water (SW)**	Connecticut River at Vernon VT	Latitude: 42° 46' 45" Longitude: 72° 30' 48"
S/N 002 **Radioactive Liquid**	Connecticut River at Vernon VT	Latitude: 42° 46' 45" Longitude: 72° 30' 48"
S/N 003 **Heating Boiler Blow down**	Connecticut River at Vernon VT	Latitude: 42° 46' 45" Longitude: 72° 30' 48"
S/N 004 **Water Treatment Carbon Filter Backwash**	Connecticut River at Vernon VT	Latitude: 42° 46' 45" Longitude: 72° 30' 48"
S/N 005 **RHR Service Water Pump - Cooling Water**	Connecticut River at Vernon VT	Latitude: 42° 46' 45" Longitude: 72° 30' 48"
S/N 006 **North Storm Drain Outfall**	Connecticut River at Vernon VT	Latitude: 42° 46' 45" Longitude: 72° 30' 48"
S/N 007 **South Storm Drain Outfall**	Connecticut River at Vernon VT	Latitude: 42° 46' 45" Longitude: 72° 30' 48"
S/N 008 **Southeast Storm Drain Outfall**	Connecticut River at Vernon VT	Latitude: 42° 46' 45" Longitude: 72° 30' 48"
S/N 009 **Strainer & Traveling Screen Backwash**	Connecticut River at Vernon VT	Latitude: 42° 46' 45" Longitude: 72° 30' 48"
S/N 010 **345kV Storm Drain Outfall**	Connecticut River at Vernon VT	Latitude: 42° 46' 45" Longitude: 72° 30' 48"
S/N 011 **115kV North Storm Drain Outfall**	Connecticut River at Vernon VT	Latitude: 42° 46' 45" Longitude: 72° 30' 48"

Use an attached sheet for Additional Discharges.

12. **3 V.S.A. Section 2822 Fees:** Call 802-241-3822 if you need assistance calculating the application review fee.

Administrative Processing Fee: $ 100.00 (does not apply to Emergency Pollution Permits)
plus Application Review Fee: $ 30,000.00 (does not apply to renewals)
Total Fee Enclosed: $30,100.00

I CERTIFY THAT TO THE BEST OF MY KNOWLEDGE AND BELIEF THIS INFORMATION SUBMITTED ABOVE IS TRUE, ACCURATE AND COMPLETE. I RECOGNIZE THAT BY SIGNING THIS APPLICATION I AM GIVING CONSENT TO EMPLOYEES OF THE STATE TO ENTER THE SUBJECT PROPERTY FOR THE PURPOSE OF PROCESSING THIS APPLICATION.

Lynn DeWald — Environmental Specialist
AUTHORIZED REPRESENTATIVE (please print) — TITLE

Lynn DeWald — 17 February 2003
SIGNATURE — DATE

This application must be signed by the applicant or an officer in the applicant's business, a municipal official, etc. The application CANNOT be signed by the applicant's attorney, engineer, contractor, etc.

Submittal of Application: Attach appropriate schedules, administrative processing and application review fees, plans, specifications and other supporting material. Send application to:

Vermont Department of Environmental Conservation
Wastewater Management Division
103 South Main Street - The Sewing Building
Waterbury VT 05671-0405

STATE OF VERNIONT
AGENCY OF NATURAL RESOURCES
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

SCHEDULE B: INDUSTRIAL/COMMERCIAL/INSTITUTIONAL WR-82B

CHAPTER 47 OF TITLE 10 VSA..

DATE: February 14 2003

B-1: APPLICANT: Entergy Nuclear Vermont Yankee, LLC ACTIVITY: Steam-Electric Generation

B-2: DISCHARGES SN: 001 DESIGNATION: Main Condenser Cooling Water

B-3: EXACT LOCATION ON RECEIVING WATER (describe and Locate on map): Discharge Structure, Vermont Yankee Nuclear Power Station. Latitude: 42° 46' 45" Longitude: 72° 31' 48" (see drawing)

B4: NATURE OF ACTIVITY: Main Condenser Cooling (Using Connecticut River Water)

B-5: POINT SOURCE CATEGORY (EPA): Transportation & Public Utility 40 CFR. SUB-PART: ________

SIC: 4911 SUB CATEGORY: Electrical Services

PRODUCT: Electricity

PRODUCTION PROCESS: Energy Conversion: Steam-Electric PRODUCTION: N/A TON/DAY N/A

B-5a: IF THE DISCHARGE IS REGULATED BY EITHER 40 CFR PART 413 OR 40 CFR PART 433 (metal finishing or electroplating), INCLUDE A TOXIC ORGANIC MANAGEMENT PLAN. *N/A*

B-6: DESCRIBE WASTES TO BE DISCHARGED: Heated Connecticut River water as a result of operation of the Station's Main Condenser.

B-7: EXISTING DISCHARGE? YES IF "YES". ARE WASTES BEING TREATED? YES EXPLAIN AND DESCRIBE

ANY LESS THAN FULL TIME OPERATION OF TREATMENT FACILITIES: Depending on ambient conditions, the mechanical draft cooling towers are sometimes used to remove heat.

IF "NO", GIVE DATE DISCHARGE WILL COMMENCE: __/__/__. WILL WASTES BE TREATED PRIOR TO DISCHARGE? N/A EXPLAIN AND DESCRIBE ANY LESS THAN FULL TIME OPERATION OF TREATMENT FACILITIES: ________

B-8: ARE NEW TREATMENT FACILITIES OR MODIFICATIONS TO EXISTING FACILITIES IN DESIGN OR UNDER CONSTRUCTION? YES IF SO, DESCRIBE AND PROVIDE SCHEDULE FOR ATTAINMENT OF OPERATIONAL LEVEL. An independent Certificate of Public Good, allowing a power uprate is being sought, but contemplates operations in accordance with the existing NPDES Permit, including as a result of cooling-tower modifications being sought.

B-9: IF DESIGN OF PROPOSED TREATMENT FACILITY REQUIRES A PERIOD FOR DATA COLLECTION. HOW MUCH TIME IS REQUIRED? N/A

B-10: DESCRIBE FLOW SEQUENCE OF DISCHARGE. INCLUDING SOURCE OF INTAKE WATER, OPERATIONS CONTRIBUTING WASTEWATER TO THE EFFLUENT AND TREATMENT FACILITIES. ATTACH LINE DRAWING SHOWING THE WATER FLOW THROUGH THE FACILITY: See SN-001Attachment A: "Schematic of Design Maximum Capacity Water flow", Revised May, 2000 and Site Plan – Recognized Environmental Conditions, May 2001.

B-11: VOLUMES OF WASTES, AFTER TREATMENT, IF ANY,TO BE DISCHARGED.

(A) SANITARY WASTES:	WEEKDAYS AVERAGE: N/A GPD		MAXIMUM: N/A GPD
	WEEKENDS AVERAGE: N/A GPD		MAXIMUM: N/A GPD
(B) ALL OTHER WASTES:	WEEKDAYS AVERAGE: N/A GPD		MAXIMUM: 543,000,000 GPD
	WEEKENDS AVERAGE: N/A GPD		MAXIMUM: 543,000,000 GPD

WILL DISCHARGES IN (B) ABOVE BE ESSENTIALLY UNIFORM OVER A 12 MONTH PERIOD? NO

IF NOT, PROVIDE MONTHLY OR SEASONAL BREAKDOWN:

October 15th – May 15th : relatively uniform (mostly open cycle): May 16th – October 14th: variable (mixed open, hybrid and closed cycle) See SN-001 Attachments B and C, providing schematics of these cycles.

B-12: IS THE PERSON WHO IS, OR WILL BE, RESPONSIBLE FOR OPERATION AND MAINTENANCE OF THE TREATMENT FACILITY CERTIFIED BY THE AGENCY OF NATURAL RESOURCES AS A TREATMENT PLANT OPERATOR? N/A

B-13: DESCRIBE THE PROCEDURES USED FOR THE DISPOSAL OF ALL SOLIDS, SLUDGES, FILTER BACKWASH OR OTHER POLLUTANTS REMOVED IN THE COURSE OF TREATMENT OR CONTROL OF WASTEWATERS. INCLUDE DISPOSAL SITE OR LOCATION: The mechanical draft cooling towers are used to remove heat from the circulating water discharge under certain conditions. The disposal of cooling tower silt and debris from the travelling screens is described on page 7 in the existing Permit, issued on 28 August 2001, see items 13 and 14.

B-14: DESCRIBE THE EFFLUENT CHARACTERISTICS OF WASTES, (B-12(A) AND (B) TO BE DISCHARGED WHICH YOU KNOW OR HAVE REASONS TO BELIEVE ARE PRESENT. PROVIDE MAXIMUM CONCENTRATIONS OR RANGE OF CONCENTRATIONS. IF NO CONSTITUENT OF THE TYPE INDICATED IS ADDED, ENTER "NONE ADDED". IF CONSTITUENT IS PRESENT IN UNKNOWN OR UNCERTAIN AMOUNT ENTER "PRESENT" AND DESCRIBE CIRCUMSTANCES RELATING TO ITS PRESENCE, INCLUDING AMOUNTS OF KNOWN CONSTITUENTS, UNDER (C) REMARKS BELOW.

A. BIOCHENICAL AND PHYSICAL CHARACTERISTICS

BOD5: not monitored mg/l

COD: not monitored mg/l

TSS: not monitored mg/l

TURBIDITY: not monitored JTU

SETTLEABLE SOLIDS: none added mg/l

OIL AND GREASE: none added mg/l

FLOATABLE SOLIDS: none added mg/l

TOTAL DISSOLVED SOLIDS: none added mg/l

TOTAL PHOSPHORUS AS P: none added mg/l

TOTAL KJELDAHL NITROGEN (TKN); none added mg/l

COLOR: none added

MATERIALS AFFECTING TASTE AND ODOR: none added.

TEMPERATURE RANGE: 70° F TO 105° F (May 16 – October 14)

pH RANGE: 6.5 TO 8.5 SU

B. CHEMICAL CONSTITUENTS

ARSENIC: none added mg/l

CADMIUM: none added mg/l

CHLORINE (FREE): 0.2 mg/l

CHROMIUM (+6): none added mg/l

CHROMIUM (+3); none added mg/l

COPPER none added mg/l

CYANIDE: none added mg/l

IRON: 0.14 – 5.1 mg/l

LEAD: none added mg/l

MANGANESE : none added mg/l

MERCURY: none added mg/l

NICKEL: none added mg/l

SELENIUM: none added mg/l

SILVER: none added mg/l

ZINC: 0.01 – 2.07 mg/l

OTHERS (including any other pollutant identified as a priority pollutant by EPA in the NRDC vs. Train consent decree of July 8, 1976)

Added Heat from Condenser Cooling

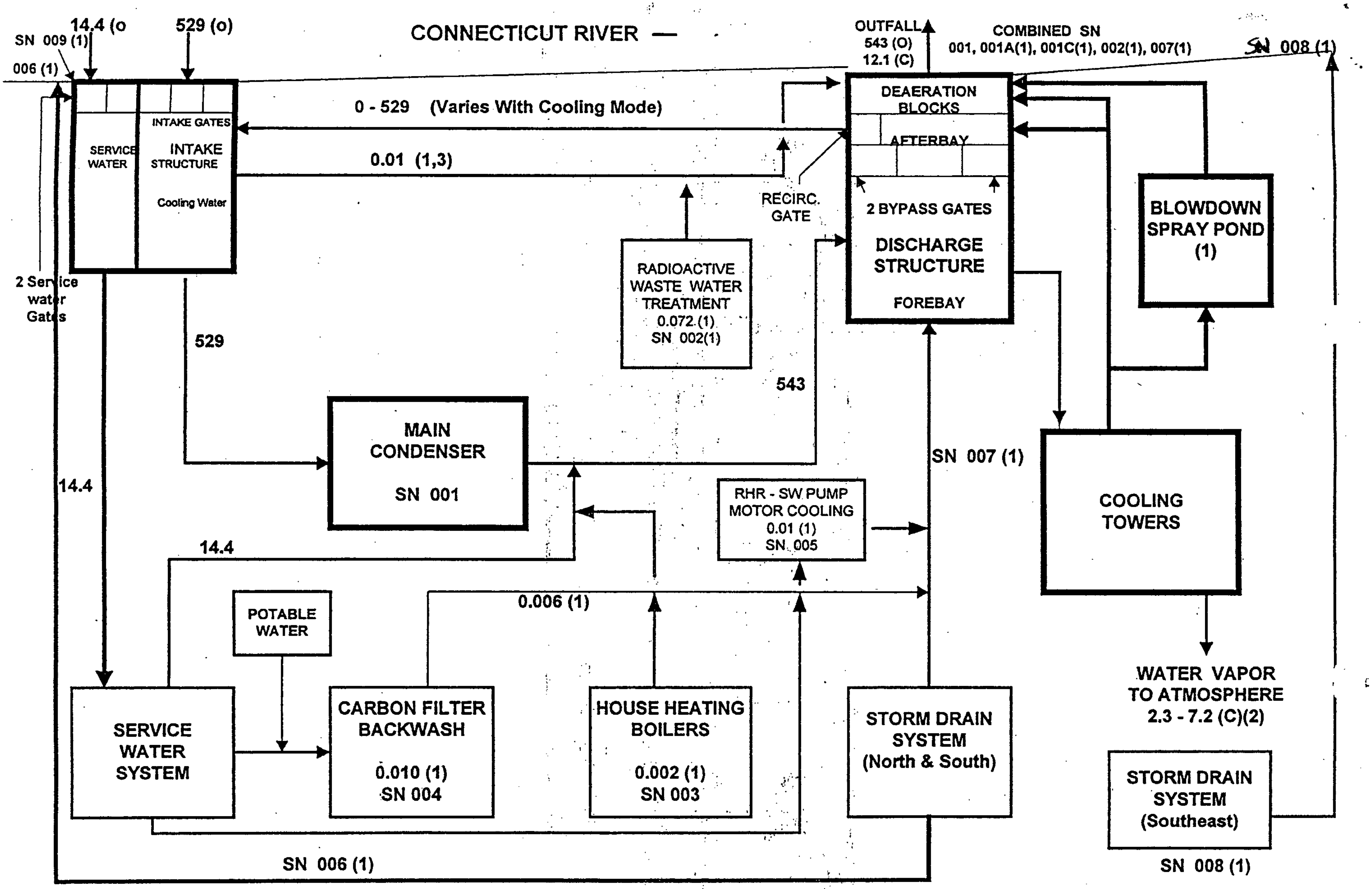
Bromine (free) 0.2 mg/l

_____ mg/l

(C) REMARKS: Data for Total Copper, Iron, and Zinc was taken from the Vermont Yankee annual reports 1996 – 2001: Ecological Studies of the Connecticut River, Vernon, Vermont that were previously submitted to the Agency.

Note: LDL = Laboratory Detection Limit.

(Instructions on reverse side)



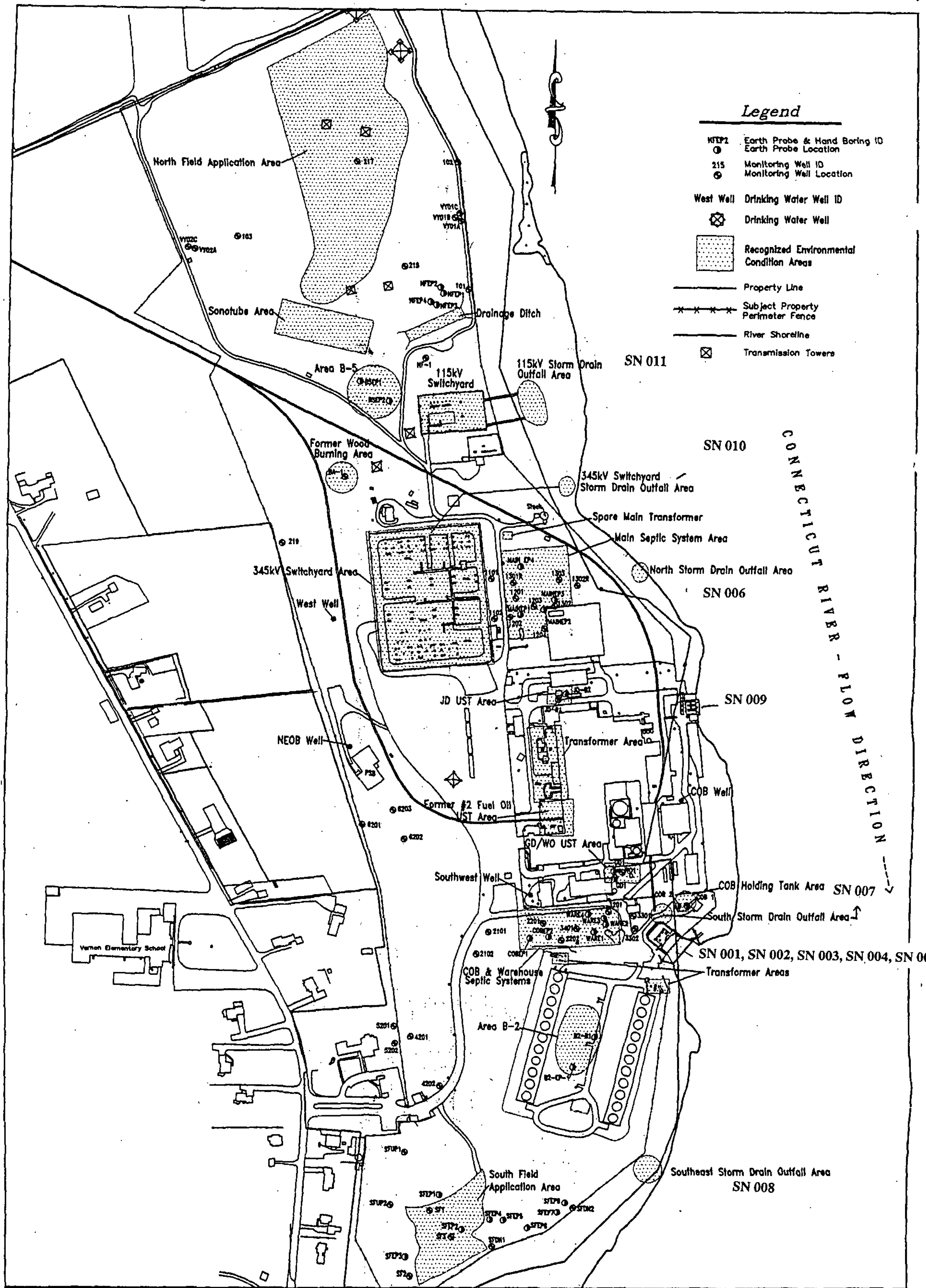
All flows x 10^6 Gal/Day (MGD)

Revised 5-01-2000

(o) Open Cycle (1) Intermittent Flow (as needed)
(c) Closed Cycle (2) Seasonal Flow, (3) Based on a 12 hour day

NOTE: Several possible hybrid cycle cooling modes are not indicated in this diagram. In hybrid cycle, SN 001 flows and heat content will vary between nearly full open cycle to nearly full closed cycle through the selective operation of gates and pumps.

Schematic of Design Maximum Capacity Water Flow



ENVIRONMENTAL COMPLIANCE SERVICES, INC.
30 Harris Place • Brattleboro, VT 05301

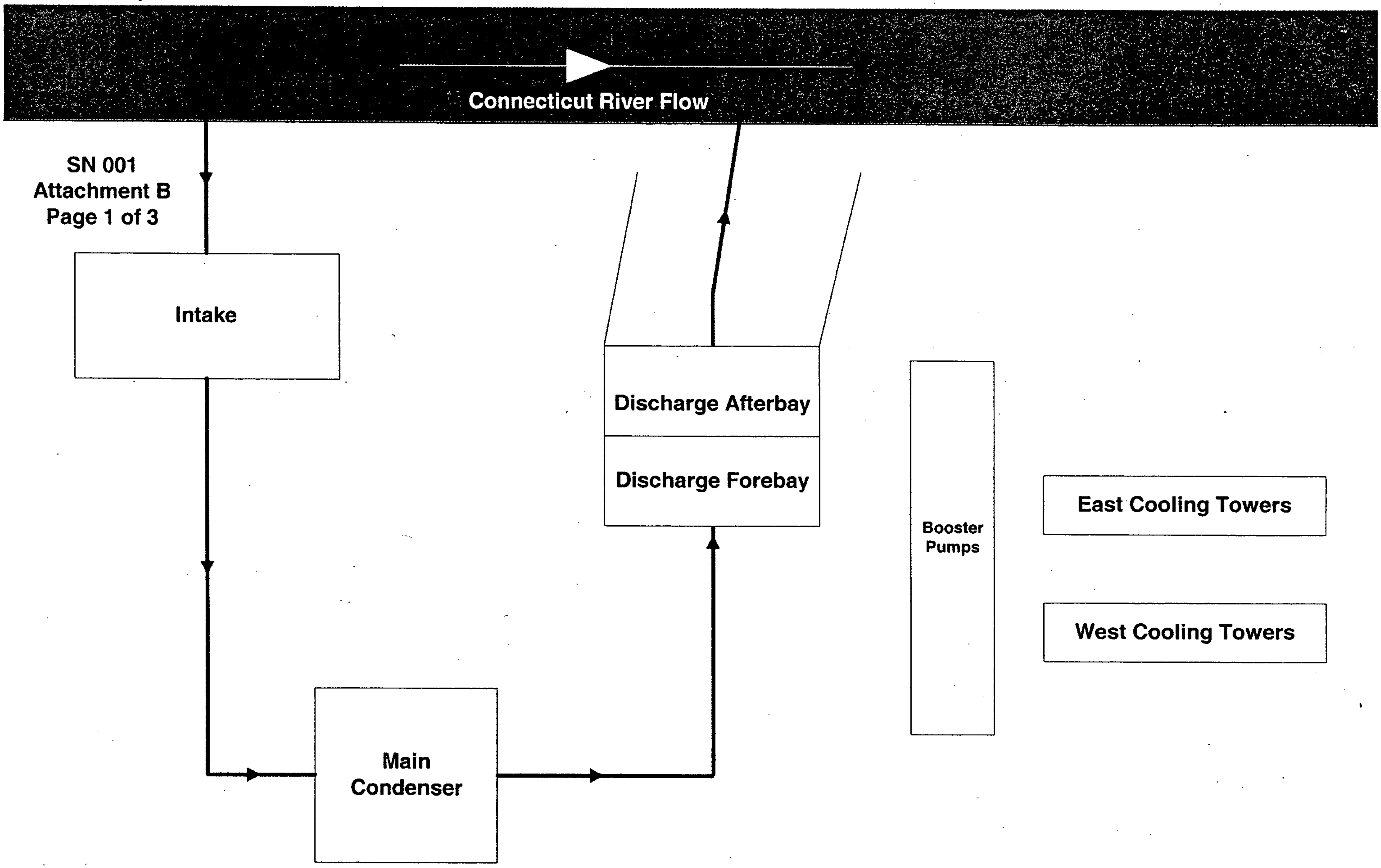
GRAPHIC SCALE: 0 150 300

PROJECT: Vermont Yankee Nuclear Power Corpration
Governor Hunt Road
Vernon, Vermont 05354

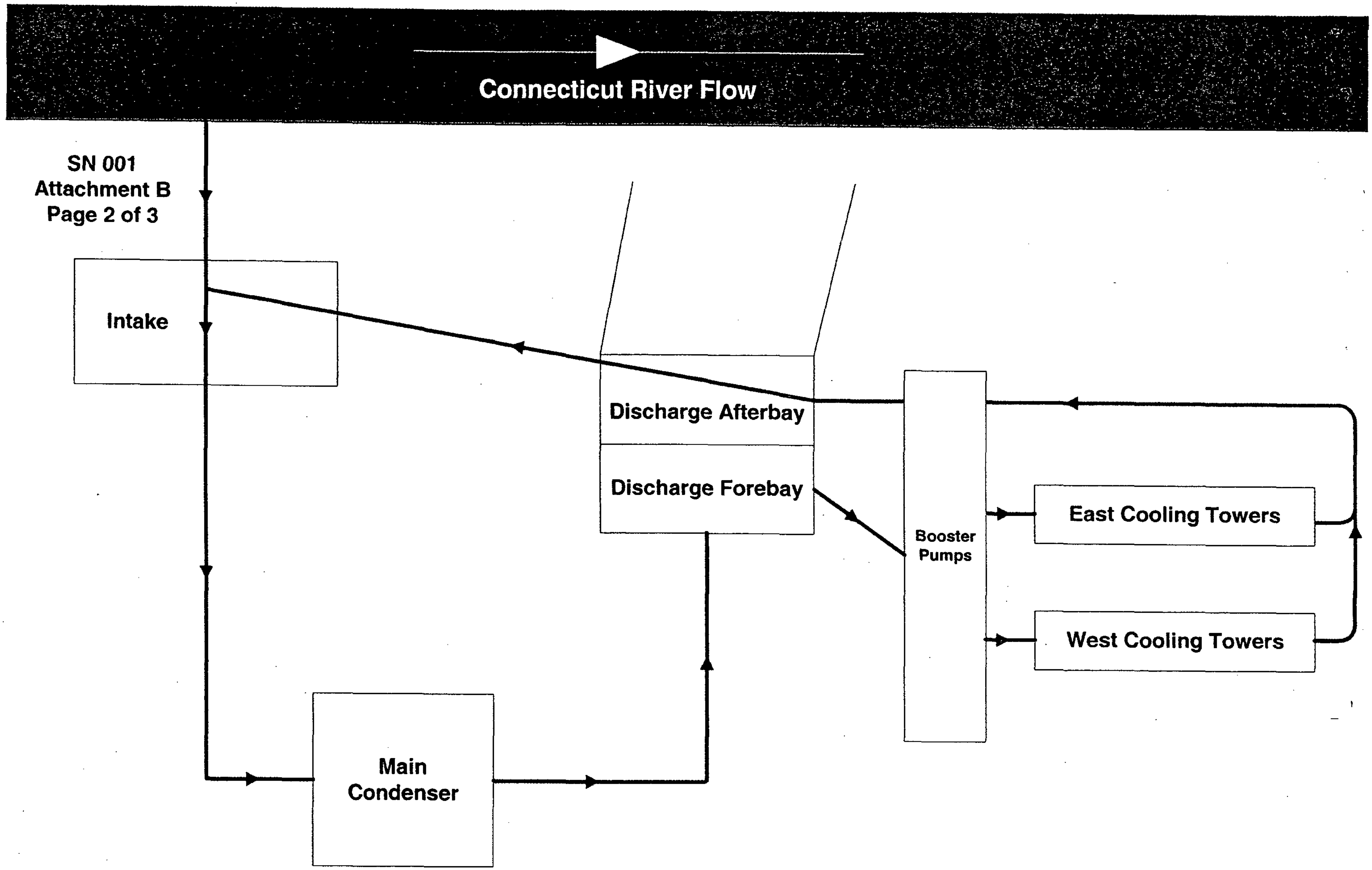
TITLE: Site Plan – Recognized Environmental Conditions

CADFILE: 40320_300sc.dwg

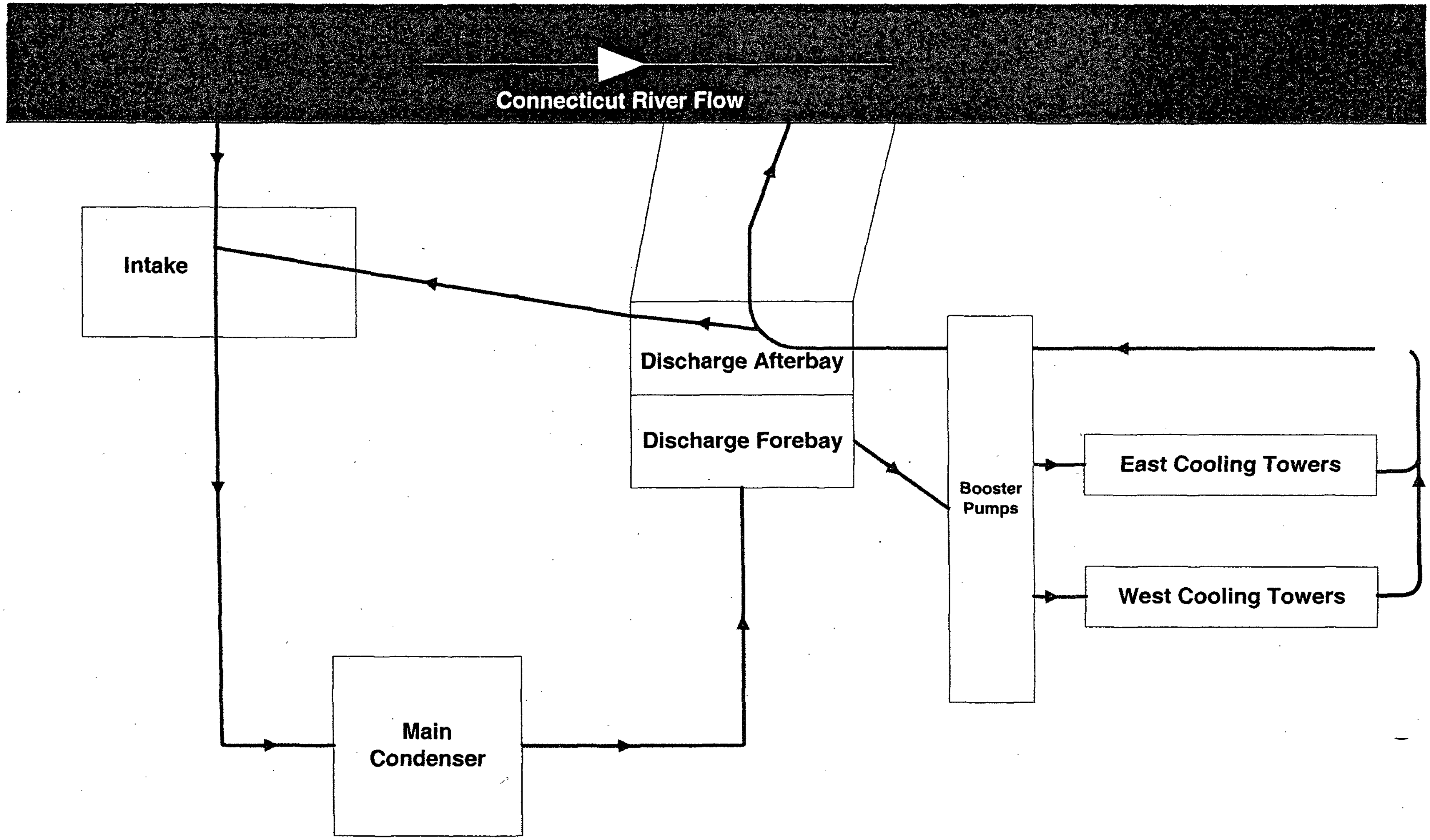
DRAWN BY:	DESIGNED BY:	CHECKED BY:	APPROVED BY:
CS	SVE	FJS	FJS
SCALE:	DATE:	JOB NO.:	FIGURE NO.:
1" = 300'	May 2001	40320	3



Vermont Yankee Open Cycle Operation.
Plan View showing piping and water flow through Station and returned back to the Connecticut River.
(not to scale)



Vermont Yankee Closed Cycle Operation.
Plan View showing piping and water flow, recycling through the Station
none returned to the Connecticut River.
(not to scale)



Vermont Yankee Hybrid Cycle Operation (partially open)
Plan View showing piping and water flow through Station, to cooling towers and returned back to the Connecticut River.
(not to scale)

Statement of Evaporative Losses

Steam generated in the Vermont Yankee reactor is used to drive the plant turbine generator to produce electricity. This driving steam is exhausted to a condenser where Connecticut River water pumped through the condenser acts to condense the exhaust steam. This process is necessary in any steam power plant, so that the condensed steam can be pumped back to the heat source (boiler, steam generator, reactor, etc.) to be reheated and complete the cycle once again. The result is that the temperature of the river water returning to the river is increased, consistent with the existing Permit.

Under the current Permit, the maximum evaporation rate under present operating conditions is approximately 5000 gallons per minute. The pending modification request has the ability to reduce cooling tower use and, as a result, corresponding evaporative losses, without adversely impacting the aquatic community.

PEARL SYSTEM
DISBURSEMENT REQUEST

Date: 10-Feb-03

Issue check in favor of: Vermont Department of Environmental Conservation

Amount: $30,100.00

Date required: 02/13/2003

Reason for check: Request to the Vermont Environmental Conservation Board to amended Entergy VY's NPDES permit

Organization	Resource Code	Activity Code	Project Code	Physical Location	Amount
K77	2533	EXEF	4C105D	VY1	$30,100.00
					Total $30,100.00

Requested By: Eileen Shuman
Signature

2/10/03
Date

Authorized By: [signature]
Signature

2/10/03
Date

STATE OF VERMONT
ENVIRONMENTAL COURT

In Re: Entergy Nuclear Vermont Yankee Discharge Permit Permit Number: 3-1199	)	Second Revised Stmt. of Questions Docket No. 89-4-06

SECOND REVISED STATEMENT OF QUESTIONS OF ENTERGY NUCLEAR VERMONT YANKEE, LLC

Pursuant to Rule 5(f) of the Vermont Rules for Environmental Court Proceedings and the Court's direction on May 24, 2006 and June 9, 2006, appellant Entergy Nuclear Vermont Yankee LLC ("Entergy") hereby sets forth its Second Revised Statement of Questions to be determined on appeal.

1. Whether this Court lacks jurisdiction to determine issues on appeal other than those placed in question by the amendment to Permit No. 3-1199 and whether issues that are not relevant to the determination whether Entergy has met its burden with regard to the 1°F thermal discharge increase – including all issues that challenge the preexisting conditions of Entergy's NPDES permit – are outside the scope of this appeal, are raised in an untimely and procedurally incorrect manner, are inappropriate for resolution by this Court, and will serve only to unduly hinder and delay these proceedings.

2. Whether this Court may assign party status to any entity that did not file Comments on draft Permit No. 3-1199 and/or any entity that fails to raise issues within the jurisdiction of the Environmental Court and Agency of Natural Resources and relating to the amendment to Permit No. 3-1199.

3. Whether VWQS 1-03, VWQS 2-04, VWQS 3-01, and/or other Vermont water quality standards may be applied to Entergy's permit request, or whether the application of

VWQS 1-03, VWQS 2-04, VWQS 3-01, and/or other Vermont thermal water quality standards to Entergy's permit requests is contrary to law.

4. Whether Amended Discharge Permit No. 3-1199 may contain a provision that "[n]otwithstanding the temperature limits in table 6.c above, when the average hourly temperature at Station 3 equals or exceeds 85°F, the permittee shall, as soon as possible, reduce the thermal output of the discharge to the extent that the average hourly temperature at Station 3 does not exceed 85°F," Amended Permit No. 3-1199 Part I.A.6.c (hereinafter, the "85°F Thermal Limit"), and/or whether that 85°F Thermal Limit is contrary to law because Entergy has fully and completely met its burden, pursuant to CWA § 316(a) and 40 C.F.R. § 125.73(a), of establishing by a preponderance of the evidence that the alternative increased thermal discharge will assure the protection and propagation of the balanced indigenous population.

5. Whether Amended Discharge Permit No. 3-1199 may contain a provision approving the 1°F thermal discharge during the period of June 16 through October 14, but fail to contain a provision approving the 1°F thermal discharge during the period of May 16 through June 15, *see* Amended Permit No. 3-1199 Part I.A.6.c, and/or whether the restriction of the 1°F thermal discharge increase to the period of June 16 through October 14 is contrary to law because Entergy has fully and completely met its burden, pursuant to CWA § 316(a) and 40 C.F.R. § 125.73(a), of establishing by a preponderance of the evidence that the alternative increased thermal discharge will assure the protection and propagation of the balanced indigenous population.

6. Whether Amended Discharge Permit No. 3-1199, may contain a "Trend Analysis," consisting of:

> a time series trend analysis consistent with the non-parametric Mann-Kendall test that was used in the permittee's § 316(a) Demonstration in Support of a Request for Increased Discharge Limits at Vermont Yankee Nuclear Power Station During May

> through October, dated April 2004 (Normandeau Associates). The trend analysis shall statistically test for significant ($p<0.05$) increasing or decreasing trends in the annual total catch per unit of effort for each of the nine representative important species collected since 1991 according to the schedule and methods required in the **Fish** section of Part IV. Each year's annual report shall include a long term trend analysis. Specifically this shall include an analysis of the current and preceding years back through 1991.
>
> Macroinvertebrates: The annual report required under Part I.A.9 shall include a time series trend analysis consistent with the non-parametric Mann-Kendall test that was used in the permittee's § 316(a) Demonstration in Support of a Request for Increased Discharge Limits at Vermont Yankee Nuclear Power Station During May through October, dated April 2004 (Normandeau Associates). The trend analysis shall statistically test for significant ($p<0.05$) increasing or decreasing trends in the annual total catch per unit effort (numbers of orgs/basket/30 days of deployment) for each of five macroinvertebrate abundance measures: total abundance; ephemeroptera; trichoptera; diptera; and crustacea. Analysis shall incorporate all rock basket data collected at stations 2 and 3 since 1996 according to the schedule and methods required in the Benthic **Macroinvertebrate** section of Part IV.

Amended Permit No. 3-1199 Part IV, p. 22, and/or whether the Trend Analysis required by Amended Discharge Permit 3-1199 is contrary to law because Entergy has fully and completely met its burden, pursuant to CWA § 316(a) and 40 C.F.R. § 125.73(a), of establishing by a preponderance of the evidence that the alternative increased thermal discharge will assure the protection and propagation of the balanced indigenous population.

7. Whether Amended Discharge Permit No. 3-1199 may vest the Environmental Advisory Council ("EAC") with oversight of the annual reports and studies required by the Trend Analysis, thereby imparting to the EAC the authority to modify the permit unilaterally, abdicating the regulator's statutory responsibility to issue and manage the permit. Amended Permit No. 3-1199 Part IV, pp. 22, 25.

ENTERGY NUCLEAR VERMONT
YANKEE, LLC

By Its Attorneys,

Of counsel:

Elise N. Zoli (by Zachary R. Gates, Esq.)
Elise N. Zoli (*pro hac vice*)
U. Gwyn Williams (*pro hac vice*)
GOODWIN PROCTER LLP
Exchange Place
Boston, MA 02109-2881
617.570.1000

Signed and dated in Montpelier, VT this
13th day of June, 2006

Barbara Ripley (by Zachary R. Gates, Esq.)
Barbara Ripley, Esq.
DOWNS RACHLIN MARTIN PLLC
52 State Street
Montpelier, VT 05601-1072
802.225.5500

Signed and dated in Montpelier, VT this
13th day of June, 2006

CERTIFICATE OF SERVICE

I hereby certify that on June 13th, 2006, I caused a true and correct copy of Entergy Nuclear Vermont Yankee, LLP's Second Revised Statement of Questions to be served upon the following:

Catherine Gjessing, Esq. (Counsel for Agency of Natural Resources)
Warren Coleman, Esq. (Counsel for Agency of Natural Resources)
Patrick A. Parenteau, Esq. (Counsel for Connecticut River Watershed Council, Trout Unlimited, and Citizen's Awareness Network)
David K. Mears, Esq. (Counsel for Connecticut River Watershed Council, Trout Unlimited, and Citizen's Awareness Network)
David Dean (Connecticut River Watershed Council)
Evan J. Mulholland, Esq. (Counsel for New England Coalition Nuclear Pollution)
John Hasen (Counsel for Natural Resources Board/Water Resources Panel)
Daniel Dutcher (Counsel for Natural Resources Board/Water Resources Panel)
James Matteau (Windham Regional Planning Commission)

6/13/06
Date

Barbara Ripley (by Gregory R. Dates, Esq.)
Barbara Ripley, Esq.
DOWNS RACHLIN MARTIN PLLC
52 State Street
Montpelier, VT 05601-1072
802.225.5500

On behalf of Entergy Nuclear Vermont Yankee, LLP

DRM

DOWNS RACHLIN MARTIN PLLC

ZACHARY R. GATES
zgates@drm.com
Direct: (802) 451-2316
Fax: (802) 258-4875

June 13, 2006

BY FIRST CLASS U.S. MAIL

Jacalyn M. Stevens, Court Manager
Vermont Environmental Court
2418 Airport Road, Suite 1
Barre, VT 05641

Re: In Re: Entergy Nuclear Vermont Yankee Discharge Permit, Permit Number 3-1199
Docket No. 89-4-06

Dear Ms. Stevens:

Pursuant to the Court's direction on May 24, 2006 and June 9, 2006, please find enclosed a Second Revised Statement of Questions of Entergy Nuclear Vermont Yankee, LLC. Thank you in advance for your assistance in this matter.

Sincerely yours,

Elise N. Zoli (by Zachary R. Gates)
Elise N. Zoli (*pro hac vice*)
GOODWIN PROCTOR LLP
Exchange Place
Boston, MA 02109-2881
(617) 570-1000

Barbara Ripley (by Zachary R. Gates)
Barbara Ripley, Esq.
DOWNS RACHLIN MARTIN PLLC
52 State Street
Montpelier, VT 05601-1072
(802) 225-5500

Enclosure
cc: Service List

Historical total impingement count of Atlantic salmon and American shad impingement at the Vermont Yankee Cooling Water Intake Structure, 1974-2006.

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total impingement
Atlantic salmon	1979 Phase V Report					0	0	0	1	0	1	0	0*	4	27	24	0	2	14	13	21	108	13	2	0	3	9	9	13	28	0	17	12	319
American shad	1979 Phase V Report					0	0	0	1	0	0	0	0*	0	0	0	0	94	26	1	6	210	10	31	1	278	7	25	1	13	73	577	3	1357

* only three samples collected

Equivalent Age 5 (life history from Savoy and Crecco 1988)	11
Equivalent spawners (life history from Savoy and Crecco 1988)	15
Equivalent Age 5 (Modified EPRI method)*	10

*Calculated using algorithm and age 1+ stock parameters from EPRI (2005), but with fecundity and ELS mortality rates from Savoy and Crecco (1988)

Fish ladder for upstream passage at Vernon dam first opened in 1981

Downstream passage conduit at Vernon dam first opened in 1991

Note: These data represent a total census of all Atlantic salmon and American shad impinged at Vermont Yankee in each year.
The NPDES permit monitoring requirements specify a continuous count of impingement for these fish, 7 days per week, 1 Apr - 15 June and 1 Aug - 31 October of each year.
1 April - 15 June covers the Adult Shad upstream migration period and salmon smolt downstream migration period
1 Aug - 31 October covers the juvenile shad downstream migration period (most in October)

Total smolts, 1967-2000*	15,759,660
Total returns, 1967-2000	17,361
% return	0.11%
Smolt impingement as % of total smolts	0.0020%

*Total smolts released + 0.13 x total fry released

Atlantic salmon Impingement at Vermont Yankee

- 1981-2006 total census of smolts impinged
  = 321 smolts
- Total smolt equivalents stocked 1981-2006
  = 15,759,660 (1.0 smolts + 0.13 fry)
- Impingement Impact on Connecticut River
  = 321/15,759,660 = 0.0020% or 2 smolts per 100,000 smolts stocked

American shad Impingement at Vermont Yankee

- 1981-2006 total census of shad impinged
  = 1,357 juvenile fish
- Age 5 Adult Equivalents impinged
  = 10, 11, or 15 depending on method used
- Total Age 5 shad entering Vernon Pool
  = 33,600
- Impingement Impact on Vernon Pool
  = 15/33,600 = 0.045% or 5 adults per 10,000 adults
- Impingement Impact on Connecticut River
  = 15/1,806,347 = 0.0008% or 8 adults per 1,000,000 adults