Public Service
of New Hampshire

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The Northeast Utilities System

John M. MacDonald
Vice President - Operations

568 DUPLICATE

D22540

May 2, 2005

Ms. Sharon Zaya
Massachusetts Office of Ecosystem Protection
U.S. Environmental Protection Agency
Region 1: New England
One Congress Street, Mail Code CIP
Boston, MA 02114-2023

Reference: Letter (C12521), Linda Murphy to John MacDonald, dated December 30, 2004.

Dear Ms. Zaya:

Merrimack Station, NPDES Permit No. NH0001465
Proposal for Information Collection

As directed by EPA (see Reference) and in accordance with 40 CFR Part 125.95(b)(1), Public Service of New Hampshire (PSNH) herein submits a Proposal for Information Collection to Address Compliance with the Clean Water Act §316(b) Phase II Regulations at Merrimack Station, Bow, New Hampshire (PIC). PSNH asserts a claim of business confidentiality with regard to Sections 3.0, 4.0 and 5.0 of the PIC and requests that EPA handle these sections in full accordance with 40 CFR Part 2, Subpart B.

PSNH has contracted with Normandeau Associates, Inc., to perform the field studies proposed in Section 8.0. Presently, work is scheduled to begin in the second half of May. If you have any questions or concerns regarding the PIC, please contact Mr. Allan Palmer, Senior Engineer, at (603) 634-2439.

Very truly yours,

John M. MacDonald
Vice President - Operations

cc: Mark Stein, EPA
Harry T. Stewart, NHDES

Attachment

PROPOSAL FOR INFORMATION COLLECTION TO ADDRESS COMPLIANCE WITH THE CLEAN WATER ACT § 316(B) PHASE II REGULATIONS AT MERRIMACK STATION, BOW, NEW HAMPSHIRE

APRIL 2005

Public Service of New Hampshire

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780 North Commercial Street, Manchester, NH 03101

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The Northeast Utilities System

January 24, 2007

D25615

Mr. John P. King
U.S. Environmental Protection Agency
Region 1: New England
Office of Ecosystem Protection (OEP)
NPDES Industrial Permits Branch (CPE)
1 Congress Street, Suite 1100
Boston, MA 02114-2023

RE: Release of Confidential Business Information

Dear Mr. King:

In response to your concerns and in the spirit of cooperation, Public Service Company of New Hampshire ("PSNH") has determined that the "Confidential Business Information" label may be removed from the following reports submitted to the EPA in order to facilitate review and to move the process along.

1. Merrimack Station, Proposal for Information Collection, April 2005
2. Merrimack Station, Proposal for Information Collection Revisions, October 2006
3. Newington Station, Proposal for Information Collection, September 2006
4. Schiller Station, Proposal for Information Collection, October 2006
5. Merrimack Station, Draft Report, Thermal Discharge Effects on Downstream Salmon Smolt Migration, May 2006
6. Merrimack Station, Draft Report, An Examination of Fish Catch between Trap Nets with 0.75-In and 2.00-In Mesh Sizes Deployed in Hooksett Pool of the Merrimack River (Bow, NH) During 2004 and 2005, June 2006
7. Merrimack Station, Draft Report, Fisheries Survey Results of 2004 and 2005 and Historic Trends Analysis of 1967 to 2005 Surveys, May 2006

PSNH plans to submit a final version of the Salmon Smolt Migration Study later this month, along with the Hydrothermal Modeling Report that was discussed during our meeting this past October. We also expect to submit a final version of the Historic Trends Analysis and a 316(a) Summary Report by March 15, 2007.

However, I would like to emphasize that by releasing the documents specifically listed herein, PSNH is not waiving its right to assert a business confidentiality claim, as appropriate, on other 316 documents and reports.

We hope this action by PSNH demonstrates our desire to work with EPA to resolve all 316 issues at our three power stations. Please contact Allan Palmer at (603) 634-2439 if you have any other concerns.

Very truly yours,

William H. Smagula

William H. Smagula, P.E.
Director – Generation

cc: David Webster, USEPA
Harry Stewart, NHDES
Linda Landis, PSNH

PROPOSAL FOR INFORMATION COLLECTION TO ADDRESS COMPLIANCE WITH THE CLEAN WATER ACT § 316(B) PHASE II REGULATIONS AT MERRIMACK STATION, BOW, NEW HAMPSHIRE

Prepared for
PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE
PSNH Energy Park
780 North Commercial Street
Manchester, NH 03101

Prepared by
NORMANDEAU ASSOCIATES, INC.
25 Nashua Road
Bedford, NH 03110

P-20411.001

April 2005

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1.0 INTRODUCTION

Public Service Company of New Hampshire ("PSNH") owns and operates two separate generating units, Unit 1 and Unit 2 (collectively, the "Units"), known together as "Merrimack Station" in Bow, New Hampshire. The Units are located on the west bank of the Merrimack River ("River") adjacent to Hooksett Pool, approximately 2.9 miles upstream from the Hooksett Dam and Hydroelectric Station and about 2.9 miles downstream from the Garvins Falls Dam. The River in Hooksett Pool is fresh water.

The primary activity of each of these Units is the generation of electric power. Unit 1, which became operational in 1960, generates at a rated capacity of 120 MW, and withdraws once-through cooling water from the waters of the United States (i.e., the River) using a cooling water intake structure ("CWIS") located on the shoreline of Hooksett Pool. Unit 2, which became operational in 1968, generates at a rated capacity of 350 MW, and withdraws once-through cooling water from the River using a separate CWIS located approximately 120 feet downstream from the Unit 1 CWIS. Each Unit has a total design intake flow in excess of 50 million gallons per day ("MGD") and uses at least 25% of the water withdrawn exclusively for cooling purposes. The current expected operating mode for each Unit over the next ten years is at a capacity utilization rate in excess of 15% and likely at or in excess of 80%.

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 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.

The Phase II Regulations require submission of a Proposal for Information Collection ("PIC") in certain circumstances. In a December 30, 2004 letter to PSNH, the United States Environmental Protection Agency ("USEPA") requested submission of the PIC for the Units "as expeditiously as practicable and prior to the start of biological and/or information collection activities, but no later than October 7, 2006." To the extent that the Phase II Regulations apply to the Units, this document constitutes the PIC for the Merrimack Station Units. PSNH reserves its right to supplement or amend this PIC in response to comments from USEPA, the New Hampshire Department of Environmental Services ("NHDES"), or any other governmental agency, results of the activities proposed in this PIC, or any litigation challenging the Phase II Regulations (40 C.F.R. §122.21(r), §122.44(b), §123.25(a)(4) and (36), and §124.10, and 40 C.F.R. Part 125, Subpart J).

2.0 SOURCE WATER BODY DESCRIPTION

The River serves as the source of cooling water for each Unit at Merrimack Station. Merrimack Station is located in the impoundment formed by Hooksett Dam and referred to as Hooksett Pool. Each Unit operates in a once-through cooling water mode by withdrawing cooling water from and discharging it back into Hooksett Pool. Hooksett Pool averages between 6 and 10 feet deep under most flow conditions, and has a surface area of 350 acres and a volume of 130 million cubic feet at full pond elevation (approximately 190 feet at each Unit). The hydraulic retention time of Hooksett Pool is approximately eight hours under Mean Annual Flow (MAF) conditions, and about five days under 7Q10 flow conditions (both of which are less than the criterion of seven days for classification as a reservoir under the Phase II Regulations). Accordingly, for purposes of the Phase II Regulations, the source water body type for each Unit at Merrimack Station is a freshwater river or stream.

Hooksett Dam is one of three hydroelectric facilities in the immediate vicinity of Merrimack Station that are known collectively as the Merrimack River Hydroelectric Project (FERC No. 1893 - NH). In addition to Hooksett Dam, there are the Garvins Falls Dam, which forms the upstream boundary of Hooksett Pool, and the Amoskeag Dam. As noted above, Merrimack Station is 2.9 miles downstream from Garvins Falls Dam, 2.9 miles upstream from the Hooksett Dam, and 10.7 miles upstream from Amoskeag Dam. The Merrimack River Hydroelectric Project is presently being relicensed by the Federal Energy Regulatory Commission ("FERC"), and settlement discussions are underway with New Hampshire regarding its §401 water quality certification. It is expected that bypass and perhaps minimum flows required to be released by each of the three dams in this Project will be modified by the new FERC license to require a more run-of-the-river flow regime in which inflow equals outflow. A run-of-the-river plan is currently being developed by PSNH and the resource agencies for inclusion in the new FERC license. While these facilities presently store and release on an hourly basis under certain lower flow conditions, none of the dams have sufficient storage capacity to modify flows significantly on a daily or longer basis. Consequently, it is expected that both the daily historical flow record that forms the basis of the 100-year MAF estimate and the River flows for the past eight years will continue to be representative of expected future flow conditions, irrespective of any flow modifications FERC may require.

The watershed area for the River at Merrimack Station is approximately 2,535 square miles ("sq. mi.") The River discharge is not gaged at Merrimack Station, but flow is gaged downstream at Goffs Falls in Manchester (drainage area = 3,083 sq. mi., USGS Gage #01092000) and upstream at Franklin Junction in Franklin (drainage area = 1,510 sq. mi., USGS Gage #01081500). In addition, there are several major tributaries flowing into the River between the Goffs Falls gage and the Franklin Junction gage where discharge is or has been gaged (Contoocook River, USGS Gage #01088000; Soucook River, USGS Gage #s 01089000 and 01089100; Suncook River, USGS Gage #01089500; and Piscataquog River, USGS Gage #01091500). Not all of these tributary gages are currently operational. Furthermore, data availability for each gage is generally concurrent with only a portion of the dataset from one or more of the other gages, e.g., several gages may not be operating at the same time. Nonetheless, in our professional opinion, the data available were more than sufficient to create a 100-year (1903-2003) database of either actual or estimated (based on adjacent watershed gaging data) stream flow data for each gaged and ungaged portion of the watershed between Goffs Falls and Franklin Junction. To determine the long-term MAF for the River at Merrimack Station, the 100-year Merrimack River flow dataset for Goffs Falls was adjusted by subtracting out the gaged and estimated non-gaged flows contributed by the watershed between Merrimack Station and Goffs Falls. As discussed in detail below, the long-term MAF at Merrimack Station was then compared to the actual River and Station intake flows observed and recorded for the past eight years (1996-2003) to estimate the percentage of MAF withdrawn by Unit 1 or Unit 2 of Merrimack Station. This adjusted dataset is representative of both current Unit operations and current River flow and therefore appropriate for the analysis in this PIC.

The estimated MAF for the River at Merrimack Station based on the 100-year period of record was 4,551 cfs. It should be noted that according to USGS, the expected error associated with the stream gages used in this analysis ranges between ±5% to greater than ±15%, depending on the specific gage and the time of year (Coakley et al. 2002). The error estimate for the Goffs Falls gage is placed at ±10% during the open-water season and ±15% during the winter months, when ice conditions in the river may affect the accuracy of the gage measurements (Coakley et al. 2002). These potential errors, in combination with unquantifiable errors associated with the MAF estimation methods for gaged and ungaged portions of the watershed between Goffs Falls and Merrimack Station, indicate that the precision associated with the MAF estimate for Merrimack Station listed above would conservatively be estimated at least ±10%. Consequently, the most scientifically credible estimate of River MAF at Merrimack Station based on the 100-year period of record is 4,551 ±455 cfs, or 4,096 to 5,006 cfs.

3.0 COOLING WATER INTAKE STRUCTURE DESCRIPTION

A separate CWIS supplies River water to each generating Unit at Merrimack Station. The north (Unit 1) CWIS is located on the west bank of Hooksett Pool at latitude 43°08'04" and longitude 71°28'04". The south (Unit 2) CWIS is also located on the west bank of Hooksett Pool, approximately 120 feet downstream from the Unit 1 CWIS, at latitude 43°08'30" and longitude 71°28'02". The north (Unit 1) CWIS has two intake pumps, and the south (Unit 2) CWIS also has two intake pumps; however, the intake pumps at Unit 2 are larger than the intake pumps at Unit 1. The CWIS bulkhead for each Unit projects outward into the River from a rip-rap stabilized shoreline approximately 25 to 30 feet.

Each Unit's CWIS has two vertical single entry/exit traveling screens (described below), one servicing each circulating water pump and providing a basic debris and fish handling and return system. A partition wall below the deck inside each CWIS divides the CWIS into two discrete forebays, separating the flow to each pump before it passes through the associated traveling screen. Each forebay opening to the River is covered with a bar rack with a 3-inch clear space (3.5 inch on-center spacing). The bar racks for each unit are located at the outer edge of the CWIS structure, which extends approximately 25 to 30 feet outward into the River, and are inclined inward at an angle of about 9° from the floor of the forebay. Water from the two pumps at each unit merges into a common pipe at a Y-junction within the pump house a short distance past the pumps. The design through-screen velocity of the Unit 1 CWIS is 1.5 feet per second ("fps"); for Unit 2, it is 1.82 fps.

3.1 UNIT 1

The floor of the Unit 1 intake forebay is at elevation 177 feet, and the associated bar racks rise upward from that point at an inward angle of about 9° to an elevation of 190 feet (which is the full pond elevation of Hooksett Pool). The Unit 1 concrete bulkhead wall extends upward from the top of the bar racks at the same angle to a deck elevation of 207 feet. A concrete debris barrier wall is located five feet outboard from the base of the bar racks and extends the floor of Unit 1 upward by five feet to a point that is at elevation 181 feet, or one foot above the river bottom at elevation 180 feet. There is a five-foot opening in the barrier wall between elevations 181 feet and 186 feet through which the cooling water intake flow passes. The outer bulkhead wall then extends upward at the same angle to the deck elevation of 207 feet. Therefore, the Unit 1 CWIS withdraws water from a horizontal slot in the outer bulkhead that is five feet wide and located between elevations 181 feet and 186 feet, i.e., about three feet to eight feet below the Hooksett Pool full pond elevation.

Each of the two traveling screens at Unit 1 is a FMC Model 45A LinkBelt screen with standard 3/8-inch (0.375-inch) square opening steel mesh panels. The traveling screens rotate periodically when the debris load is light and continuously when the debris load is heavy. Each screen has a single-pressure spray header to wash fish and debris into a trough in the floor of the CWIS deck for return to the river. The trough servicing the two Unit 1 traveling screens carries the fish, debris and wash water from the Unit 1 CWIS into an 18-inch-diameter corrugated steel pipe that runs southward for about 250 feet to a discharge point at the river bank that is about 100 feet south (downstream) of the Unit 2 CWIS. When Hooksett Pool is at a full pond elevation of 190 feet, the discharge location for the common debris and fish sluice from Unit 1 is approximately four feet from the edge of the River.

3.2 UNIT 2

The floor of the Unit 2 intake forebay is at elevation 176 feet, and the associated bar racks rise to the full pond elevation for Hooksett Pool of 190 feet at an inward angle of about 9°. The Unit 2 concrete bulkhead wall extends upward from that point to an elevation of 207 feet. A concrete debris barrier wall is located eight feet outboard from the base of the bar racks and extends the floor of Unit 2 upward by five feet to a point that is at elevation 181 feet, or one foot above the river bottom at elevation 180 feet. Unlike Unit 1, there is no upper portion of the outer concrete barrier wall at Unit 2. Therefore, the Unit 2 CWIS withdraws water from nearly the entire water column between an elevation of 181 feet (or one foot above the River bottom) and the full pond surface elevation of Hooksett Pool of 190 feet.

Each of the two traveling screens at Unit 2 is a Rex Chain Belt two-post screen with standard 3/8-inch (0.375-inch) square opening steel mesh panels. The traveling screens rotate periodically when the debris load is light and continuously when the debris load is heavy. Each screen has a single-pressure spray header to wash fish and debris into a trough for return to the river. The trough servicing the two Unit 2 traveling screens carries the fish, debris, and wash water from the Unit 2 CWIS into an 18-inch smooth steel pipe that joins the Unit 1 wash water pipe at a point about 25 feet south of the Unit 2 CWIS; the fish, debris and washwater continue downstream in a common 18-inch-diameter corrugated steel pipe that runs southward for about 225 feet to a discharge point at the river bank that is about 100 feet south (downstream) of the Unit 2 CWIS. When Hooksett Pool is at a full pond elevation of 190 feet, the discharge location for the common debris and fish sluice is approximately four feet from the edge of the River.

4.0 COOLING WATER INTAKE SYSTEM DESCRIPTION

As detailed above, a separate CWIS supplies each generating Unit with cooling water. The north (Unit 1) CWIS has two intake pumps, each with a design intake capacity of 29,500 gpm (65.73 cfs), resulting in a combined design intake capacity for both pumps at Unit 1 of 59,000 gpm (131.45 cfs). The south (Unit 2) CWIS also has two intake pumps, each with a design intake capacity of 70,000 gpm (155.96 cfs), and a combined design intake capacity for both circulating water pumps at Unit 2 of 140,000 gpm (311.92 cfs).

While, as USEPA is aware, USGS information on River flow for 2004 is not yet available, the Station has compiled nine years (1996-2004) of monthly actual cooling water intake flow data that is realistically representative of the current and expected future CWIS operations for each Unit, and has used this information (including for year 2004, which is consistent with the prior eight-year period) where appropriate (see Tables 1 and 2). These intake flow data are representative of operating conditions at each Unit in that they account for the fact that the actual pumping rate of each Unit historically has been significantly less than the CWIS's design intake flow. As detailed below, the actual pumping rates have been lower than the design flows for each Unit because these pumps typically operate at a higher head differential than the design rating, and because each Unit's cooling water needs vary in response to reduced generation and periodic maintenance outages, among other factors. The observed actual annual cooling water intake flows for the Unit 1 CWIS during the nine-year period of 1996-2004 ranged from 82.5 cfs to 103.5 cfs (53.3 MGD to 66.9 MGD), averaging 96.1 cfs (62.1 MGD) over the nine-year period of record (Table 1). The observed actual annual cooling water intake flows for the Unit 2 CWIS ranged from 226.1 cfs to 255.6 cfs (146.1 MGD to 165.2 MGD), averaging 238.8 cfs (154.3 MGD) over the nine-year period of record (Table 2). Therefore, based on the most recent nine-year period of record, the Unit 1 mean annual intake flow (MAIF) was 96.1 cfs (62.1 MGD), and the Unit 2 MAIF was 238.8 cfs (154.3 MGD).

Actual intake flows were 26.9% lower than design intake flows for Unit 1 (Table 1), and 23.5% lower than design intake flows for Unit 2 (Table 2), over the most recent nine years of operational records at Merrimack Station. These intake flow reductions reflect several factors. First, Hooksett Pool is maintained at a lower elevation than the design head for the intake pumps at each Unit. Second, maintenance outages of four to eight weeks are scheduled to occur at approximately 24-month intervals for Unit 1, and at about 12-month (annual) intervals for Unit 2 (Table 3). Third, as reflected in the dataset, the operational practice of running one intake pump at each Unit during periods of cold ambient River water temperatures contributes to the observed lower actual intake flows as compared to the design intake flows for Unit 1 and Unit 2.

Two additional features of each Unit's water distribution system further reduce the actual cooling water withdrawal flows below design intake capacity, but these reductions were not used to calculate the actual flow reductions described above. Approximately 2.5 MGD (4.0%) of the actual intake flow from Unit 1 and 4.0 MGD (2.6%) of the actual intake flow from Unit 2 is used for sluice water flow to carry slag into a settling pond. In addition, during the winter months, when ambient air conditions are often below freezing, approximately eight MGD (5555 gpm or 12.4 cfs) of heated condenser cooling water from Unit 1 is recirculated back into the intake forebay of Unit 1 for de-icing and tempering. Similarly, for Unit 2, approximately 13 MGD (9028 gpm or 20.1 cfs) of heated condenser cooling water is recirculated back into the intake forebay of Unit 2. The de-icing flow is discharged at a location about eight feet outboard from the trash racks at an elevation of about 179 feet. As a result, Unit 1 design intake flows are reduced by an additional 9% to 13%, and Unit 2 design intake flows are reduced by an additional 6% to 8% during de-icing operations. Because the Station has not included these two additional flow reductions in its calculations of intake flows, the actual intake flows presented for Unit 1 and Unit 2 in this PIC are even more conservative estimates in that they underestimate the actual flow reductions due to station operations as compared to design flows.

While intake flow data for 2004 were included in the analysis of actual intake flows, since USGS data for River flow for 2004 is not yet available, only eight years of actual intake flow data from 1996-2003 were used for comparison with River MAF. (These eight years of actual intake flow data representing 1996-2003 are virtually identical to the actual intake flows for the past nine years (1996-2004) in terms of average annual use (Tables 1 and 2)). Based on a direct comparison between the eight-year MAF of the River at Merrimack Station (1996-2003) and the concurrent eight-year record of Station cooling water intake flows (1996-2003), the actual intake flow for the Unit 1 CWIS was 1.95% of the River MAF (4,943 cfs), and the Unit 2 CWIS cooling water flow was 4.83% of the River MAF. Use of the 1996-2003 MAF and corresponding CWIS flows for each unit is consistent with the Phase II Regulations. (See 69 Fed. Reg. at 41635 "Representative historical data (from a period of time up to 10 years, if available) must be used to make this determination"). Furthermore, the 1996-2003 MAF is within the conservatively estimated 100-year MAF for the River (4,096-5,006 cfs). As a result, we request that the USEPA conclude, based upon the overwhelming weight of the technical evidence, that Units 1 and 2 each withdraw 5% or less of the MAF of the source water body, and therefore are exempted from the entrainment requirements of the Phase II Regulations.

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

5.1 CURRENTLY IMPLEMENTED TECHNOLOGIES AND OPERATIONAL MEASURES

Operational measures currently implemented at each Unit of Merrimack Station to reduce impingement mortality and entrainment are intake flow reductions, including those resulting from pump differentials, maintenance outages, and the winter usage of heated condenser cooling water for de-icing (discussed above), among other factors. The average flow reduction for Unit 1 over the nine-year period of record was 26.9% compared to the maximum intake design flow (Table 1), while the average flow reduction for Unit 2 over the nine-year period of record was 23.5% compared to the maximum intake design flow (Table 2). The above-described de-icing flows further increase each Unit's flow reductions during the winter months of December through March by an additional 9 to 13% at Unit 1 and an additional 6 to 8% at Unit 2. It is important to note again that PSNH has not included these de-icing flows in the calculations presented in Tables 1 or 2. As a result, USEPA should view these flows as providing an even more conservative "buffer" of additional flow reduction when they assess each Unit's current operational measures for compliance with the Phase II Regulations.

5.1.1 Impingement

Operational flow reductions have provided an annual average reduction in impingement mortality of 26.9% for Unit 1 and 23.5% for Unit 2 compared to expected baseline conditions of maximum intake design flows and under the assumptions that (1) there is a direct (1:1) relationship between flow reductions and the number of fish impinged, and (2) there is 100% mortality of impinged fish in the current traveling water screen and fish return system at each Unit. The existing traveling screen and fish return system is assumed to have 100% impingement mortality due to the location of the return system discharge; however, impingement is not uniform throughout the year, so it will be appropriate to calculate a flow-weighted annual impingement mortality reduction based on the results of the proposed impingement studies described in Section 8.1 below. The most recent monthly impingement data (1976-1977) did not differentiate the collections between Unit 1 and Unit 2 and therefore were not useful as a first-order estimate of the flow-weighted annual impingement mortality at each Unit (see Section 6, below); however, based on the actual timing of operational flow reductions and the historically low monthly impingement rates at the Station, the estimated annual reduction in impingement mortality due to such operational measures (an evaluation of which would be included in any Comprehensive Demonstration Study) is expected to exceed the percentages representing the unweighted flow reductions described above.

5.1.2 Entrainment

As noted above, neither Unit 1 nor Unit 2 at Merrimack Station is subject to the entrainment requirements of the Phase II Regulations.

5.2 PROPOSED TECHNOLOGIES AND OPERATIONAL MEASURES

5.2.1 Impingement

PSNH expects to evaluate three technological options for further reducing impingement mortality at Unit 1 and Unit 2: (1) optimizing one or both Units' existing fish handling and return system, (2) installing a new basic fish handling and return system, and (3) installing a new fish handling and return system that incorporates conservation devices such as baskets and uses continuously rotating traveling screen and a washwater spray header system to remove juvenile and adult fish from each Unit's traveling screens.

If appropriate, in accordance with 40 C.F.R. §125.94(a)(5), PSNH may estimate whether the costs of these technological 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 of such fish return systems). If appropriate, PSNH 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 each Unit individually and presented these in Appendix A of the preamble to the final Phase II Regulations (See 69 Fed. Reg. 41670). For the Unit 1 CWIS, USEPA estimated that the annualized compliance cost would be $120,181, the total capital cost would be $808,777, and the total net revenue losses from net construction down time would be $5,399,114 (for both units). For the Unit 2 CWIS, USEPA estimated that the annualized compliance cost would be $218,874, the total capital cost would be $1,524,044, and the total net revenue losses from net construction down time would be $5,399,114 (for both units). 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 also reflect a USEPA-selected technology of "addition of passive fine-mesh screen system (cylindrical wedgewire) near shoreline with mesh width of 1.75 mm."

5.2.2 Entrainment

As noted above, neither Unit 1 nor Unit 2 of Merrimack Station is subject to the entrainment requirements of the Phase II Regulations.

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

6.1 IMPINGEMENT

Existing data from annual impingement reports reveal negligible impingement rates at Merrimack Station during periods of low River flows when the proportional CWIS flow is the greatest and, therefore, impingement would be expected to be most severe (Table 3). For example, according to Merrimack Station's 2003 Annual Fish Impingement Report, submitted to the USEPA and NHDES in December 2004, the average impingement rate for 2003 was 0.04 fish per million cubic feet ("mcf") of actual intake flow (both Unit 1 and Unit 2 combined). As the report notes, "[s]imilar to all previous seasons, this rate is very low by all industry standards even though the data was collected during worst case conditions, i.e., when river flows are less than 900 cfs." Further, the Station has reported that it never experienced anything that can reasonably be construed as a significant impingement episode.

The very low rate of impingement by Merrimack Station is reflected in its permitting history. USEPA eliminated the majority of impingement sampling requirements from the Station's NPDES permit beginning in 1979 when, in a letter dated 8 May 1979 from Leslie A. Carothers, Director to Mr. Warren A. Harvey Vice President of PSNH, it stated that "[a]fter careful analysis, we have concluded that, under present environmental conditions, the location, design, and capacity of the intake structure does reflect the best technology available for minimizing adverse environmental impact as required by Section 316(b) of the Federal Water Pollution Control Act, as amended. The existing intake structure is approved and no further entrainment or impingement monitoring is required at this time." Consistent with USEPA's determination, the current NPDES permit for Merrimack Station requires that 48-hour impingement sampling be conducted only when River flow at the Goffs Falls USGS gage drops below 900 cfs, presumptively due to concerns that impingement rates would increase during low water periods. Merrimack Station impingement monitoring results have been reported annually to USEPA and to NHDES without agency response.

Further, a two year impingement study conducted at Merrimack Station from January 1976 through December 1977 also documented very low annual impingement rates across all months and flows (Table 4, reproduced from Normandeau 1979, Appendix Table E-5). In this study, impingement sampling was conducted for 48 hours per week for 104 consecutive weeks between January 1976 and December 1977. The 1976-77 study report did not differentiate whether the impinged fish came from Unit 1 or Unit 2 screens – all the fish collected on each sampling date were reported for both Units combined. The total number of fish captured in the 1976 impingement collections was 256, representing 20 taxa (Table 4). The total number of fish captured in the 1977 impingement collections was 301, representing 16 taxa (Table 4). Game fish species such as largemouth and smallmouth bass accounted for only 4.7% of the catch by number in 1976 and only 0.7% of the catch by number in 1977. Projections using the observed 1976-1977 impingement collection data (Table 4) and the hours of CWIS pump operations for Unit 1 and Unit 2 (combined) estimated a total annual impingement of 1449 fish in 1976 and 2504 fish in 1977 (Normandeau 1979). The 1977 total annual impingement of 2504 fish was composed primarily of minnow species (74% or 1853 individuals, Normandeau 1979).

Based on the results of the 1976-1977 impingement study, USEPA and NHWSPCC granted a waiver for future impingement monitoring at Unit 1 and Unit 2 with two stipulations (USEPA letter dated 8 May 1979 addressed to PSNH): (1) that impingement monitoring would resume during May and June 1978 to determine if Atlantic salmon smolts were susceptible to impingement, and (2) that sampling would resume during the fall to see if American shad juveniles introduced into Hooksett Pool were susceptible to impingement (Normandeau 1979). Accordingly, impingement monitoring was conducted during the spring and fall of 1978. During the spring downstream salmon migration, no salmon smolts were impinged, and during the fall downstream migration, only one American shad juvenile was collected. This study indicates that American shad juveniles and Atlantic salmon smolts were not impinged in substantial numbers while migrating downstream through Hooksett Pool. No further impingement monitoring requirements were specified as a condition of any of Merrimack Station's subsequent NPDES permits, other than the low flow impingement monitoring described above.

6.2 ENTRAINMENT

As noted above, neither Unit 1 nor Unit 2 is subject to the entrainment requirements of the Phase II Regulations. This section discusses historic monitoring solely for informational purposes.

The susceptibility of drifting fish larvae to entrainment at Merrimack Station was first studied using an epibenthic larval trawl to sample in the nearfield portion of Hooksett Pool just in front of the intake structure for Unit 1 and Unit 2. Sampling was conducted by taking tows using a 0.5 m by 1.0 m tucker trawl with a 505 micron mesh nylon net. Duplicate tows were taken in front of the intakes at a weekly interval during the months of June and July of 1975 (Normandeau 1976). In 1976 and 1977, the sampling period was increased to cover the spring period when larval fish were most abundant; weekly duplicate tows were conducted from April through September (Normandeau 1979). No fish eggs were collected during the 1975-1977 study, and the number of fish larvae collected was considered minimal. Sunfish (Centrarchid) larvae were the most frequently collected larvae in this study. No larvae were collected in April, May, August and September in front of the intake structures; sunfish larvae were primarily captured in June and July.

Entrainment sampling was performed again at Merrimack Station during 1978 when water entering the CWIS of Unit 1 was sampled on the diel basis using an ichthyoplankton pump system. Diel entrainment pump samples were collected from 23 May through 27 July, 1978 and encompassed 23 sampling dates (Normandeau 1979). Pumped entrainment sampling generally occurred for 48 continuous hours each week between 23 May and 27 July 1978. An exception to this sample regime occurred between 10 July and 20 July when sampling was suspended due to a pump malfunction. A recessed impeller trash pump rated at 41,000 gallons per hour maximum with 4-inch suction and discharge pipes was used to sample the Unit 1 intake at three depths. The five foot deep Unit 1 intake opening was sampled simultaneously at the top, mid-point and bottom. The three intake pipes were manifolded into one pipe before entering the pump. The pumped water was filtered through a 0.5 meter, 505 micron net suspended in a 55 gallon drum; the net suspended in water helped prevent mutilation of the fish larvae against the mesh by the water flow. The pump rate was calibrated every 24 hours by recording the time required to fill the 55 gallon drum, and converting this figure to liters per second. White sucker, golden shiner, minnows (*Notropis* spp.) and sunfish larvae were the most commonly collected larvae during the 1978 entrainment program at Unit 1. No fish eggs were collected during this pumped entrainment study. Overall, the total number of fish larvae collected during the 1978 pumped entrainment study (261 larvae) was considered to be minimal.

In 1995, nearfield ichthyoplankton tows were taken in Hooksett Pool in the vicinity of Merrimack Station; samples were collected from Merrimack Station's ambient, mixing and thermally affected zone weekly from 10 May through 27 June, 1995 (Normandeau 1996). Larvae of yellow perch and bluegill were first collected when sampling began on 10 May, suggesting that the entrainment season may have begun in late-April or early May 1995, in contrast to prior years when the first larvae were seen in June. As the 1995 study progressed, at least one larva of 13 fish species were collected, with the most abundant species being bluegill, spottail shiner, rainbow smelt and common shiner. The maximum densities of these species observed during 1995 were as follows: 7.2 bluegill larvae per 50 m^3 during the week of 10 May, 2.7 spottail shiner larvae per 50 m^3 during the week of 6 June, 5.3 rainbow smelt larvae per 50 m^3 during the week of 30 May, and 1.5 common shiner per 50 m^3 during the week of 20 June 1995 (Normandeau 1996). No fish eggs were collected during this study, corroborating observations from all prior studies.

6.3 Biological Conditions in the Source Water Body

Improved water quality due to infrastructure improvements in water treatment made at point source discharges upstream from Merrimack Station (in response to the Federal Water Pollution Control Act) is widely considered to have had a major positive impact on the River's aquatic community as a whole. The fish species assemblage that existed in Hooksett Pool during the 1960's was one that developed when the River was at its most polluted state historically (Normandeau 1979), and fish community changes in the subsequent decades have largely been in response to improved water quality. In addition, these changes also reflect a fish community response to stocking and the introduction of non-native species.

Electrofishing surveys have been performed in Hooksett Pool by consultants for PSNH using consistent and documented methods at the same sampling stations over the past four decades. The fish community sampled in 2004 exhibited significantly ($p<0.05$) greater relative diversity and evenness than in either the 1970's or 1990's, and is therefore currently more robust than was observed at any time in the past 40 years (Table 5). In the 1970's, the electrofishing catch comprised 16 fish species and was dominated by pumpkinseed (53.4%), resulting in a Shannon-Weaver diversity index (Poole 1974) of 1.32 and an evenness of 0.60 (Tables 5 and 6). By 1995, the fish community was represented by 14 species and was co-dominated by spottail shiner (43.6%) and bluegill (41.7%); the Shannon-Weaver diversity index was 1.19 and the evenness was 0.48 (Tables 5 and 6). No statistically significant differences ($p<0.05$) in species diversity were observed between the 1970's and 1995 (Table 5). During the most recent two decades (1995 and 2004), the species composition in Hooksett Pool has continued to change, most likely due to species introductions by the resource agencies and others, and their effects on existing community. For example, pumpkinseed fell from the number one fish captured in the early studies to seventh in abundance in 1995, likely due to increased competition from introduced bluegills. The 2004 fish community sampled by electrofishing comprised 18 species, and exhibited a significantly ($p<0.05$) greater Shannon-Weaver diversity index ($H' = 1.93$) and evenness ($H'/H'_{max} = 0.77$) than in either of the previous two decades sampled (Table 5), with no single or pair of species exhibiting hyper-dominance, as was seen during the 1970's and in 1994 (Table 6). Because hyper-dominance is often correlated with poor water quality, the significant recent (2004) improvements in diversity and evenness in the fish community of Hooksett Pool reveals their response to improved water quality compared to the 1970's or 1995. Spottail shiner remained the most abundant fish in Hooksett Pool in both recent decades, but decreased in relative abundance from 43.6% in 1995 to 28.3% in 2004, as other fish species increased in relative abundance. Largemouth bass was the second most abundant fish in 2004 and comprised more than 11% of the total electrofishing catch. Smallmouth bass have also increased in abundance in 2004 compared to 1995. One reason these two important gamefish have increased in relative abundance may be linked to the increase in the forage base (spottail shiners and alewives) that was observed between 1995 and 2004. Black crappie was collected for the first time in Hooksett Pool during the 2004 study, and rock bass was first collected in 1994 (Table 6). Yellow perch abundance declined after the 1970's, likely as a result of improved water quality, to its present ranking in the recent 2004 electrofishing survey.

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

USEPA already has determined that § 316(b) is satisfied at the two Units comprising Merrimack Station. The Station's existing permit explicitly states that "[i]t has been determined, based on engineering judgment, that the circulating water intake structure presently employs the best technology available for minimizing adverse environmental impact."

PSNH's consultations with Federal and State fish and wildlife agencies, and consultations between these agencies, addressing § 316(b) contributed to this conclusion. Documents relevant to these consultations are summarized in Appendix 1, below. PSNH reserves its right to supplement Appendix 1 in the event it determines that it inadvertently has not referenced a relevant consultation or listed a relevant document; as noted above, PSNH has been operating the Units for more than three decades and has many documents in its files relating to each Unit's operations, and it is possible that it has not located or does not have all relevant documents.

8.0 SAMPLING PLAN FOR NEW FIELD STUDIES

8.1 IMPINGEMENT

PSNH proposes a one-year impingement sampling program for Unit 1 and Unit 2 of Merrimack Station beginning in 2005 because the most recent and comprehensive annual impingement data were obtained during the 1976-1977 study described in Section 6 of this PIC, and because the fish community in the River has changed since then. PSNH may undertake a second year of impingement sampling to verify the results observed during 2005-06 if appropriate. The goal of the proposed program is to estimate the annual total potential mortality of juvenile and adult fish that become impinged on the traveling screens of the Unit 1 and Unit 2 CWISs. The impingement 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 2.

The impingement sampling protocol for each Unit will reflect appropriate peak and off-peak sampling periods of the year, using a design that is consistent with numerous impingement programs both completed or on-going at CWIS's located on freshwater rivers throughout the United States. Weekly impingement sampling will be conducted at each unit separately during the peak period beginning in mid-March and continuing through October. Biweekly impingement sampling will be conducted at each unit during the off-peak period of November through mid-March. Weekly impingement sampling at each unit will consist of collecting one 24-hour sample representing the period 0900 on Monday through 0859 on Tuesday, followed by one six-day sample. Biweekly sampling at each unit will consist of collecting one 24-hour sample representing the period 0900 on Monday through 0859 on Tuesday, followed by one thirteen-day (biweekly) sample. There is no need to collect impingement samples representative of intervals less than 24 hours, because each unit is base-loaded and therefore without the operational flexibility to implement fish conservation measures on a more frequent (diel) basis. This design will provide 33 twenty-four-hour samples and 32 six-day samples representative of the peak impingement period at each unit, and nine 24-hour samples and nine thirteen-day samples representative of impingement during the remaining portion of the year. The 24-hour impingement samples are considered the primary samples, and the "long interval" samples of six or thirteen days are considered secondary samples.

Impingement sampling will be conducted by placing baskets made from the same wire mesh as the traveling screens (3/8 inch square mesh) in the fish and debris return pipes of each of the two units to catch all of the fish and debris washed off of the operating traveling screens in each primary (24-hour) sample. Following collection of each primary sample from each unit, the collection basket will be placed back into service and allowed to sample unattended during the ensuing six-day or thirteen-day period to collect the long interval samples. The following information will be recorded for the primary impingement samples from Unit 1 and from Unit 2: fish species composition and abundance, predominant type and amount (gallons) of debris, and number of circulating water pumps and screens operating. The following environmental parameters will also be recorded at the beginning and end of each sampling interval: mid-depth water temperature, dissolved oxygen concentration, conductivity, and river surface conditions (wave height, wind direction and velocity, water level, cloud cover, and precipitation). Each long interval sample will be processed in the same way as the primary samples; however, only the four migratory species will be enumerated (American shad, Atlantic salmon, alewife, American eel). All data will be subject to a standard and appropriate quality assurance/quality control review including a 10% average outgoing quality level (AOQL) for all field and laboratory measurements, and a 1% AOQL for all data files, computations and reports. Please note, for example, that 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 any industry standards for impingement and entrainment studies. Computerized operational data files from each Unit at Merrimack Station will be obtained and used to extrapolate impingement rates based on the actual total circulating water flow through each unit for each sampling period.

Any Atlantic salmon collected through impingement sampling will be handled with great care and released alive if possible. Any dead Atlantic salmon collected through impingement sampling will be identified, measured and frozen. Appropriate agencies will be contacted (NMFS, USFWS) in accordance with the scientific collector's permit.

8.2 ENTRAINMENT

As noted above, neither Unit 1 nor Unit 2 is subject to the entrainment requirements of the Phase II Regulations. Accordingly, no new entrainment studies are proposed.

9.0 LITERATURE CITED

Coakley, M.F., Ward, S.L., Hilgendor, G.S., and Kiah, R.G. 2002. Water resources data, New Hampshire & Vermont Water Year 2001: U.S. Geological Survey Water-Data Report NH-VT-01-1,194p.

Normandeau Associates, Inc. (Normandeau). 1976. Merrimack River Monitoring Program, 1975. Prepared for Public Service Company of New, Manchester, NH. 205pp.

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Normandeau. 1997. Merrimack Station (Bow) Fisheries Study. A report submitted to the Public Service Company of New Hampshire, Manchester, NH. 28pp.

Poole, R.T. 1974. An Introduction to Quantitative Ecology. McGraw-Hill Book Co., New York. 532p.

USEPA. 2001. EPA Requirements for Quality Assurance Project Plans. EPA QA/R-5. EPA/240/B-01/003, March 2001.

Table 1. **Monthly actual operational flow reductions for Merrimack Station Unit 1 compared to the design intake flows using the plant records available for either the nine-year period of 1996 through 2004 or the eight-year period of 1996-2003.**

	Unit 1 Monthly Average Flow (cfs) or Percentage Flow Reduction (%)												
Nine Years (1996-2004)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Actual Unit 1 withdrawal flow (cfs) 1996-2004	101.5	98.1	100.9	94.4	90.1	101.5	103.3	102.5	84.0	74.4	97.0	105.2	**96.1**
Maximum design capacity (cfs)	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	**131.5**
Flow Reduction													
(cfs)	30.0	33.4	30.6	37.1	41.4	30.0	28.2	29.0	47.5	57.1	34.5	26.3	**35.4**
(%)	22.8	25.4	23.2	28.2	31.5	22.8	21.4	22.1	36.1	43.5	26.2	20.0	**26.9**
	Unit 1 Monthly Average Flow (cfs) or Percentage Flow Reduction (%)												
Eight Years (1996-2003)	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Actual Unit 1 withdrawal flow (cfs) 1996-2003	101.6	97.1	101.6	93.2	89.3	100.9	103.0	102.1	82.2	83.0	95.9	105.2	**96.3**
Maximum design capacity (cfs)	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	131.5	**131.5**
Flow Reduction													
(cfs)	29.9	34.4	29.9	38.3	42.2	30.6	28.5	29.4	49.3	48.5	35.6	26.3	**35.2**
(%)	22.7	26.2	22.7	29.1	32.1	23.3	21.7	22.4	37.5	36.9	27.1	20.0	**26.8**

Table 2. Monthly actual operational flow reductions for Merrimack Station Unit 2 compared to the design intake flows using the plant records available for either the nine-year period of 1996 through 2004 or the eight-year period of 1996-2003.

	Unit 2 Monthly Average Flow (cfs) or Percentage Flow Reduction (%)												
Nine Years (1996-2004)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Actual Unit 2 withdrawal flow (cfs) 1996-2004	248.3	251.6	217.4	180.3	181.2	255.2	262.8	273.9	239.4	263.8	249.9	241.2	**238.8**
Maximum design capacity (cfs)	312.0	312.0	312.0	312.0	312.0	312.0	312.0	312.0	312.0	312.0	312.0	312.0	**312.0**
Flow Reduction (cfs)	63.7	60.4	94.6	131.7	130.8	56.8	49.2	38.1	72.6	48.2	62.1	70.8	**73.2**
(%)	20.4	19.3	30.3	42.2	41.9	18.2	15.8	12.2	23.3	15.5	19.9	22.7	**23.5**
	Unit 2 Monthly Average Flow (cfs) or Percentage Flow Reduction (%)												
Eight Years (1996-2003)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Actual Unit 2 withdrawal flow (cfs) 1996-2003	248.6	249.8	217.7	191.7	181.4	251.6	262.4	272.7	233.9	261.2	245.7	246.3	**238.6**
Maximum design capacity (cfs)	312.0	312.0	312.0	312.0	312.0	312.0	312.0	312.0	312.0	312.0	312.0	312.0	**312.0**
Flow Reduction (cfs)	63.4	62.2	94.3	120.3	130.6	60.4	49.6	39.3	78.1	50.8	66.3	65.7	**73.4**
(%)	20.3	19.9	30.2	38.6	41.9	19.4	15.9	12.6	25.0	16.3	21.2	21.1	**23.5**

Table 3. **The average fish impingement rates reported for the Merrimack Generating Station (Unit 1 and Unit 2 combined) from 48-hour samples taken during periods of low Merrimack River flows (<900 cfs at Goffs Falls) 1997 through 2003.**

	Dates	Total Number of 48 hour samples	Average Impingement Rate per million cu ft.	Total Number of Fish
1997	Aug-Oct	6	1.00	431
1998	Aug-Oct	6	0.89	384
1999	Jul-Sep	10	0.01	9
2000	Sep-Oct	3	0.09	19
2001	Jul-Oct	14	0.03	30
2002	Jul-Oct	14	0.01	12
2003	Jul-Sep	7	0.04	16

APPENDIX 1

Reports and Relevant Agency Correspondence Regarding §316(b) at Merrimack Station

Normandeau Reports

Normandeau Associates, Inc. (Normandeau). 1975. Merrimack River Monitoring Program, 1974. Prepared for Public Service Company of New, Manchester, NH. 211pp.

Normandeau Associates, Inc. (Normandeau). 1976. Merrimack River Monitoring Program, 1975. Prepared for Public Service Company of New, Manchester, NH. 205pp.

Normandeau Associates, Inc. (Normandeau). 1979a. Merrimack River Monitoring Program, 1978. Prepared for Public Service Company of New, Manchester, NH. 179pp.

Normandeau Associates, Inc (Normandeau). 1979b. Merrimack River Monitoring Program Summary Report. A report submitted to the Public Service Company of New Hampshire, Manchester, NH. 227pp.

Relevant Agency Correspondence

3/12/1975 – NHWPCC to USEPA – State certification of draft NPDES permit.

3/27/1975 – USEPA to PSNH – Final NPDES Permit: *Effective through 10/1/1979, with Section 3 that addresses effects of intake structure on fish population, and Section 10a that addresses biological monitoring.*

9/17/1975 – USEPA to PSNH: *Comments on scope of work for biological monitoring.*

1/26/1979 – PSNH to NHWSPCC – Permit Modifications from Jan 12 Meeting: *Outlines monitoring plan for juvenile American Shad and Atlantic salmon smolts to be conducted based on presence of "significant numbers" present in Hooksett Pool*

2/7/1979 – NHWSPCC to PSNH – NPDES Permit Modifications: *Addresses "significant numbers" wording.*

2/9/1979 – NHF&G to PSNH – Comments on Permit Modifications: *Addresses wording regarding numbers of shad/salmon.*

1/26/1979 – PSNH to USEPA – Permit Reapplication and Modifications: *Conditions impingement monitoring for shad and salmon on "significant numbers" being present*

6/25/1979 – USEPA to PSNH –Final NPDES Permit: *Effective through 10/1/198, with Section 5A that addresses shad and salmon monitoring.*

3/8/1985 – NHF&G to USEPA – Comments on draft NPDES permit: *Due to significant entrainment mortalities of juvenile shad, recommends impingement monitoring for salmon.*

9/30/1985 – USEPA to PSNH – Final NPDES Permit: *Section 5A addresses impingement monitoring for clupeids (from September 15 to October 31) and salmon smolt (April 15 to June 15); Section 5B addresses pump entrainment monitoring for shad (June 15 to July 15 if "significant numbers" present).*

7/29/1991 – NHF&G to NHDES – Review of draft NPDES permit: *Cites 1987 permit amendment requiring impingement monitoring when flows at Garvin's Falls Station drop below 900 cfs at any time from July through October, and recommends monitoring annually from July 1 to October 15.*

8/26/91 – NHWSPCC/NHF&G to USEPA – Comments on draft NPDES permit: *Discusses permit language relative to impingement monitoring and pump entrainment monitoring (shad and salmon).*

12/5/1991 – USEPA Fact Sheet: *Discusses §316b.*

2/18/1992 – PSNH to USEPA – Comments on draft NPDES permit – *Proposes retaining existing permit condition requiring impingement monitoring when flows at Garvin's Falls Station drop below 900 cfs at any time from July through October, with addition that NHF&G could require weekly impingement monitoring when it is determined that "significant numbers" of juvenile clupeids are likely to pass Merrimack Station.*

6/30/1992 – USEPA to PSNH - Final NPDES Permit: *Section 10b1 requires impingement monitoring when flow at Garvin's Falls drops below 900 cfs (July 1 to October 15); Section 10b2 requires reporting of "extraordinary impingement events," which are defined as "an event when 50 or more fish at any one time, of any size or species, are either distressed or killed as a result of impingement"; Section 10c requires clupeid ichthyoplankton pump entrainment monitoring from June 15 to July 15 when significant numbers of upstream migrating clupeids pass Hooksett Dam.*

9/30/1997 – PSNH to USFWS – Extraordinary impingement event at Merrimack Station

10/3/1997 – PSNH to NHF&G - Extraordinary impingement event at Merrimack Station

10/7/1997 – PSNH to NHF&G - Extraordinary impingement event at Merrimack Station

11/4/1997 – PSNH to NHF&G - Extraordinary impingement event at Merrimack Station

3/19/98 – PSNH to USEPA – Annual Fish Impingement Report (1997)

3/2/99 – PSNH to USEPA – Annual Fish Impingement Report (1998)

3/13/00 – PSNH to USEPA – Annual Fish Impingement Report (1999)

11/30/2001 – PSNH to USEPA – Annual Fish Impingement Report (2000)

12/20/02 – PSNH to USEPA – Annual Fish Impingement Report (2001)

12/18/03 – PSNH to USEPA- Annual Fish Impingement Report (2002)

12/27/2004 – PSNH to USEPA – Annual Fish Impingement Report (2003)

12/30/2004 –USEPA to PSNH: Section 308 letter describing §316(b) supplemental information requirements under Phase II Regulations.

APPENDIX 2

Merrimack Station Quality Assurance Plan
and
Standard Operating Procedures for Impingement Monitoring

April 2005

Merrimack Station Quality Assurance Plan and Standard Operating Procedures for Impingement Monitoring

Revision 0
April 2005

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1.0 INTRODUCTION

Public Service Company of New Hampshire ("PSNH") owns and operates two separate generating units, Unit 1 and Unit 2 (collectively, the "Units"), known as "Merrimack Station" in Bow, New Hampshire. The Units are located on the west bank of the Merrimack River ("River") adjacent to Hooksett Pool, approximately 2.9 miles upstream from the Hooksett Dam and Hydroelectric Station and about 2.9 miles downstream from the Garvins Falls Dam. The primary activity of each of these Units is the generation of electric power. Unit 1, which became operational in 1960, generates at a rated capacity of 120 MW, and withdraws once-through cooling water from the waters of the United States (i.e., the River) using a cooling water intake structure ("CWIS") located in a bulkhead at the shoreline of Hooksett Pool. Unit 2, which became operational in 1968, generates at a rated capacity of 350 MW, and withdraws once-through cooling water from the River using a separate CWIS located in a bulkhead approximately 120 feet downstream from the Unit 1 CWIS.

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 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.

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 2 of the PIC that PSNH is submitting to the United States Environmental Protection Agency ("USEPA") (Normandeau 2005). They detail Normandeau's methods for completing the 2005 impingement study at Merrimack Station.

2.0 IMPINGEMENT FIELD STANDARD OPERATING PROCEDURES

2.1 COOLING WATER INTAKE STRUCTURE DESCRIPTION

A separate CWIS supplies River water to each generating Unit at Merrimack Station. The north (Unit 1) CWIS is located on the west bank of Hooksett Pool at latitude 43°08'04" and longitude 71°28'04". The south (Unit 2) CWIS is also located on the west bank of Hooksett Pool approximately 120 feet downstream from the Unit 1 CWIS, at latitude 43°08'30" and longitude 71°28'02". The north (Unit 1) CWIS has two intake pumps, and the south (Unit 2) CWIS also has two intake pumps; however, the intake pumps at Unit 2 are larger than the intake pumps at Unit 1. Each Unit's CWIS has two vertical single entry/exit traveling screens (described below), one servicing each circulating water pump and providing a basic debris and fish handling and return system. A partition wall below the deck inside each CWIS divides the CWIS into two discrete forebays, separating the flow to each pump before it passes through the associated traveling screen. Each forebay opening to the River is covered with a bar rack with a 3-inch clear space (3.5 inch on-center spacing). The bar racks for each unit are located at the outer edge of the CWIS structure, and are inclined inward at an angle of about 9° from the floor of the forebay. Water from the two pumps at each unit merges into a common pipe at a Y-junction within the pump house a short distance past the pumps.

2.1.1 Unit 1 (North)

The floor of the Unit 1 intake forebay is at elevation 177 feet, and the associated bar racks rise upward from that point at an inward angle of about 9° to an elevation of 190 feet (which is the full pond elevation of Hooksett Pool). The Unit 1 concrete bulkhead wall extends upward from the top of the bar racks at the same angle to a deck elevation of 207 feet. A concrete debris barrier wall is located five feet outboard from the base of the bar racks and extends the floor of Unit 1 upward by five feet to a point that is at elevation 181 feet, or one foot above the river bottom at elevation 180 feet. There is a five-foot opening in the barrier wall between elevations 181 feet and 186 feet through which the cooling water intake flow passes. The outer bulkhead wall then extends upward at the same angle to the deck elevation of 207 feet. Therefore, the Unit 1 CWIS withdraws water from a horizontal slot in the outer bulkhead that is five feet wide and located between elevations 181 feet and 186 feet, i.e., about three feet to eight feet below the Hooksett Pool full pond elevation.

Each of the two traveling screens at Unit 1 is a FMC Model 45A LinkBelt screen with standard 3/8-inch (0.375-inch) square opening steel mesh panels. Screen A at Unit 1 is at the south (downstream) side of the Unit 1 CWIS, and Screen B at Unit 1 is at the north (upstream) side of the Unit 1 CWIS (Figure 1). The traveling screens rotate periodically when the debris load is light and continuously when the debris load is heavy. Each screen has a single-pressure spray header to wash fish and debris into a trough in the floor of the CWIS deck for return to the river. The trough servicing the two Unit 1 traveling screens carries the fish, debris and wash water from the Unit 1 CWIS into an 18-inch-diameter corrugated steel pipe that runs southward for about 250 feet to a discharge point at the river bank that is about 100 feet south (downstream) of the Unit 2 CWIS. When Hooksett Pool is at a full pond elevation of 190 feet, the discharge location for the common debris and fish sluice from Unit 1 is approximately four feet from the edge of the River.

2.1.2 Unit 2 (South)

The floor of the Unit 2 intake forebay is at elevation 176 feet, and the associated bar racks rise to the full pond elevation for Hooksett Pool of 190 feet at an inward angle of about 9°. The Unit 2 concrete bulkhead wall extends upward from that point to an elevation of 207 feet. A concrete debris barrier wall is located eight feet outboard from the base of the bar racks and extends the floor of Unit 2 upward by five feet to a point that is at elevation 181 feet, or one foot above the river bottom at elevation 180 feet. Unlike Unit 1, there is no upper portion of the outer concrete barrier wall at Unit 2. Therefore, the Unit 2 CWIS withdraws water from nearly the entire water column between an elevation of 181 feet (or one foot above the River bottom) and the full pond surface elevation of Hooksett Pool of 190 feet

Each of the two traveling screen at Unit 2 is a Rex Chain Belt two-post screen with standard 3/8-inch (0.375-inch) square opening steel mesh panels. Screen A at Unit 2 is at the south (downstream) side of the Unit 2 CWIS, and Screen B at Unit 2 is at the north (upstream) side of the Unit 2 CWIS (Figure

1). The traveling screens rotate periodically when the debris load is light and continuously when the debris load is heavy. Each screen has a single-pressure spray header to wash fish and debris into a trough for return to the river. The trough servicing the two Unit 2 traveling screens carries the fish, debris, and wash water from the Unit 2 CWIS into an 18-inch smooth steel pipe that joins the Unit 1 wash water pipe at a point about 25 feet south of the Unit 2 CWIS; the fish, debris and wash water continue downstream in a common 18-inch-diameter corrugated steel pipe that runs southward for about 225 feet to a discharge point at the river bank that is about 100 feet south (downstream) of the Unit 2 CWIS. When Hooksett Pool is at a full pond elevation of 190 feet, the discharge location for the common debris and fish sluice is approximately four feet from the edge of the River.

2.2 SAMPLING SCHEDULE AND LOCATION

The study year will be divided into two periods: a peak period and an off-peak period. Weekly impingement sampling will be conducted during the peak period beginning in mid-March and continuing through October. Biweekly impingement sampling will be conducted during the off-peak period of November through mid-March. Weekly impingement sampling will consist of collecting one 24-hour sample followed by one six-day sample, and biweekly sampling will consist of collecting one 24-hour sample followed by one thirteen-day (biweekly) sample. This design will provide 33 twenty-four-hour samples and 32 six-day samples representative of the peak impingement period, and nine 24-hour samples and nine thirteen-day samples representative of impingement during the remaining portion of the year. The 24-hour impingement samples are considered the primary sampling units, and "long interval" samples of six or thirteen days are considered secondary sampling units.

2.3 EQUIPMENT

Impingement sampling at Merrimack Station will be conducted by placing a basket in the fish and debris return pipe at each unit, Unit 1 and Unit 2, to catch all of the fish and debris washed off of the operating traveling screens before it flows into the river. The basket mesh will be of the same construction as the mesh on the traveling screens, with openings no larger than the openings in the mesh of the traveling screens. The baskets will be placed in sampling position and removed using a davit and chainfall that is installed by PSNH specifically for impingement sampling.

The following additional equipment is required for impingement field sampling:

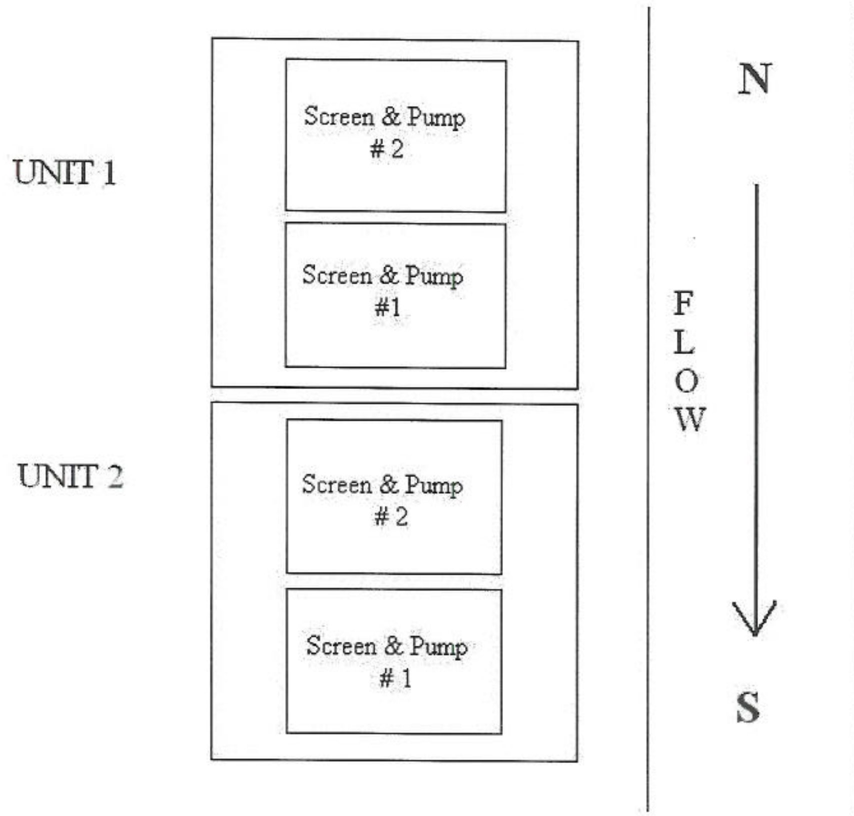


Figure 1. Orientation of the traveling screens and associated pumps at Units 1 and 2 of Merrimack Station, Bow NH.

- copy of SOP and copy of Health & Safety Plan
- data sheets, clipboard, and pencils,
- buckets, plastic bags, and ties,
- labels and waterproof markers,
- net mending kit,
- scale and tape measure,
- temperature/conductivity meter,
- dissolved oxygen meter,
- hard hats,
- gloves,
- hand tools to aid in sorting through debris,
- first aid kit,
- measuring board,
- quality control log,
- appropriate clothing, footwear, and personal protective equipment as specified in the Health & Safety Plan.

2.4 SAMPLING PROCEDURES

2.4.1 Initial Screen Wash

Prior to the collection of the first sample in this year-long program, the traveling screens, debris deflector shields, and debris sluice at each Unit will be thoroughly cleaned and washed to remove all debris and organisms. The pre-wash procedures described in Section 2.4.2.1 below will be followed for this initial screen wash, with the exception that all material removed during this initial cleaning will be discarded according to plant procedures.

2.4.2 Impingement Sample Collection (24-Hour Samples)

2.4.2.1 Pre-Wash

At the start of each 24-hour impingement sampling period, all operable traveling screens at each Unit will be pre-washed to begin the sampling period. The traveling screens will be washed at each Unit proceeding in a direction from north to south. Pre-washing means that each traveling screen is rotated for at least one complete revolution to clean the accumulated debris and organisms from the screen, deflector, and trough. Following the pre-wash rotation, the access door at the side of each screen will be opened and a long-handled rake or hoe will be use to remove any remaining debris, vegetation, and fish that may have not been washed out of the trough or off-of the screen wash deflector. The collection baskets will be installed; and the traveling screens will be allowed to rotate as needed during the 24-hour sample period.

2.4.2.2 Collecting the 24-Hour Impingement Sample

After the initial basket installation and set-up are completed, Normandeau personnel will return at the conclusion of the 24-hour impingement sampling period (± 1 hour). The termination of each 24-hour impingement collection will consist of returning to the Unit 1 and Unit 2 CWISs approximately 24 hours (± 1 hour) after the pre-wash date and time to rotate all operational traveling screens in a north to south sequence again for one complete revolution to wash all accumulated fish and debris into the baskets. Once again, the access door at the side of each screen will be opened and a long-handled rake or hoe will be use to remove any remaining debris, vegetation, and fish that may have not been washed out of the trough or off-of the screen wash deflector. This material will be washed into the collection basket for each Unit and will contain the fish impinged during the preceding 24-hour sample. The contents of the impingement basket for each Unit will then be retrieved and a separate sample from each CWIS (Unit 1 and Unit 2) will be processed. Under no circumstances will the contents of the impingement sample from Unit 1 be combined with the contents of the impingement sample from Unit 2. The elapsed time between setting and retrieving the collection device will be recorded to the nearest minute as the impingement sample duration for the sample from each Unit.

All fish in the 24-hour impingement sample from each Unit will be identified to lowest distinguishable taxon (generally species), counted, and measured to the nearest 1-mm total length (TL). Subsampling for lengths may be necessary for samples where large numbers of fishes are impinged, using a quota of 50 randomly selected individuals per species. The following information will be recorded separately for impingement samples from the Unit 1 and Unit 2 pump houses: fish species composition and abundance, the predominant type and amount (gallons) of debris, and the number of circulating water pumps and screens operating.

2.4.2.3 Long-Interval (6-Day) Samples

The sampling basket for each Unit will be placed back into service following each 24-hour sample and allowed to sample unattended during the ensuing six-day or thirteen-day period to collect the "long interval" sample for each Unit. The contents of each "long interval" sample will be processed in the same way as described in the preceding subsection for the 24-hour samples, with the exception that only four migratory species will be enumerated (Atlantic salmon, American shad, river herring [alewife], and American eel). These "long interval" samples have the advantage of increasing the probability of detecting the key migratory fish species if impinged. However, "long interval" samples have uncertainty associated with the volume of water they represent because they sample for long periods unattended. The contents of "long interval" samples may overflow during periods of high debris loading or may be lost due to decomposition in warm weather or due to scavengers. The "long-interval" samples will be regarded as supplementary samples to the 24-hour samples, and they will not be tended between the start and end. If there are any indications that overflow or decomposition occurred in one of the "long-interval samples," than the sample will not be treated as a valid (Use Code = 1) sample, but instead will be classified as either a Use Code = 2 or Use Code = 5 sample depending on whether any of the four migratory species were collected (see Section 2.4.3 below for a description of Use Codes).

2.4.2.4 24-Hour Samples Collected During Periods of High Debris Loads

During the periods of high debris loading, the sampling baskets for each Unit will be tended by Normandeau staff who will remain on-site for the complete 24-hour sampling interval. During these sampling periods with 24-hour coverage, the baskets will be emptied as often as necessary to prevent overflowing, and the contents will be accumulated to represent one 24-hour period for each Unit.

2.4.3 Use Code

Each impingement sample collected will be assigned a Use Code (1, 2, or 5) that defines its use in analytical tasks. Use Code 1 samples will be impingement collections from which valid data were collected and no sampling problems were encountered. Use Code 1 impingement samples can be used for all analytical tasks. Use Code 2 samples will be collections in which fish were captured, but sampling problems were encountered. Use Code 2 samples will be excluded from calculations involving catch per unit of effort and length-frequency distribution, but in the case of the long-interval samples, would be useful for reporting the presence or absence and relative abundance of key migratory fish species. Use Code 5 samples will be Use Code 2 samples where no fish are caught. Use Code 5 samples will be excluded from all analysis.

2.4.4 Environmental Parameters

2.4.4.1 Specifications

The following environmental parameters will be observed and recorded at one of the pump houses at both the start and end of each 24-hour collection: mid-depth water temperature, dissolved oxygen concentration, conductivity, and river surface conditions (wind direction and velocity, water level, cloud cover, and precipitation).

2.4.4.2 Deployment

Water quality measurements will be taken at both the start and end of each 24-hour collection. Temperature, conductivity, and dissolved oxygen (nearest 0.1 mg/L) will be measured with a YSI model 85 dissolved oxygen meter. Air temperature (nearest 1.0°C) will be measured with an armored mercury thermometer.

Table 2-1 presents the saturation concentrations of DO in water at various water temperatures. Any DO concentrations that are greater than the saturation levels at a given temperature are suspect. If DO readings are above saturation, all connections on the meter should be checked, the membrane checked for contamination and bubbles, and the reading retaken. If the reading is still above saturation note any pertinent environmental conditions that may cause supersaturation such as excessive water turbulence below a dam and record these observations in the COMMENTS section.

2.4.4.3 YSI Model 85 Dissolved Oxygen Meter Maintenance and Calibration

Batteries will be recharged or replaced every six months or when the **LO BATT** appears on the LCD display. The instrument batteries are six "AA" size cells located inside the instrument. The probe's electrolyte fluid and membrane will be replaced at two-week intervals or when a bubble appears in the electrolyte.

Calibration checks of the dissolved oxygen meter will be performed at the beginning of a sampling day to maintain a field check on instrument performance and data quality. Calibration checks of the dissolved oxygen measurement system will be performed using water-saturated air. These checks will be performed in the following manner and documented in an instrument calibration log:

- Inspect the probe to ensure that there are no air bubbles under the membrane and that it is not fouled.
- If air bubbles or fouling are observed, replace the membrane following procedures in the owner's manual.
- Ensure that the sponge inside the instrument's calibration chamber is wet and the probe is blotted dry.
- Insert the probe into the calibration chamber.
- Turn the instrument on by pressing the **ON/OFF** button on the front of the instrument.
- Press the **MODE** button until the dissolved oxygen is displayed in mg/L or %.

Table 2-1. 100% saturation level of oxygen in water exposed to water saturated air at 1.0 atmospheric pressure and 0.0 ppt chlorinity.

WATER TEMPERATURE (°C)	DISSOLVED OXYGEN (mg/l)
0	14.6
2	13.8
4	13.1
6	12.4
8	11.8
10	11.3
11	11.0
12	10.8
13	10.5
14	10.3
15	10.1
16	9.9
17	9.7
18	9.5
19	9.3
20	9.1
22	8.7
24	8.4
26	8.1
28	7.8
30	7.6

- Wait for the dissolved oxygen and temperature readings to stabilize (usually 15 minutes is required).
- Use two fingers to press and release the **UP ARROW** and **DOWN ARROW** buttons at the same time once.
- 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 indicates 1200 feet.
- The Model 85 should now display **CAL** in the lower left of the display, the calibration should be displayed in the lower right of the display and the actual % should be on the main display.
- Press the **ENTER** button and the display should read **SAVE** then should return to the Normal Operation Mode.

All calibrations should be completed at a temperature that is as close as possible to the sample temperature.

2.4.5 Impingement Sample Processing

2.4.5.1 Measurements and Conditions

All impinged fish in the sample will be identified to lowest distinguishable taxon (generally species), counted, and measured. Total length (nearest mm) will be recorded for each fish species (up to a maximum of 50 individuals per 24-hour collection period). The entire sample of each species will be weighed, and this species-specific wet weight will be recorded to the nearest gram. The condition (live, injured, or dead) for each individual measured wil be determined, andthe data will be recorded in the appropriate spaces provided in the Impingement Count Data Sheet.

2.4.5.2 Fish Requiring Special Handling

Any Atlantic salmon captured alive will be processed immediately. Salmon will be examined for tags, and each specimen will be measured (total length) and weighed, handling it with care, and re-turned to the water alive if possible (whether tagged or not), away from the intake. Any dead salmon will be frozen and saved.

2.4.5.3 Fish for Collection Efficiency Studies

After analysis , fish that will be needed for the next collection efficiency study will be bagged. From the species making up at least 10% of the month's total collection, at least 100 fish will be needed for each release. The fish will be marked and frozen.

2.4.5.4 Debris Processing

The amount of biological and other debris will be estimated to the nearest gallon for each 24-hour period. The volume and the dominant debris type will be recorded on the Impingement Field Data Sheet.

2.4.6 Collection Efficiency Studies

Impingement collection efficiency will 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 device (Schedule, Appendix B). "Long interval" samples will not be adjusted for collection efficiency. 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 a randomly selected operating intake screen at each Unit (100 fish per release lot at Unit 1 and 100 fish per re-lease lot at Unit 2). Each lot of marked fish will be introduced in a stream of water through a 4-in. PVC pipe with the outlet held in front of the ascending face of an operating traveling screen near the river surface. 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 collec-tion device at the end of the sampling period, divided by the number released, represents the im-pingement collection efficiency for that period. These impingement collection efficiency factors will be applied to other 24-hour impingement collections from each one-month period centered on the date of the collection efficiency test. For example, if collection efficiency tests were performed during the Monday – Tuesday 24-hour samples taken at each Unit during weeks 27 and 31, then the results from the week 27 test will be applied to any 24-hour collections taken within the period 15 days before or 15 days after Monday date for week 27, and the results from the week 31 test will be applied to any 24-hour collections taken within the period 15 days before or 15 days after Monday date for week 31. Collection efficiency adjustments will not be applied to the "long interval" samples.

2.4.7 Impingement Survival

Impingement survival studies will be performed monthly at Unit 1 and Unit 2 to simulate operating the existing traveling screens in a continuously rotating mode with a continuous feed of screen wash water (Schedule, Appendix B). This proposed simulation is intended to determine how much improvement in survival can be derived by changes in the screen wash procedures and fish return system.

Impingement mortality will be determined by collection of fish off of continuously rotated and washed screens from each unit at Merrimack Station during one four hour period per month. Impinged fish will be collected by diverting the screen wash water flow into a collection and holding tank located at the downstream end of each intake facility. The collection facility will be staffed continuously during each four-hour collection period, and once per hour all fish collected will be separated from the debris, gently removed and placed into separate predator and prey holding tanks, and classified as alive, stunned, or dead. All alive or stunned fish will be held to determine latent (24-hour) mortality. Collections of ambient fish at each unit will also be supplemented, if needed, by introduction of lots of 200 marked bait fish (100 each at Units 1 and 2) obtained from local bait dealers to insure an adequate sample size for initial and latent mortality statistics. Prior to placement in holding tanks, the number of individuals in each of four survival classes will be determined and recorded on the Survival Study Count Sheet.

An additional 100 control fish will be marked and introduced directly into the collection tank at the mid-point of one collection interval at one randomly-selected Unit and handled in the same manner as impinged fish to quantify handling mortality and separate it from impingement mortality.

Fish to be held for survival studies will be separated into predator and prey holding tanks for each unit. Various size tanks may be used depending on the number of fish to be tested per category. To prevent overcrowding, add fish to the holding tanks according to the following limits.

Fish – Size Range (mmtl)	# of Fish/Minimum Tank Volume
< 50	75/5 gallons
50-75	20/5 gallons
76-150	3/5 gallons
151-225	2/10 gallons
> 225	1/10 gallons

The condition of captured fish will be categorized according to the following four criteria: alive with no visible external injury; alive with obvious external injury (stunned); dead with no visible external injury; and dead with obvious external injury. Alive with no visible external injury is defined as fish that are actively swimming in an upright position with strong opercular movement. Alive with obvious external injury is defined as fish that are stunned with visible external physical damage, weak swimming ability, inability to remain upright, and weak opercular movement. Twenty-four hours (+/- 1 hour) after placement in holding tanks all fish will be removed, identified to species, measured for total length, and classified into one of the four survival categories. This data will be recorded on the Impingement Survival Length Measurement Data Sheet.

2.5 SAMPLE HANDLING

When processing of a sample is complete, the disposition of the sample (whether to discard it or subject it to QC procedures) will be determined by checking the updated logs regarding QC needs. After any fish requiring special handling, fish for collection efficiency testing, and any fish needed for the reference collection or needing verification have been removed from the sample, the sample (organisms and debris) will be discarded. Any fish that cannot be positively identified to species based on field examination (i.e. young of the year sunfishes) will be saved for examination in the laboratory. Fish saved will be frozen. Preservation with formalin is not required for impingement samples except for voucher specimens.

2.6 DATA HANDLING

2.6.1 Data Sheets and Coding Instructions

2.6.1.1 Impingement Field Data Sheet

A unique sample number will be assigned to each impingement collection or survival study at one of the two units. The sample identification and type, plant operation data, collection times, water quality data, environmental parameter data, and debris data on the Impingement Field Data Sheet (Appendix A) will be recorded according to the instructions below. The space for comments at the bottom of the data sheet should be to explain any problems or unusual circumstances. A separate data sheet will be used for each 24-hour diel period.

In the unusual event that subsampling needs to be conducted due to high detrital loads (Section 2.3.3), a separate data sheet will be used for each 5-minute subsample. Plant operating data and water quality data will be recorded on only the first subsample data sheet, but record collection times and debris data will be recorded for every subsample.

VARIABLE	INSTRUCTIONS
Year	Record current calendar year
Task Code	Enter the task code (Sample type) 1 = 24 hr. Impingement Sample 2 = 6 day Impingement Sample 3 = 13 day Impingement Sample 4 = Survival Study

VARIABLE	INSTRUCTIONS
Sample	Enter current sample # (Using different sample numbers for the two units)
Unit	Enter the code indicating the Unit from which the data was collected 1 = Unit One 2 = Unit Two
Use Code	Enter code for status of sample: 1 = data collected, no sampling problems 2 = fish were collected, sampling problems occurred 5 = no fish collected, sampling problems occurred
Comments	If comments are written at the bottom of the data sheet, enter 1; if not, leave it blank
Screen	Precoded 1-2 to identify individual screens, numbered from south to north
Mode	For each screen, enter the code for its screenwash mode at the start of a 24-hr sample: 0 = off 1 = continuous wash 2 = intermittent wash
Prewash	For each screen, enter the code for its prewash status at the start of a 24-hr sample: 0 = not prewashed 1 = prewashed (a screen was prewashed if it was in continuous wash mode for at least 30 minutes)
Pump	Precoded 1 and 2 to identify individual circulating water pumps, two at Unit 1 and two at Unit 2
On?	For each circulating water pump, enter the code for its operational status at the start of a 24-hr sample: 0 = off 1 = on
Start Month	Record the month that 24-hr collection began
Start Day	Record the day that 24-hr collection began
End Month	Record the month that 24-hr collection ended
End Day	Record the month that 24-hr collection ended
Start Hour	Record the hour that the sample (or a subsample) began, using 24-hr clock (0000-2359 hrs)
Start Min	Record the minute that the sample (or a subsample) began, using 24-hr clock (0000-2359 hrs)
End Hour	Record the hour that the sample (or a subsample) ended, using 24-hr

VARIABLE	INSTRUCTIONS
	clock (0000-2359 hrs)
End Min	Record the minute that the sample (or a subsample) ended, using 24-hr clock (0000-2359 hrs)
Start Temp.	Record the temperature to the nearest 0.1°C, at the start of 24 hr.
End Temp.	Record the temperature to the nearest 0.1°C, at the end of 24 hr.
Start Cond.	Record the conductivity in micro mhos, at the start of 24 hr.
End Cond	Record the conductivity in micro mhos, at the end of 24 hr.
Start D.O.	Record the dissolved oxygen concentration to the nearest 0.1 mg/l (ppm), at the start of 24 hr.
End D.O.	Record the dissolved oxygen concentration to the nearest 0.1 mg/l (ppm), at the end of 24 hr.
Start Air Temp	Record air temperature (°C) at start of 24 hr. period
End Air Temp	Record air temperature (°C) at end of 24 hr. period
Start Cloud Cover	Record the cloud cover at the start of the 24 hr. period 0 = 1-9% 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%
End Cloud Cover	Record the cloud cover at the end of the 24 hr. period 0 = 1-9% 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 the 24 hr. period

VARIABLE	INSTRUCTIONS
	0 = None 1 = Light Rain 2 = Heavy Rain 3 = Snow
End Precip.	Record the precipitation at the end of the 24 hr. period 0 = None 1 = Light Rain 2 = Heavy Rain 3 = Snow
Start Wind Dir.	Record the wind direction at the start of the 24 hr. period 0 = No Wind 1 = North 2 = South 3 = East 4 = West
End Wind Dir.	Record the wind direction at the end of the 24 hr. period 0 = No Wind 1 = North 2 = South 3 = East 4 = West
Start Wind Speed	Record the wind speed (MPH) at the start of the 24 hr. period 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 the 24 hr. period 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
Start Hooksett Pool Water Level	Record water level at the start of the 24 hr. period
End Hooksett Pool Water	Record the water level at the end of the 24 hr. period

VARIABLE	INSTRUCTIONS
Level	
Debris Gal.	Record the estimated volume of debris in the sample (or subsample) to the nearest gallon (no decimal). If less than 1 gallon, record as 1 gallon. If none, record as zero.
% of Each Debris Type	Record the dominant type of debris in sample 1 = Aquatic Vegetation 2 = Terrestrial Vegetation 3 = Trash 4 = Other

2.6.1.2 Impingement Count Data Sheet

The counts and total weights will be recorded by species on the Impingement Count Data Sheet (Appendix A) according to the following instructions. A new data sheet will be used for each sample. The sample number at the top of the data sheet must correspond to the correct sample number on the Impingement Field Data Sheet (Section 2.6.1.1).

VARIABLE	INSTRUCTIONS
Year	Record current calendar year
Task Code	Enter the task code (Sample type) 1 = 24 hr. Impingement Sample 2 = 6 day Impingement Sample 3 = 13 day Impingement Sample 4 = Survival Study
Sample	Corresponds to Impingement Field Data Sheet
Unit	
Taxon	Enter Merrimack River taxon code. Enter a code of 33 for any fish taxon without an assigned code, or for any specimens that require subsequent identification or verification.
Weight	Record the total weight to the nearest gram (no decimal). Record the weight as one gram if it is <0.5 g.
Count	Record the total count unless the taxon was subsampled (leave blank for subsampled taxa)
Sub. weight	Leave blank unless the taxon was subsampled. If subsampling was used for counting the taxon, record the combined weight of the organisms in the subsample to the nearest gram (no decimal).
Sub. count	Leave blank unless the taxon was subsampled. If subsampling was used for counting the taxon, record the combined count of the organisms in the subsample.

2.6.1.3 Impingement Length Data Sheet

Measurement and condition data will be recorded for individual fish on the Impingement Length Data Sheet (Appendix A) according to the following instructions. A separate data sheet will be used for each taxon and Unit.

VARIABLE	INSTRUCTIONS
Year	Record current calendar year
Task Code	Enter the task code (Sample type) 1 = 24 hr. Impingement Sample 2 = 6 day Impingement Sample 3 = 13 day Impingement Sample 4 = Survival Study
Sample	Corresponds to Impingement Field Data Sheet
Unit	Enter the code indicating the Unit from which the data was collected 1 = Unit One 2 = Unit Two
Taxon	Enter Merrimack River taxon code
Id	Precoded with sequential fish identification number (1-50 for each length class for the week).
AD	Enter the code for condition: 1 = alive 2 = dead 3 = injured or stunned
Length	Record total length of fish.

2.6.1.4 Impingement Survival Study Count Sheet

The treatment type, species and a count of survival status types will be recorded on the Survival Study Count Sheet (Appendix A) according to the following instructions. A new data sheet will be used for each Unit. The sample number at the top of the data sheet must correspond to the sample number on the Impingement Field Data Sheet (Section 2.6.1.1).

VARIABLE	INSTRUCTIONS
Year	Record current calendar year
Task Code	Precoded 4 for survival study
Sample	Enter current sample # (Using different sample numbers for the two units)
Unit	Enter the code indicating the Unit from which the data was collected 1 = Unit One

VARIABLE	INSTRUCTIONS
	2 = Unit Two
Treatment	Enter the code indicating the study treatment the fish belong to 1 = Ambient (wild Hooksett Pool) fish 2 = Control released fish
Time Status	Enter the code indicating when count took place 1 = initial count at start of 24 hours 2 = count of fish status' after 24 hour time period
Taxon	Enter Merrimack River taxon code. Enter a code of 33 for any fish taxon without an assigned code, or for any specimens that require subsequent identification or verification.
Alive, no external injury	Record tally of fish in this category
Alive, external injury	Record tally of fish in this category
Dead, no external injury	Record tally of fish in this category
Dead, external injury	Record tally of fish in this category

2.6.1.5 Impingement Survival Length Measurement Data Sheet

The treatment type, species fish ID, length and survival status will be recorded on the Impingement Survival Status Data Sheet (Appendix A) according to the following instructions. A new data sheet will be used for each Unit. The sample number at the top of the data sheet must correspond to the sample number on the Impingement Field Data Sheet (Section 2.6.1.1).

VARIABLE	INSTRUCTIONS
Year	Record current calendar year
Task Code	Precoded 4 for survival study
Sample	Enter current sample # (Using different sample numbers for the two units)
Unit	Enter the code indicating the Unit from which the data was collected 1 = Unit One 2 = Unit Two
Treatment	Enter the code indicating the study treatment the fish belong to 1 = Ambient (wild Hooksett Pool) fish 2 = Control released fish
Time Status	Precoded for data collected after 24-hr. hold period
Species	Enter Merrimack River taxon code. Enter a code of 33 for any fish taxon without an assigned code, or for any specimens that require subsequent identification or verification.

VARIABLE	INSTRUCTIONS
Year	Record current calendar year
Task Code	Precoded 4 for survival study
Fish ID	Record a sequential fish identification number
Length	Record total length of the fish
A/D	Record Survival Status of the fish 1 = alive, no external injury 2 = alive, external injury 3 = dead, no external injury 4 = dead, external injury

2.6.2 Storage and Chain of Custody of Data Sheets

All data sheets will be reviewed to ensure that they are completely and correctly filled out. Normandeau staff will be alert to any unusual or unexpected data values. The original data sheets will be transported to the Bedford office.

2.7 QUALITY CONTROL

2.7.1 Tasks Subject to Quality Control

The efficiency of separating fish from debris, as well as all field identifications, counts, weights, and measurements will be subject to quality control (QC) inspection. The following items will be subjected to QC:

- Sorting of fish from debris
- Identification of all species
- Total count by fish species
- Total weight by fish species
- Subsample count by fish species
- Subsample weight by fish species
- Total length of individual fish
- Condition of individual fish

2.7.2 Inspection Plans

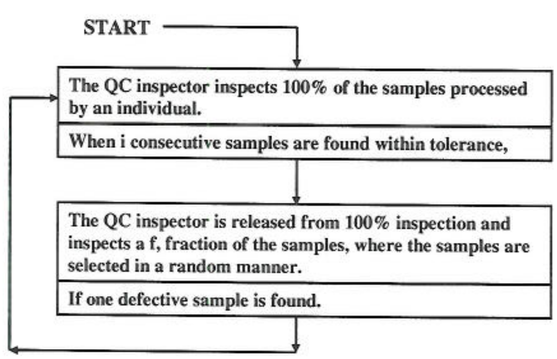
Items will be chosen for inspection using a "CSP-1" QC procedure derived from MIL-STD (military-standard) 1235 (Single and Multiple Level Continuous Sampling Procedures and Tables for Inspection by Attributes) to achieve a 10% Average Outgoing Quality Limit (i.e., ≥90% of samples are within specified quality control tolerance limits). Separate QC inspection plans will be applied for each individual processor within three categories of data: (1) sorting of fish from debris in a sample; (2) identification, counts, and weights by species; and (3) length and condition of individual fish. For sorting, a QC sample will consist of one complete 24-hour sample at one unit. For the count/weight data and the length/condition data, the term "sample" for the purposes of QC inspections will mean

QC sample and is not the same as an entire 24-hour impingement sample. For identification/count data, one QC sample will consist of one line of data on the Impingement Count Data Sheet, including the taxon, total weight, and total count recorded on that line. All data appearing on a line selected as a QC sample for inspection must be within tolerance. If any of those values on the line fails, then that QC sample (data line) will fail. For species subsampled for counting, 100% of the subsample weights and subsample counts will be checked. For length/condition data, a QC sample will consist of the length and associated condition for one fish (both must agree with the QC inspection for that line of data to pass).

The QC sampling plan will be conducted in two modes as described below and illustrated in Figure 2.

- *Mode 1.* Reinspect one hundred percent of the QC samples until "i" consecutive samples pass. (The value of the parameter "i" depends on the anticipated size of the data set, differing among the three types of data, as shown in the table following the description of Mode 2).
- *Mode 2.* After "i" consecutive samples pass QC reinspection, randomly choose (using a random numbers table) the fraction "f" of QC samples for reinspection. (The value of the parameter "f" depends on the anticipated size of the data set, differing among the three types of data, as shown in the table below.) If any QC sample fails during a Mode 2 inspection, then return to Mode 1.

QC inspection plan parameters for Merrimack Station impingement		
QC Plan	**i**	**f**
Sorting	6	1/4
count/weight	7	1/5
length/condition	8	1/7



Procedure for using Quality Control Inspection Plan CSP-1.

Figure 2. The two modes of the QC sampling plan.

2.7.3 Acceptance/Rejection Criteria

A qualified person other than the original processor will conduct quality control reinspections. All QC reinspections will be performed "blindly," i.e., the individual doing the QC reinspection will have no knowledge of the original processor's results. The tolerance for each task will be

- 10% of the total fish count for sorting
- ±10% for count when the QC count ≥20
- ±2 for count when the QC count <20
- ±3% for weight when the QC weight >33 g
- ±1 g for weight when the QC weight ≤33 g
- ±3% for length when the QC length >33 mm
- ±1 g for length when the QC length ≤33 mm
- no difference for condition (must agree)

The percent error will be calculated as

% error = 100% x (original value – QC value)/QC value

For the sorting task, the QC value for this calculation will be the total of the number of fish found by the original processor plus any additional fish found by the QC inspector. A resolution value may be determined for any QC sample found to exceed tolerance. Any person who has made an incorrect identification of his/her error should be advised and provided with help. If any discrepancies between the original value and the QC value exceed the acceptance criteria, the data sheet must reflect the corrected value.

2.7.4 Quality Control Records

All QC checks will be documented in QC logs and made available to any utility representative(s) at his/her request. A separate QC log will be maintained for each task type (sort, count, or length) for each individual processor (Appendix A). For each QC sample selected for reinspection, the following information will be recorded in the log:

a. identity of the QC sample:
   (1) sample number for sorting QC,
   (2) sample number and taxon for count/weight QC, or
   (3) sample number, taxon, and fish identification number for length/condition QC
b. date of QC
c. original count or measurement value
d. QC count or measurement value
e. percent error
f. resolution value (if any)
g. initials of all processors

2.8 REFERENCE COLLECTION

It will be ensured that each fish taxon collected during the Merrimack Station impingement program is represented in the general reference collection at Normandeau's Bedford office. That reference collection will be supplemented as needed by removing specimens from Merrimack Station impingement samples and preserving them in formalin. Each jar will be labeled with external and internal labels containing the scientific name, date of capture, and capture location.

2.9 INSTRUMENT CALIBRATION AND MAINTENANCE

2.9.1 Schedule and Calibration Logs

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 DATA PROCESSING

3.1 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.

3.2 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 3.4).

3.3 DATA FILE FORMAT

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

3.4 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 are 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

4.0 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.

5.0 QUALITY ASSURANCE PLAN

Normandeau's Program Manager is Mr. Richard Simmons. The program Technical Director is Dr. Mark Mattson, who will 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. Drew Trested, who will also contribute as a report author and data analyst. Field crew members include Mr. Michael Jeanneau, Mr. Cory Francis, and Mr. Donald Mason. Normandeau's laboratory fish taxonomist is Mr. Joseph Strube. Normandeau's technical information processing services will be provided by Ms. Holly Carson and her staff.

5.1 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.

5.2 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.

5.3 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.

5.4 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 impingement 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.

5.5 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 PSNH. Operations with Class A or B deficiencies will be subject to reaudit 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

MERRIMACK GENERATING STATION, 2005

Impingement Field Data Sheet

Year [0] Task Code [ ] Sample [ ] Unit [ ] Use Code [ ] Comments [ ]

PLANT OP.

	screen	mode	prewash		pump	on?
South	1			South	1	
North	2			North	2	

SCREENWASH DATE & TIME

	month	day		hour	min
start			start		
end			end		

WATER QUALITY

	Start	End
temp.		
cond.		
D.O.		

ENVIRONMENT

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

DEBRIS

gallons [ ] dominant type [ ]

COMMENTS

CODES

Unit	1=Unit 1; 2=Unit 2
Task Code	1=24hr. Imp Sample; 2=6day Imp. Sample; 3=13 day Imp. Sample; 4= Survival Test
Use Code	1=valid sample; 2=fish collected, problems encountered; 3=no fish collected, problems encountered
Comments	1=yes; blank=no
Mode	0=off; 1=continuous; 2=intermittant
Prewash	0=not prewashed; 1=prewashed
On?	0=off; 1=on
Cloud Cover	0=1-9%; 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%
Precip.	0=None; 1=Light Rain; 2=Heavy Rain; 3=Snow
Wind Dir.	0=No Wind; 1=North; 2=South; 3=East; 4=West
Wind Speed	1=Leaves rustle, wind on face; 2=leaves and twigs in constant mtn, flag waves; 3=raises dust/loose paper, flag in motion; 4=small trees begin to sway; 5=whole trees in motion
Dominant type	1=aquatic veg.; 2=terrestrial veg.; 3=trash; 4=other

MERRIMACK GENERATING STATION, 2005

Impingement Count Data Sheet

Year	Task Code	Sample	Unit
0			

taxon	weight	count	sub. weight	sub. count

MERRIMACK GENERATING STATION, 2005

Impingement Length Data Sheet

AD codes 1 = alive
2 = dead
3 = injured

Year	Task Code	Sample	Unit
0			

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

MERRIMACK GENERATING STATION, 2005

Survival Study Count Sheet

Year	Task Code	Sample	Unit	Treatment	Time Status
0	4				

Treatment: 1= wild fish, 2 = released fish, 3 = control fish
Time Status: 1 = initial count, 2 = latent (24hr.) count

taxon	Alive, no external injury	Alive, external injury	Dead, no external injury	Dead, external injury

MERRIMACK GENERATING STATION, 2005

Impingement Survival Status Data Sheet

Year	Task Code	Sample	Unit	Treatment	Time Status
0	4				2

Treatment: 1= wild fish, 2 = released fish, 3 = control fish

Species	Fish ID	Length (mm)	A/D

Species	Fish ID	Length (mm)	A/D

A/D - 1 = alive, no external injury, 2 = alive, external injury, 3 = dead, no external injury, 4 = dead, external injury

Merrimack Generating Station
Quality Control Log Book

Processor: ____________________ **Task Type: Sort / Count / Length**

Length/Condition QC***								
Count/Weight QC**								
Sort QC*								
Sample Number	**Taxon**	**Fish ID #**	**Date**	**Original Value**	**QC Value**	**% Error**	**Resolution Value**	**QC Initials**

* For a sample sorting QC, fill in Sample # - leave Taxon and Fish ID blank

** For a count or weight QC, fill in Sample # and Taxon and leave Fish ID blank

*** For a length or condition QC, fill in Sample #, Taxon and Fish ID

APPENDIX B

Scheduled Dates for Impingement Sampling

Scheduled sampling dates for the 2005 impingement sampling program at Merrimack Generating Station.

MONTH	S	M	T	W	T	F	S	WEEK
	1	2	3	4	5	6	7	18
	8	9	10	11	12	13	14	19
	15	16	17	18	19	20	21	20
MAY	22	23	24	25	26	27	28	21
2005	29	30	31					22
				1	2	3	4	22
	5	6	7	8	9	10	11	23
	12	13	14	15	16	17	18	24
JUN	19	20	21	22	23	24	25	25
2005	26	27	28	29	30			26
						1	2	26
	3	4	5	6	7	8	9	27
	10	11	12	13	14	15	16	28
	17	18	19	20	21	22	23	29
JUL	24	25	26	27	28	29	30	30
2005	31							31
		1	2	3	4	5	6	31
	7	8	9	10	11	12	13	32
	14	15	16	17	18	19	20	33
AUG	21	22	23	24	25	26	27	34
2005	28	29	30	31				35
					1	2	3	35
	4	5	6	7	8	9	10	36
	11	12	13	14	15	16	17	37
SEP	18	19	20	21	22	23	24	38
2005	25	26	27	28	29	30		39
							1	39
	2	3	4	5	6	7	8	40
	9	10	11	12	13	14	15	41
	16	17	18	19	20	21	22	42
OCT	23	24	25	26	27	28	29	43
2005	30	31						44

MONTH	S	M	T	W	T	F	S	WEEK
			1	2	3	4	5	44
	6	7	8	9	10	11	12	45
	13	14	15	16	17	18	19	46
NOV	20	21	22	23	24	25	26	47
2005	27	28	29	30				48
					1	2	3	48
	4	5	6	7	8	9	10	49
	11	12	13	14	15	16	17	50
DEC	18	19	20	21	22	23	24	51
2005	25	26	27	28	29	30	31	52
	1	2	3	4	5	6	7	1
	8	9	10	11	12	13	14	2
	15	16	17	18	19	20	21	3
JAN	22	23	24	25	26	27	28	4
2006	29	30	31					5
				1	2	3	4	5
	5	6	7	8	9	10	11	6
	12	13	14	15	16	17	18	7
FEB	19	20	21	22	23	24	25	8
2006	26	27	28					9
				1	2	3	4	9
	5	6	7	8	9	10	11	10
	12	13	14	15	16	17	18	11
MAR	19	20	21	22	23	24	25	12
2006	26	27	28	29	30	31		13
							1	13
	2	3	4	5	6	7	8	14
	9	10	11	12	13	14	15	15
	16	17	18	19	20	21	22	16
APR	23	24	25	26	27	28	29	17
2006	30							18

Yellow: Denotes a 24-hr impingement sampling

Green: Denotes a 24-hr impingement sampling and Collection Efficiency Test

Blue: Denotes a 24-hr Survival Study