

**PROPOSAL FOR INFORMATION COLLECTION
TO ADDRESS COMPLIANCE WITH THE CLEAN WATER ACT
§316(b) PHASE II REGULATIONS AT
JAMES A. FITZPATRICK NUCLEAR POWER PLANT
(SPDES PERMIT NO. NY 0020109) LYCOMING, NEW YORK**

Submitted By



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1.0 INTRODUCTION

Entergy Nuclear FitzPatrick, LLC owns and operates the James A. FitzPatrick Nuclear Power Plant (“JAFNPP”). JAFNPP is located on the southeastern shore of Lake Ontario approximately 7 miles (11 km) northeast of the city of Oswego, New York in Lycoming, New York. Lake Ontario is one of the Great Lakes, and the JAFNPP off-shore submerged cooling water intake structure (CWIS) is found in Lake Ontario. The cooling water source is located within the state of New York and considered waters of the United States.

The primary activity of JAFNPP is the generation of electric power. JAFNPP began commercial operation on 28 July 1975, currently generates at a rated capacity of 866 mWe (gross), and withdraws once-through cooling water from an off-shore submerged CWIS. The JAFNPP CWIS has a total design intake flow in excess of 50 million gallons per day (“MGD”) and uses at least 25% of the water withdrawn exclusively for cooling purposes.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 JAFNPP over the next ten years is at a capacity utilization rate in excess of 15%.

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.

In a March 14, 2005 letter to Mr. Michael Rodgers of JAFNPP, Mr. Roy A. Jacobson, Jr. Steam Electric Unit Leader for the New York State Department of Environmental Conservation (“NYSDEC”), requested submission of information about JAFNPP consistent with the Phase II Regulation’s description of a Proposal for Information Collection (“PIC”), including:

- “identifying information previously submitted to the Department,
- need to update existing information, and
- need to collect new information or conduct monitoring studies.”

To the extent that the Phase II Regulations apply to the JAFNPP, this document constitutes the information requested by Mr. Jacobson in his March 14, 2005 letter by format and content of a PIC. This PIC provides general and in some cases specific information regarding the Comprehensive Demonstration Study (CDS):

- Source Water Body Description
- Cooling Water Intake Structure
- Cooling Water Intake System
- Currently Implemented Technologies, Operational and/or Restorative Measures
- Discussion of Appropriate Additional Technologies, Operational and/or Restorative Measures
- Historical Impingement and Entrainment Characterization Studies
- Summary of Relevant Regulatory Consultations
- Proposed Sampling Plans and Quality Assurance Program.

The PIC does not, however, commit JAFNPP to any particular technology, operations, or any other course of action other than the preparation of the Compliance Demonstration Study. JAFNPP reserves its right to supplement or amend this PIC in response to comments from the New York State Department of Environmental Conservation (“NYSDEC”), United States Environmental Protection Agency (“USEPA”), or any other governmental agency, results of the activities proposed in this PIC, or any litigation challenging the Phase II Regulations (including but not limited to 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 and 6NYCRR §704.5). In light of the several pending challenges to federal and state intake structure requirements, JAFNPP must fully reserve its rights to raise any legal or factual argument or challenge, and nothing herein shall be otherwise interpreted to limit those rights.

2.0 SOURCE WATER BODY DESCRIPTION

The source water body type for JAFNPP is a Great Lake for purposes of the Phase II Regulations. JAFNPP is a 700 acre facility located in Lycoming, New York on Nine Mile Point, a slight promontory on the southeastern shore of Lake Ontario adjacent to the Nine Mile Point Nuclear Station (NMPNS). The offshore slope at the plant site is steep (5-10% grade) at the beach, flattening to a 2-3% grade at the 15 foot depth contour, then increasing to a 4% slope lakeward (NMPNS 2004). There is little sediment deposition along the shoreline in the vicinity of JAFNPP, especially in areas where water depth is less than 40 feet (TI 1979). In general, bottom sediments in the nearshore area are composed primarily of bedrock overlain with boulders, cobble, pebbles and coarse sand; finer sediments occur further offshore at the 40 and 60 foot depth contours (TI 1979).

Lake Ontario, the easternmost of the five Great Lakes, is roughly 193 mi (311 km) long and 53 miles (85 km) wide at its maximum dimensions. Although the smallest of the Great Lakes based on volume, Lake Ontario ranks as the twelfth largest lake in the world. Approximately 52% of Lake Ontario’s 7,340 mi² (18,960 km²) of surface area lies within the Province of Ontario, and the remainder is in the state of New York. Lake Ontario is relatively deep, with an average depth of 283 ft (86 m) and a maximum depth of 802 ft (244 m). Lake Ontario has a volume of approximately 390 mi³ (1,626 km³).

Although the bottom topography of Lake Ontario is relatively smooth, there are two distinct sedimentary basins. The Kingston Basin is located in the northeastern end of the lake. The Kingston basin is separated from the deeper main basin by the Duck-Galoo Sill (Figure 2-1). Within the main basin there are three deep sub-basins from west to east: the Niagara, Mississauga, and Rochester basins. These basins are bordered by a shallow inshore zone that extends along the perimeter of the main basin. The differentiation among the three most westerly sub-basins is relatively subtle while the Duck-Galoo Sill provides a pronounced distinction between the Rochester sub-basin and Kingston Basin (Kerr and LeTendre 1991). Kingston Basin is shallower and has unique water quality characteristics compared to the three westerly basins (Flint and Stevens 1989). The JAFNPP intake structure is located 900 feet (274 m) offshore in approximately 24 feet (7.3m) of water in the inshore zone adjacent to the Rochester sub-basin.

The lake’s drainage area of 24,720 mi² (64,030 km²) is dominated by forests (49%) and agriculture (39%). A total of 7% of the basin is urbanized (Stewart et al. 1999). Major urban centers include Hamilton, Toronto, and Rochester. There are approximately 6.6 million people living within the Lake Ontario basin with most of the population concentrated in the western half (including the

Toronto-Hamilton crescent (Stewart et al. 1999)). The New York shore is less urbanized and not as intensively farmed. The Lake Ontario Basin in New York state drains an area of about 3,000 mi² (4288 km²) and is inhabited by approximately 700,000 people (NYSDEC 2000).

Approximately 86% of inflow into Lake Ontario originates from the upper Great Lakes and Lake Erie via the Niagara River (Kerr and LeTendre 1991). The remaining water inflow comes from Lake Ontario basin tributaries and precipitation. The St. Lawrence River is the sole outlet for Lake Ontario and flows northeast in the Gulf of St. Lawrence. Approximately 93 percent of the water in Lake Ontario flows out to the St. Lawrence River; the remaining 7 percent leaves through evaporation. Water retention time is estimated to be approximately 7 years.

Since 1960, Lake water levels have been regulated by a series of dams and locks in the St. Lawrence River under the authority of the International St. Lawrence River Board of Control (ISLRBC). The current plan regulating Lake Ontario outflows is Plan 1958D, which specifies weekly outflows based on the water level of the Lake and water supplies to the Lake and seeks to balance a number of interests including hydropower, commercial navigation, and shoreline property owners. By managing Lake water elevations, the natural range in water level fluctuations has been reduced to a target range from 243.3 feet to 247.3 feet International Great Lakes Datum (IGLD).

The prevailing west-northwest winds combined with the eastward flow of water from the Niagara River are the most important features on lake circulation. In its simplest form, the largest general circulation of Lake Ontario is counterclockwise with flow to the east along the south shore in a relatively narrow band and somewhat less pronounced flow to the west along the north shore (Pickett and Bermick 1977). Circulation of water generally occurs along the eastern shore and within the sub-basins of the main lake; there is little net flow along the north, inshore zone (Kalinauskas 2004).

However, circulation patterns on a shorter temporal scale observed at any given time are more complex and are affected by transient winds, which can alter currents in a matter of hours (TI 1979). During preoperational studies at JAFNPP, currents off Nine Mile Point were measured from May to October 1969 and July 1970 (Gunwaldson et al. 1970, PASNY 1971). Wind speed frequency data averaged over a 6 hour period indicate that winds exceeding 20 miles per hour (32 km/hr) occurred 21.6% of the time over the year. From June through September, winds in excess of 20 miles per hour occurred 13.9% of the time. At the 19 ft. depth contour, the measured current speed of six-hour duration exceeded with comparable frequency is about 0.2 feet per second (USNRC 1985). The predominant direction of currents was alongshore, as dictated by continuity. On the occasions when onshore or offshore currents were observed, their magnitudes were substantially less than those of alongshore currents. During the summer, alongshore currents from either the west or east were equally frequent about 33% of the time. Onshore and offshore currents each accounted for nearly 5% of the observations; the remaining 30% of the observations were below the flowmeter threshold of 0.5 knots (2.5 cm/sec, 0.09 ft/sec). Lake currents were measured at selected locations in the vicinity of the Oswego Steam Station (about 6 miles west of Nine Mile Point) for 5 days between 12 October and 19 November 1970. These surface current velocities were mostly alongshore, with speeds ranging from less than 0.08 feet per second (2.5 cm/sec.) to 0.50 feet per second (15 cm/sec.).

Two other important examples of wind-induced effects on the general circulation pattern in Lake Ontario are upwelling and internal oscillation of thermocline depth (NMPNS 2004). Upwelling is characterized by the rising of colder, denser, bottom water toward the surface. A variety of theories have been proposed to account for the oscillations, which are a common feature of Lake Ontario

temperature records (USNRC 1985). The most direct explanation is that an upwelling displaces the thermocline from equilibrium by converting the kinetic energy from wind gusts into potential energy that alters the thermocline position. When the wind stress is removed, internal waves are set in motion and contribute to the dissipation of this energy. Internal waves increase in amplitude after storms. In Lake Ontario, approximately three complete oscillations occur every 2 days (USNRC 1985).

Lake Ontario has a seasonally dependent pattern of both horizontal and vertical stratification (Kalinauskas 2004) which alter circulation patterns. Changes in stratification result from atmospheric heat exchange and wind-induced mixing. In the spring, nearshore waters warm up more quickly than deep offshore waters, creating isotherms relatively parallel to shore. As temperatures continue to warm, the lake becomes vertically stratified between the nearshore and offshore zones with little mixing. This thermal stratification lasts until about the middle of June when offshore waters warm and mixing occurs. As summer progresses the Lake experiences a period of horizontal stratification with little mixing between the warm surface waters and cool deeper waters. Summer stratification is characterized by warmer, less dense water at the surface layers and cooler, denser water in the lower layer. Progressive heating develops stable thermal stratification and a well-defined epilimnion (warm surface water layer), mesolimnion (transition mid-depth temperatures), and hypolimnion (cool deep water layer). This thermal stratification in Lake Ontario, generally extends from late June to October of each year, when the epilimnion averages nearly 70°F (21 °C) and the hypolimnion averages approximately 39 °F (3.9 °C) (NMPNS 2004). Mixing of these thermal strata begins as the thermocline breaks down in the fall as surface waters cool. In late fall after overturn has occurred, the lake is essentially isothermal, thereby permitting a free exchange of water from surface to bottom. The Great Lakes mix from top to bottom (overturn) twice yearly, in the spring and in the fall. The timing of the overturn is closely related to the time when the surface water temperatures fluctuate through the temperature of maximum density of fresh water (i.e. 4°C).

Towards the end of winter, the entire water mass cools down to below 4°C, with the coldest water remaining close to the shore. During winter, ice begins to form in the nearshore waters of the Great Lakes in December and January and in the deeper offshore waters in February and March, reaching its greatest extent in late February or early March. Expected maximum ice cover for Lake Ontario is 24 percent (Assel et al. 1983), however during a severe winter maximum ice cover can exceed 90 percent (Assel et al. 1996). During a mild winter, maximum ice cover is usually limited to the nearshore waters (Assel 1985).

Intake water temperature recorded at JAFNPP in 2004 ranged from a minimum of 0.6 °C (33.0°F) in early January to a maximum of 23.7 °C (74.6°F) in early October (Table 2-1, EA 2005). Intake water temperatures begin to rise in mid-March and peak from mid-July through September (Figure 2-2).

Summer and early winter inshore water temperatures have increased significantly in Lake Ontario over the past several decades, paralleling global warming and temperature extremes, particularly those associated the El Nino and La Nina (Casselman 2002). It is expected that future global warming will lead to increasing water temperatures in Lake Ontario and thereby affect fish community dynamics and their habitat (Mills et al. 2003). Global warming's impact on fish species may be either positive or negative depending on species-specific thermal requirements and changes in thermal habitat.

3.0 COOLING WATER INTAKE STRUCTURE DESCRIPTION

3.1 PHYSICAL DESCRIPTION, LOCATION AND DEPTH OF INTAKE STRUCTURE

The CWIS at JAF is a submerged, shore-facing, remote intake with a total design intake flow of 388,600 gallons per minute (gpm). The CWIS is shared primarily by the Circulating Water (CW) and Service Water (SW) systems, and is located about 990 feet from the shoreline of Lake Ontario at coordinates N43°31'37" and E76°23'49". The top of the CWIS is at elevation 232.8 feet, approximately 14 feet beneath the lake surface, which typically varies from elevation 244.0 feet to 248.0 feet. The intake consists of four segmented shore-facing openings, each 22 feet wide and 8 feet high, feeding a 14 foot diameter D-shaped intake tunnel that runs beneath the lake bed approximately 1,150 feet to the offshore screenwell and pumphouse. The base mat of the CWIS is at elevation 222.8 feet, approximately four feet above the lake bottom elevation of 218.8 feet.

Nine acoustical projector housings are symmetrically installed on top of the remote intake structure roof, located at elevation 232.8 feet, to provide for fish deterrence. The projectors are removed for the winter months due to the ice packs possibly defacing the projector faces. The function and effectiveness of this system is discussed in detail in Section 5.1 (below) describing "Currently Implemented Technologies".

3.2 AS-BUILT PLAN AND SECTIONAL VIEWS OF INTAKE STRUCTURE

Refer to Appendix 2, "Drawings with Plan and Sectional Views of Intake Structure". The following JAF plant drawings are included in this Appendix:

- FC-42A, Intake & Discharge Tunnels
- FC-43B, Intake Structure
- FM-7A, Screenwell & Water Treating, Plans & Sections
- FM-7C, Screenwell & Water Treating, Sections

Additional applicable plant drawings are listed in the "Literature Cited" section of this report.

3.3 BAR-RACK DESCRIPTION, DIMENSIONS, OPERATION, AND DEBRIS LOADING

There are two sets of bar racks, an internally heated bar rack at the remote intake, and a trash bar rack in the screenwell of the CWIS. The heated bar rack at the remote offshore intake consists of 3 inch by 2 inch rectangular vertical bars on 12 inch centers across each 22 foot by 8 foot intake opening, a total of 88 bars. The primary purpose for this heated bar rack is the prevention of intake clogging due to frazil ice and/or large debris (a potential NRC safety concern). The bar rack heaters are energized anytime water temperature is $\leq 37^{\circ}\text{F}$ to prevent/remove ice formation. There are no installed systems to remove large debris from these racks with the plant operating, although original plant design provided "reverse flow" capability to backwash the remote intake racks when the plant is not at power. The design water velocity through the bar rack at the remote intake is 1.2 feet per second with all three circulating water pumps operating (fps; TI 1979).

The trash bar rack in the CWIS consists of three 12 foot wide vertical bar racks, one installed in front of each traveling water screen, retaining debris equal to or greater than 3.125 inches. A movable trash rake is used to clear away debris collected on the screenwell trash racks, capable of being

manually traversed to service any of the three racks to remove debris. Permanent instrumentation monitors trash bar rack differential pressure, and Operations manually rakes trash off the racks when high differential pressure, i.e. debris loading, is indicated. If differential pressure is excessively high, >10 inches W.C., an alarm is annunciated in the control room and compensatory actions must be initiated.

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

The traveling water screens are furnished by Jeffrey Manufacturing Company of Columbus, Ohio, in accordance with Purchase Specification APO-36. Three 12 foot wide traveling screens, fabricated from No. 10 gauge 304 stainless steel wire with 3/8 inch clear openings, are situated between the trash racks and the pump intake sluice gates. Each screen has a design capacity of 125,000 gpm, is 12'-0" wide and 43'-4" high, and has a design approach velocity of 1.2 fps. Screen rotation speed ranges from 10 fpm to 20 fpm. The traveling screens retain debris $\geq 3/8$ inches and dump it into a collecting trough. The steel trash trough has flanged ends for each screen section designed so that the flanged ends will mate for bolting when the screens are installed in place to form one continuous pitched trash trough mated to a trough extension. The bottom flange of each panel forms a trash shelf extending the entire width of the panel. The shelf design includes a substantial dredging leaf rake extending the width of each panel at the panel midpoint for refuse removal and is designed for minimum reduction of free area. This rake has tines to engage and raise moss and other lake vegetation. The carrying ledge portion of the lip is able to retain fish and is perforated to drain water. The panels are constructed and so attached to the chain that there is no opening larger than the screen cloth opening for debris to get through at the line of articulation along the sides or bottom when they are stationary or moving.

Two 100% capacity (1 running, 1 standby) screen wash pumps take suction from the SW discharge header to provide backwash spray water for the traveling screens. The spray system utilizes non-clogging, wear resistant deflector type nozzles, designed to project overlapping fan shaped jets of spray water across the width of the screen so that all material picked up on the screen, trash shelf, and the special dredging leaf rake will be jetted off when the panels are ascending. Debris is jetted in a direction opposite the direction of flow of water in the intake channel. The design screen wash pumps spray flow rate is 720 gpm/screen, at a minimum of 80 psi gauge pressure. Water is sprayed on all screens simultaneously from two screen wash headers whenever the traveling screens are rotating.

The traveling screens and screen wash pumps are equipped with an automatic differential level control to limit debris loading and can be operated manually or in automatic mode. When in the automatic mode, the screens and pumps will start when the screen wash pump discharge pressure is > 100 psig, and either of two conditions occur:

1. High screen differential level, ≥ 4 inches W.C., as sensed by level detectors across the screens.
or
2. 10-minute daily exercise timer is initiated.

Design debris loading conditions for the traveling screens correspond to 1.6 inches differential W.C. clean, up to 6 inches differential W.C. fully loaded. The traveling screens will automatically stop if the screen differential level is <2 inches W.C. for 10 minutes. An adjustable timer is included to insure that the screen will run for at least 1-1/3 revolutions after minimum level differential is attained to assure that debris is completely removed and not just lifted out of the water and allowed to dry on

the panels. If any of the screens runs continuously for 30 minutes or if the differential level across the screens reaches 6 inches W.C., an alarm is sounded in the main control room. Per the CW Operating Procedure OP-4, the traveling screens are operated at least once per shift, either in “automatic” mode, or manually in “continuous” mode.

4.0 COOLING WATER INTAKE SYSTEM DESCRIPTION

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

The JAFNPP CWIS contains three vertical, mixed flow, dry pit type circulating water pumps. Each single speed intake pump has a rated 27 feet of total dynamic head (TDH), and a rated flow of 120,000 gallons per minute (GPM). The pump drivers are open, drip-proof, induction motors rated at 1,000 HP. During normal plant operation, all three CW pumps are operating with a combined design circulating water intake flow of 360,000 GPM (5.184×10^8 GPM) measured through the condensers.

4.2 HYDRAULIC ZONE OF INFLUENCE

A mathematical model of the Hydraulic Zone of influence (HZOI) for the cooling water intake structure (CWIS) will be prepared using computational flow dynamics (CFD) software. Using existing electronic intake drawings and topographic information collected for the site, a three-dimensional model of the CWIS and its immediate vicinity will be constructed and used to estimate the HZOI, approach velocities, and appropriate sampling areas, within the entire water column while providing a graphic representation for these estimates when applied under normal or median atmospheric and operational conditions. Early stage development of the CFD model may be used in later stages of the CDS development as an evaluation tool to predict regulatory performance of the CWIS. Evaluation of appropriate operational or technological modifications may utilize this same modeling process for performance comparison and/or cost benefit analysis.

The HZOI for the plant’s CWIS and subsequent biological sampling areas will be determined by

1. Defining a coarse CFD grid using an existing CAD model of the off-shore intake structure
2. Applying reasonable (non-zero) influence boundaries to the CFD problem definition
3. Mapping existing lake bottom topographic information
4. Incorporating available basic bathymetric data and median water level
5. Running the CFD calculation
6. Generating a graphic representation of the results
7. Determining an estimated Hydraulic Zone Of Influence
8. Report the results for use to support biological sampling boundaries.

This report will be prepared and submitted for review by the permitting authority at least 30 calendar days prior to sampling start.

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

Three 50% capacity, vertical wet-pit, 18,000 gpm SW pumps take suction from the same common intake bay as the CW pumps, downstream of the traveling screens. The design SW total flow, with two pumps running and one in standby, is 36,000 gpm.

Water entering the intake and passing through the traveling screens consolidates in a common pre-entry area from which suction is taken for all the CW and SW pumps. The SW pumps support safety related systems within the plant and as such must be available all of the time. Any modification to the intake structure, bar racks and rake, or the traveling water screens must be evaluated and assessed against the design basis monitored and regulated by the NRC.

4.4 ADDITIONAL PUMPS TAKING SUCTION FROM THE COMMON INTAKE BAY

Although the primary intake flows are for the CW and SW systems, there are periodic, minor flows to the Emergency Service Water System, the Fire Protection System, RHR Service Water, and the Makeup Demineralizer System.

4.5 BIOFOULING CONTROL

Biofouling control at JAFNPP is administered by the application of sodium hypochlorite in the service water system and the condenser waterboxes. In both cases, the sodium hypochlorite is injected after the travelling screens. Service water injection occurs continuously not to exceed the SPDES Permit limit of 0.2 ppm TRC as measured in the discharge canal. Waterbox chlorination is limited to less than two hours per day, to less than nine hours total per week, and to daylight hours only to minimize the impact on entrained organisms. Waterbox chlorination also has a SPDES Permit limit of 0.2 ppm TRC as measured in the discharge canal.

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

The baseline cooling water intake capacity is 360,000 GPM, based on the combined design rated flow of the three circulating water pumps.

4.7 IDENTIFICATION OF REDUCTIONS IN RAW WATER INTAKE FROM TEMPERING FLOW (RECIRCULATION)

During periods of cold weather, when inlet water temperature is below approximately 45°F, warm discharge water is recirculated via a tempering gate to obtain proper temperature of the CW and SW inlet water. This flow path delivers some of the water in the discharge tunnel to the intake bay, upstream of the traveling screens. The tempering gate can be controlled from 0%-100% open, and all positions in between, from the main control room. The JAF raw water intake from Lake Ontario is effectively reduced by the amount of recirculation flow during this mode of operation. Based on historical data, the tempering recirculation flow effectively reduces the plant cold water intake at extreme (cold) intake water temperatures.

4.8 CALCULATION OF MONTHLY AND ANNUAL FLOW REDUCTION FROM BASELINE

JAFNPP has compiled more than seven years (January 1998 through July 2005) of monthly actual intake flow data for the CWIS that is representative of the current and expected future CWIS operations (Table 4-1). These intake flow data are representative of operating conditions at the CWIS in that they account for the fact that the actual pumping rate historically has been less than the CWIS's design intake flow. As detailed below, the actual pumping rates have been lower than the design flows because these pumps operate at various head differentials between MHW and the MLW design rating, and because the unit's cooling water needs vary in response to reduced generation and periodic maintenance outages, among other factors. The observed actual average monthly cooling water intake flow for the JAFNPP CWIS during the 2001 through 2004 period of available data was 480.7471 million gallons per day (MGD) (Table 4-1). The design flow baseline intake is calculated comparatively at 518.4000 MGD, resulting in an immediate 7.3% average flow reduction.

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

5.1 CURRENTLY IMPLEMENTED TECHNOLOGIES AND OPERATIONAL MEASURES

The primary technological design feature currently implemented at JAFNPP CWIS to reduce impingement mortality and entrainment is the offshore, submerged, mid-water, shore-facing intake located 900 feet out in Lake Ontario. JAFNPP also operates a state of the art fish deterrence system (FDS) installed at this offshore intake structure that has been proven to be Best Technology Available (BTA) for reducing impingement mortality (Ross et al. 1993, 1996; Dunning and Ross 1998), and accepted as BTA by NYSDEC (letter from P.Kolakowski NYSDEC to D. Dunning NYPA, 1 March 1996). Operation of this fish deterrence system is required as Additional Requirement 9 of JAFNPP's current SPDES No. NY 002 0109 from the first week in April into October of each year. Operational measures currently implemented at the JAFNPP CWIS to reduce impingement mortality and entrainment are intake flow reductions, including those resulting from pump differentials, maintenance outages, and from recirculation of heated condenser flow that is used for tempering the incoming ambient Lake Ontario water during the winter. The average flow reduction for the JAFNPP CWIS over the most recent period of record was 7.3% based on the observed actual average annual intake flow compared to the maximum annual intake design flow.

5.2 PROPOSED TECHNOLOGIES AND OPERATIONAL MEASURES

This Proposal for Information Collection ("PIC") is designed as "a proposal stating what information will be collected to support the Comprehensive Demonstration Study." 69 Fed. Reg. 41634 (July 9, 2004). The document is, however, necessarily iterative to some degree in that the data collected through the sampling plan discussed below may indicate that other alternative technologies, operating procedures, or restoration measures may be suitable for application toward the facility's compliance with section 316(b). Thus, the description of proposed technologies and measures included in this PIC is meant to serve as a frame of reference for the evaluation of the data collection proposed but is not meant either as a commitment to implement specific technologies or measures or as a decision not to pursue other technologies or measures. The decision of what proposed technologies and measures

to implement, if required, will be presented in the final Comprehensive Demonstration Study as supported by the data collected through the PIC.

5.2.1 Impingement

JAFNPP presently operates a state of the art fish deterrence system installed at the offshore intake structure that has been proven to be Best Technology Available (BTA) for reducing impingement mortality and accepted as BTA by NYSDEC (Section 5.1 above). Full operation of this fish deterrence system is required as Additional Requirement 9 of JAFNPP's current SPDES No. NY 002 0109 from the first week in April into October of each year. Unforeseen circumstances preventing full operations in April must be documented in a letter to NYSDEC, and if there is a refueling outage in October, the deterrence system may be winterized (turned off) during September of that year.

JAFNPP asserts that the present intake design, flow reductions, and operation of the FDS meet the impingement mortality standard for the 316(b) Phase II Regulations. As part of the Comprehensive Demonstration Study (CDS), JAFNPP may evaluate the efficacy of other technological options to further reduce impingement mortality at JAFNPP, if warranted, by new or additional information. Examples of technologies may include (1) a fish return system for impingement survival, (2) conservation devices such as fine mesh screens and baskets (3) continuously rotating traveling screen, or (4) a low pressure wash water spray header system.

Under the assumption that impingement abundance is directly proportional to CWIS flow (a fundamental assumption upon which the Phase II Regulations are based), JAFNPP may also consider one or more technological / operational flow reduction methods to further reduce impingement mortality achieved by one or more of the following measures: (1) seasonal flow reductions through modifying refueling outage schedules to occur during periods of high impingement mortality, (2) installation and operation of variable speed intake pumps to potentially reduce intake flows during periods of excess cooling capacity within the existing SPDES permit thermal limits, or (3) increasing the SPDES thermal discharge limits and using proposed operational measures 1 and/or 2 (above) to further reduce impingement mortality.

If appropriate, in accordance with 40 C.F.R. §125.94(a)(5), JAFNPP may estimate whether the costs of these technological and/or operational options will be significantly greater than (a) the Appendix A costs established by USEPA for the facility, 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 additional technologies and / or implementation of modified operational measures). If appropriate, JAFNPP 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).

5.2.2 Entrainment

The construction and offshore location of the JAFNPP CWIS minimizes the impacts to shoreline organisms susceptible to entrainment. The 316(b) Phase II Regulations recognize the difference of location and depth of the CWIS as it relates to both impingement and entrainment potential. Sampling plans provided in Section 8.2 outline the gathering of additional data which will include both near shore and intake collection. Near shore data is intended to quantify baseline conditions as defined in the 316(b) Phase II Regulations. Both sets of data will be evaluated and compared during the CDS

process. JAFNPP is confident that, through the CDS process, the plant will demonstrate compliance with the entrainment standards when compared to baseline criteria.

If warranted, JAFNPP may consider the addition of passive fine-mesh screen to the existing offshore intake with mesh width of 1.75 mm, which is USEPA's selected technology for its cost calculations presented in Appendix A to the final Phase II Regulations (See 69 Fed. Reg. 41671). The USEPA estimated annualized 316(b) compliance costs comprised of annualized capital and operation and maintenance ("O&M") using a USEPA estimated design intake flow (See 69 Fed. Reg. 41646). USEPA did not, however, estimate the total net revenue losses from net construction down-time for JAFNPP.

Under the assumption that entrainment is directly proportional to CWIS flow (a fundamental assumption upon which the Phase II Regulations are based), JAFNPP may also consider one or more flow reductions options as described in Section 5.2.1. Technological and Operational flow reductions for the purpose of reducing entrainment at JAFNPP are the same as described above in Section 5.2.1 for reducing impingement mortality, although they may be implemented in a different period or periods depending on the seasonal occurrence of entrainment.

If appropriate, in accordance with 40 C.F.R. §125.94(a)(5), JAFNPP may estimate whether the costs of these technological / operational options will be significantly greater than (a) the costs considered by USEPA for a like facility in establishing the applicable performance standards, corrected to the extent necessary to account for errors in USEPA's calculation, or (b) the demonstrable benefits of complying with the applicable performance standards (i.e., demonstrable reductions in impingement mortality that would be obtained by installation of such technology / operations). If appropriate, JAFNPP 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).

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

6.1 WATER QUALITY

A long period of habitat loss and water quality degradation followed European colonization of the Lake Ontario watershed (Smith 1995). Initially, water quality deteriorated slowly from the effects of forest clearance, but deterioration accelerated during 1940-1970 because of increasing urban runoff (Schelske 1991). Historic changes in land use and uncontrolled pollutant discharge into the Great Lakes contributed to eutrophication of the entire lake system, characterized by high phosphorus concentrations and high turbidity up to the late 1970s.

Because of its depth and dilution capacity, adverse eutrophication effects have been minimal in Lake Ontario compared with those for parts of Lake Erie. Oxygen saturation is usually above 80% in the hypolimnion during summer and averages over 90% in the epilimnion throughout the year (TI 1979, 1980). There are no persistent lakewide eutrophication problems at this time, although near shore and major tributary impairments have been noted (NYSDEC 2000).

Changes in selected water quality parameters over the last 30 years are shown in Table 6-1. These data were collected at the Nine Mile Point area in 1972 and 1978, at the City of Oswego water intake

located about eight miles southwest of JAFNPP in 1998 and 1999, and at the Monroe County water intake in 2000, approximately 50 miles west of JAFNPP. General reductions in pollutants such as phosphorus and dissolved solids, and in turbidity levels, have been observed over the last 30 years. Water clarity, measured by a Secchi disk, has increased by more than 100% in Lake Ontario during the 1990's (3.1m to 6.7 m, EPA 2005- <http://www.epa.gov/glnpo/monitoring/limnology>).

The largest source of primary nutrients into Lake Ontario is Lake Erie via the Niagara River. Additional phosphorus and nitrogen enter Lake Ontario from runoff from agricultural lands, urban areas, and sewage outflows. With the intent of preventing further pollution and eutrophication of the Great Lakes system from continuing population growth, resource development, and increasing use of water, the United States and Canada signed the Great Lakes Water Quality Agreement (GLWQA) in 1972. Since the implementation of GLWQA, phosphorus levels in the Great Lakes have been significantly reduced (Stevens and Neilson 1987, Millard et al. 2003) as a result of better sewage treatment and land use practices in the watershed, which has shifted Lake Ontario back towards its historical oligotrophic condition (Mills et al. 2003).

Spring open-lake (offshore) total surface phosphorus levels peaked in 1973 at 25 to 30 ug/l and then declined at an average rate of 1.35 ug/l per year between 1973 and 1986 (NYSDEC 2000). By 1986 the 10 ug/l target for open-lake phosphorus had been achieved (GLWQB 1989). Decreases in phosphorus were accompanied by decreases in Lake Ontario algal biomass. Eutrophic conditions of the 1960s and 1970s resulted in explosive growth of *Cladophora*, a green filamentous algae. After the implementation of phosphorus reduction programs in the early 1970s, Lake Ontario *Cladophora* biomass and growth rate decreased 50% between 1972 and 1982 (Painter and Kamaitis 1985). Similar decreases were seen in phytoplankton biomass over the same time period (Gray 1987).

Nitrogen concentrations in Lake Ontario, although not considered as major a cause of eutrophication in the 1960's and 1970's as phosphorus, have been increasing in all the Great Lakes (Williams 1992, Neilson et al. 1995). The causal factors are not well understood, but agricultural runoff and atmospheric deposition are considered the most likely sources (NYSDEC 2000). Lean (1987) concluded that the increase in nitrate was associated with higher loading from the watershed and was not associated with reduced algal demand because the nitrate increase occurred before implementation of phosphorus control. Millard et al. (2003) showed that the rate of nitrate increase paralleled nitrogen fertilizer use in the Great Lakes basin and mirrored the observed Lake Ontario mid-lake increase up to the mid-1980s.

Nutrient concentrations are greatest in early spring, before algal production begins (Williams et al. 1998). During thermal stratification, nutrients such as orthophosphate, nitrate, and silica generally increase from surface to bottom, reflecting uptake by phytoplankton in the photosynthetic zone and perhaps release from bottom sediments (TI 1979).

Because Lake Ontario is the most downstream of the Great Lakes, it is impacted by human activities occurring throughout the Lake Superior, Michigan, Huron, and Erie basins. Persistent, bioaccumulative toxic chemicals (PBTs), which include mirex, PCBs, dioxins, etc., entered Lake Ontario via tributaries and historically were accumulated in the sediments. Concentrations of toxic chemicals in Lake Ontario led the International Joint Commission (IJC) to designate Lake Ontario as the most contaminated of the Great Lakes. Canada and the United States developed the "Lake Ontario Toxics Management Plan" in 1989 to address PBTs through regulation of toxic chemical manufacture and use (NYSDEC 2000). The reductions have been generally attributed to restrictions

placed on the manufacture and use of those chemicals. The downward trend of toxic chemical concentrations has leveled off since the 1980's and may be due, in part, to a sequestering of the chemicals in benthic sediments. Consumption advisories for numerous fish species based on concentrations of PBTs found in fish tissue samples continue to be issued by the NYSDEC (NYSDEC 2000).

Monthly and semimonthly water quality sampling programs conducted in the Nine Mile Point vicinity from 1973 through 1978 included weekly thermal profiles at the 100 foot depth contour (TI 1979). Although many of the parameters analyzed fluctuated monthly and annually, there were no persistent trends (TI 1979). During any given year, there were temporal cycles for many of the parameters, particularly nutrients and water temperatures. Inorganic nitrogen and phosphorus characteristically increased during winter and decreased during summer with a corresponding summer increase in organic nitrogen and organic phosphorus compounds (TI 1979). Data collected from 1973-1978 showed no short term or long term effects from operation of NMPNS or JAFNPP (TI 1979). The Oswego River, west to east longshore currents, and hypolimnetic upwellings of cold, often nutrient rich waters exert the most influence on the physiochemical parameters at Nine Mile Point (TI 1979).

6.2 PLANKTONIC COMMUNITY

Historical phosphorus loadings from wastewater discharge and runoff from urban and agricultural sources contributed to significant eutrophication of Lake Ontario and accompanying algal community during the 1960s-1970s. The increased phytoplankton and zooplankton productivity contributed to increasing turbidity within Lake Ontario during that period. Nutrient loading reductions that were a result of the United States Clean Water Act and the GLWQA have allowed Lake Ontario's plankton community to shift back to a more balanced, oligotrophic state (NYSDEC 2000, Mills et al. 2003). Net productivity has declined by 18% and late summer zooplankton production had been reduced by 50% since the 1970s (NYSDEC 2000). Comparison of lakewide surveys conducted in 1970 (high phosphorus) and 1990 (low phosphorus) showed an increase of oligotrophic over eutrophic phytoplankton species (Vollenweider et al. 1974, Munawar and Munawar 1996, Munawar et al. 2003). Shifts in phytoplankton community structure indicate improvement in Lake Ontario's trophic status and have closely resembled the changes in the available nutrients. Predominant eutrophic species of diatoms and cyanobacteria have either been replaced by oligotrophic species or occur in very low numbers, and the relative abundance of oligotrophic species of diatoms and chrysophytes has increased. Recently invading *Dreissena* spp. mussels have caused a redistribution of a large portion of Lake Ontario's available planktonic nutrients from the water column to the benthic environment and contributed to decreases in turbidity (Mills et al. 2003).

The impact of alewife on the zooplankton species composition since the early 1970s in Lake Ontario has been significant. Intense planktivory by these fish has structured the community toward small species (Mills et al. 2003). Zooplankton are the principal food of juvenile and adult alewife (Mills et al. 1992, Urban and Brandt 1993), and alewife were responsible for > 96% of the predation on zooplankton by Lake Ontario fish as late as 1990 (Rand et al. 1995). Alewife abundance has declined 42% from the early 1980s to the early 1990s (O'Gorman et al. 2000-cited in Mills 2003), and subtle changes were observed in the zooplankton community coincident with this decline (Mills et al. 2003).

6.3 BENTHIC COMMUNITY

One of the most significant changes in the benthic macrofauna of Lake Ontario has been the establishment of two species of *Dreissena*. The exotic zebra mussel (*Dreissna polymorpha*) and quagga mussel (*Dreissena bugensis*) have amplified the effects of reduced nutrient levels by filtering and clarifying the water column throughout Lake Ontario. The zebra mussel was first detected in Lake Ontario in 1989, and by 1991 the quagga mussel was observed co-existing with the zebra mussel (Mills et al. 1993). These mussels had colonized western Lake Ontario and the south shore by 1991-92 and the eastern outlet basin by 1993. South-shore studies between 1992 and 1995 showed that total *Dreissena* biomass had increased and that areas of lake bottom dominated by zebra mussels in 1992 were dominated by quagga mussels in 1995 (Mills et al. 1999). *Dreissna* mussels are capable of colonizing areas from the waters edge to depths beyond 400 feet, zebra mussels are primarily found in water less than 10 feet deep. Quagga mussel density has increased to over 18,800 mussels/ yd² in water 246 feet deep and over 2,000/ yd² in water 425 feet deep (NYSDEC 2003).

After 1994, benthic macroinvertebrate populations declined in many areas of Lake Ontario (Lozano et al. 2001, Dermott 2001). Associated with the dramatic increase in *Dreissena* spp. was a collapse of the larger fingernail clams (*Sphaerium* spp.) likely due to competition with *Dreissena* for food and space. Coincident with the ascent of *Dreissena* spp., numbers of the shallow water amphipod *Gammarus fasciatus* increased, perhaps because they benefited from the structural complexity associated with mussel colonies and energy transfer to the benthos through pseudofecal deposition (Stewart and Haynes 1994, Haynes et al. 1999). Colonization of Lake Ontario by the filter-feeding *Dreissena* spp. has likely decreased crustacean zooplankton production, particularly in nearshore (< 30 m depth) areas if the ecological response is similar to that of Lake Erie, where dreissenid mussels depressed zooplankton production through their impact on pelagic primary production (Johannsson et al. 2000). The nearshore macrobenthos community has undergone further change with the replacement of the gastropod snails *Ammicola* spp. and *Valvata* spp. with the exotic New Zealand mud snail (*Potamopyrgus antipodarum*; Zaranko et al. 1997).

The deepwater scud (*Diporeia*) was historically the dominant benthic invertebrate in most offshore areas of Lake Ontario (Nalepa 1991) representing 60-80% of benthic biomass of Lake Ontario (Johannsson et al. 1985). *Diporeia* is an important prey item for alewife, rainbow smelt, slimy sculpin, young lake trout and lake whitefish (Hoyle et al. 2003). In the Kingston Basin, density of *Diporeia* increased between 1983 and 1989 and reached a seasonal average just over 13,000/m² in 1988 (Mills et al. 2003). After 1990, *Diporeia* density in the Kingston Basin (at depths <35 m) plummeted to < 4/m² by October 1995 and to zero in April 1996 (Dermott 2001). Lozano et al. (2001) also observed a significant decline in *Diporeia* density between 1972 and 1997 at depths of 12-88 m. A zone of low *Diporeia* density (< 4/m²) encompassing a significant portion of the soft sediment habitat in Lake Ontario currently extends to 26 km offshore and as deep as 160 m (Lozano et al. 2001). The diversion of algal production into *Dreissena* tissue and biodeposits may deprive *Diporeia* of food settling from the water column. This reduction of *Diporeia* is expected to have a significant impact on the fish of Lake Ontario that are dependent on these organisms for their growth and survival (Mills et al. 2003).

6.4 HISTORICAL FISH COMMUNITY IN LAKE ONTARIO

The Lake Ontario ecosystem has undergone dramatic change since European colonization, primarily due to human impacts on Lake Ontario and its watershed (Christie 1973, Smith 1995). The native fish community of Lake Ontario comprised a rich forage base that included coregonids (whitefish family) and sculpins. Atlantic salmon (*Salmo salar*), lake trout (*Salvelinus namaycush*), and burbot (*Lota lota*) were the most abundant offshore predators in Lake Ontario. In nearshore waters, warmwater predator species such as yellow perch (*Perca flavescens*), walleye (*Stizostedion vitreum*), northern pike (*Esox lucius*), and lake sturgeon (*Acipenser fulvescens*) were in abundance. Prey species included deepwater ciscoes (*Coregonus* spp.) and sculpins (*Myoxocephalus thompsoni* and *Cottus cognatus*) in offshore areas, and emerald shiner (*Notropis atherinoides*) and spottail shiner (*Notropis hudsonius*) in nearshore areas (Stewart et al. 1999). Coregonids and salmonids constituted the largest components of the fish population in the Great Lakes, which reflected their oligotrophic character (Smith 1995). The earliest records of the Lake Ontario fish community involve the commercial fishery (Baldwin et al. 1979). Historically, the Lake Ontario commercial fishery was based on a variety of species including lake herring, deepwater ciscoes, lake trout, lake whitefish, American eel (*Anguilla rostrata*), walleye, yellow perch, northern pike and bullheads (*Ictalurus* spp.).

Habitat and water quality degradation, overfishing and the introduction of exotic species contributed to the decline of the native fish community (Christie 1973, 1974, Smith 1995). By the 1970's, these impacts culminated in the virtual extinction of large piscivores, the reduction or extinction of other native fishes, and proliferation of exotic species. Atlantic salmon, deepwater sculpins, lake trout, burbot, and coregonids had all disappeared or had seriously declined in abundance. Notable changes to the fish community began over 100 years ago with the arrival of several exotic species (Christie 1973, Smith 1995, Kerr and LeTendre 1991, Stewart et al. 1999). Alewife (*Alosa pseudoharengus*), sea lamprey (*Petromyzon marinus*), and rainbow smelt (*Osmerus mordax*) colonized Lake Ontario most likely via migration through the New York State Canal System. Sea Lampreys established a reproducing population, and their parasitic feeding habits decimated native lake trout fish stocks until the 1970s when control measures were implemented. Alewife and rainbow smelt proliferated in the virtual absence of predators and became overabundant by the 1960s. Eutrophic conditions in Lake Ontario and abundant phytoplankton perpetuated the population growth of both alewife and smelt.

Early efforts to stock the Great Lakes with various species of salmon and trout met with little or no success. Renewed stocking efforts began in the 1960's in an attempt to control nuisance levels of alewife and quickly became focused on developing a recreational fishing industry. In the early 1970's, New York State and the Province of Ontario began to establish recreational fisheries and rehabilitate lake trout by accelerating the introductions of lake trout, brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*Oncorhynchus kisutch*) and Atlantic salmon. The introductions initially failed to establish fisheries due to high parasitic lamprey induced mortality (Pearce et al. 1980). In the early 1980s sea lamprey were effectively controlled (Christie and Kolenosky 1980) and the survival of stocked salmonids improved. Hatchery programs in both New York and Ontario were expanded and the number of salmonids stocked rapidly increased during the 1970's and 1980's (Stewart and Schaner 2002).

In the following years, activity in the recreational fishery greatly expanded. Total annual expenditures by anglers in Lake Ontario's recreational fisheries were \$ 53 million (Canadian) for Ontario in 1995 (Department of Fisheries and Oceans 1997) and \$ 71 million (U.S.) for New York in 1996 (Connelly et al. 1997). In the mid-1980s, the state of New York and the province on Ontario

agreed to limit stocking to 8 million salmonids annually (Kerr and LeTendre 1991) in response to concerns about the sustainability of the high predator levels, declining alewife, record fishery yields and perceived risks to the burgeoning recreational fishery (Kocik and Jones 1999, O’Gorman and Stewart 1999). Salmonid consumption of alewives was estimated to exceed supply in 1992 (Stewart et al. 1999). To reduce the risk of an alewife collapse and associated adverse impacts on the recreational fishery stocking levels were reduced to 4.5 million salmonids in 1996, and have been maintained at between 4 and 5.5 million annually. In 1999, the percentage of the total salmonid stocked by species was 39.2 % chinook salmon, 18.8% lake trout, 17.2% rainbow trout, 12.2% brown trout, 7.2% coho salmon, and 5.5% Atlantic salmon (Stewart and Schaner 2002).

In the 1970s and early 1980s, Lake Ontario’s offshore fish community was dominated by non-native planktivores (alewife and rainbow smelt) and a native benthivore, slimy sculpin (Owens et al. 2003). Data prior to the build-up of predator levels (pre 1985) suggests that alewife and smelt were regulated by intraspecific and interspecific competitive interactions, cannibalism, and weather (Smith 1968, Christie 1973, Christie et al. 1987a, O’Gorman 1974, O’Gorman et al. 1987, Smith 1995, O’Gorman and Stewart 1999). The diet of salmonids in Lake Ontario is comprised almost entirely of smelt and alewife (Brandt 1986, Rand and Stewart 1998). The combination of predation from stocked salmonids and changes in the trophic structure resulting from declines in nutrients and zebra and quagga mussel colonization in Lake Ontario resulted in marked declines in alewife and rainbow smelt by the early 1990’s. Compared to the early 1980s, the biomass of prey fish like the alewife and rainbow smelt has been reduced by one-half (Stewart et al. 1999). The results of midwater trawls combined with acoustical transects conducted by NYSDEC and the Ontario Ministry of Natural Resources in Lake Ontario revealed an 80% reduction in the alewife population between October 1991-1994 (Lantry and Schaner 1998). Dreissenid mediated changes in the trophic structure of Lake Ontario toward a more benthic oriented foodweb and resultant decreases in planktonic prey upon which alewife feed also affect the alewife population.

Alewives exert the dominant biotic influence on fish communities in Lake Ontario and are the principal prey of most predatory fish and fish eating birds (Brandt 1986, Jones et al. 1993, Weseloh and Collier, Rand et al. 1994). Chinook salmon, in particular, rely heavily on alewives in their diet even when alewife numbers are low (Stewart and Ibarra 1991). A number of changes have been observed in recent years as alewife abundance has declined: lake trout began to successfully reproduce, threespine stickleback abundance increased, lake whitefish populations have increased, populations of other native fish species (yellow perch, emerald shiner, and lake herring) improved (Stewart et al. 1999). Two native pelagic species, threespine stickleback (*Gasterosteus aculeatus*) and emerald shiner (*Notropis atherinoides*), have recently increased in abundance and may reflect a significant change in the Lake Ontario fish community. Owens et al. (2003) suggested that the seminal event that allowed these fishes to reproduce successfully was a relaxation of predation on their larvae resulting from the shift of alewife to deeper water. Alewives prey on the pelagic larvae of many fish species (Brandt et al. 1987, Eck and Wells 1987, Krueger et al 1995, Mason and Brandt 1996). Male threespine sticklebacks establish and defend territories during breeding season and build nests of submerged aquatic vegetation and sand grains with mucus from kidney secretions (Wooten 1976). Suitable nest sites may be in short supply in some habitats and males nesting in rocky areas had fewer eggs in their nests than males in vegetated areas (Kynard 1979). An additional factor contributing to increasing abundance of threespine stickleback in Lake Ontario may be an increase in nesting habitat quantity and quality due to the increased growth of macrophyte beds in many littoral areas since dreissenid mediated increases in water clarity.

Slimy sculpin are native benthic fish that are important to the diet of lake trout (Elrod and O’Gorman 1991). Numbers of slimy sculpins fell sharply in southern Lake Ontario between 1982 and 1984 due to predation by stocked juvenile lake trout (Owens and Bergstedt 1994). Numbers slowly rose from 1984 to 1991, declined abruptly in 1992, and remained low during 1993-1998 (Owens et al. 2003). Owens et al. (2003) hypothesized that the decline of slimy sculpins was due to reductions in productivity brought on by nutrient abatement and to reductions in *Diporeia*, an important prey item, brought on by dreissenid colonization.

The current Lake Ontario fish community is in a dynamic state, affected by trophic changes triggered by invasive species as well as through manipulation by agency stocking programs. The system is largely composed of a mix of exotic species that have no evolutionary sympatry (Stewart and Schaner 2002). Recruitment of dominant predators, and the associated top-down influence on fish communities is largely controlled through stocking levels (Stewart and Schaner 2002). An imbalance of predators and prey has resulted, with important forage species (alewife and rainbow smelt) at low population levels. As a result, conventional ecological paradigms are difficult to apply, and descriptions of historical fish community structures are not useful for understanding or predicting species interactions or equilibrium states (Christie et al. 1987b, Eshenroder and Burnham-Curtis 1999- cited in Mills 2003).

More recent invasions of exotic fish include the European ruffe (*Gymnocephalus cernuus*), blueback herring (*Alosa aestivalis*), and the round goby (*Neogobius melanostomus*). Blueback herring have not become as abundant as had been expected, although they have been found in the Oswego area (NMPNS 2004). Round goby, a predator of *Dreissena*, are established in Rochester, New York and have spread eastward to the Sodus, New York area, approximately 30 miles west of Nine Mile Point. Round gobies, which are native to Eastern Europe, were introduced into the St. Claire River in 1990, probably via contaminated ballast water of transoceanic ships. The goby is a bottom-dwelling fish that has great potential for causing impacts on Great Lakes fisheries. Round gobies are thriving in the Great Lakes Basin because they are aggressive, voracious feeders that can forage in total darkness. The round goby takes over prime spawning sites traditionally used by native species, competing with native fish for habitat and changing the balance of the ecosystem. The round goby is already causing problems for other bottom-dwelling Great Lakes native fish like mottled sculpin, logperch, and darters. Goby spawn more often and over a longer period than native fish. Unfortunately, they have shown a rapid expansion of their range through the Great Lakes (Marsden and Dude 2003). No round gobies were collected in impingement samples in 2004 or in previous years at JAFNPP or NMPNS (NMPNS 2004, EA 2005). Another species that resource managers are watching is the invasive species ruffe (*Gymnocephalus cernuus*). Although the ruffe has yet to be found in Lake Ontario, they are rapidly moving east from the Upper Great Lakes and appear to compete with the walleye and yellow perch (McLean 1994). The goby and ruffe do not appear to have reached this area of the Great Lakes based on extensive impingement monitoring at JAFNPP (EA 2005).

6.5 NEARSHORE FISH COMMUNITY

With few exceptions, most Lake Ontario fish spend at least part of their life cycle in the nearshore zone. The resident fish community inhabiting the nearshore zone varies with season, the degree of nutrient enrichment, temperature, and available habitat (Stewart et al. 1999). Dominant fish species that spend most of their life cycle in the nearshore zone include walleye, smallmouth bass, largemouth bass, northern pike, freshwater drum, yellow perch, white perch, gizzard shad, trout

perch, white sucker, various minnows and several sunfishes (e.g. rock bass, pumpkinseed, bluegill, black crappie: Stewart et al. 1999, Hoyle et al. 2001, Hoyle and Schaner 2002). The American eel is an important nearshore fish predator, but is currently at historically low levels of abundance (Casselman et al. 1997). The lake sturgeon, which inhabits a wide- range of water depths, is a formerly common species showing a moderate resurgence in recent years (Hoyle and Schaner 2002). The alewife, primarily an offshore pelagic species, utilizes the nearshore as spawning and nursery habitat and can be seasonally very abundant in nearshore areas.

The fish community in the coastal nearshore areas surrounding the main body of Lake Ontario is relatively sparse, therefore much of the nearshore fish community production comes from major embayments such as the Bay of Quinte, and Lake Ontario's relatively shallow Outlet Basin (Hoyle et al. 2001, Hoyle and Schaner 2002). Here, several species of management interest have shown dramatic changes in abundance in the past decade. The Bay of Quinte and eastern Lake Ontario ecosystems have undergone tremendous change, both gradually since water quality clean up efforts initiated in the late 1970s, and rapidly following the invasion and proliferation of dreissenid mussels in the early to mid 1990s (Hoyle et al. 2001). The ecosystem change has included increased water clarity, increased levels of submerged aquatic vegetation, and a modified fish community. Smallmouth bass, abundant throughout the 1980s, declined dramatically in the Outlet Basin of Lake Ontario after 1992 (Hoyle et al. 2001). The decline appears to be largely due to unfavorable summer water temperatures during the exceptionally cool years of the early 1990s (Hoyle et al. 1999). However, recruitment conditions were especially good in the late 1990s, particularly the warm summers of 1995 and 1998, and smallmouth bass abundance has not shown any significant resurgence (Mills et al. 2003). Recent smallmouth bass decline has also been attributed to increased predation by double-crested cormorant (Lantry et al. 2002).

Walleye are an important keystone predator of the inshore fish community of eastern Lake Ontario. Walleye have resurged from low levels in the early 1970s and reached record setting high levels in the Bay of Quinte in the early 1990s. The resurgence began as a result of an extremely large year-class in 1978 after the winterkill of its larval predators, alewife and white perch, which occurred after the severe winters of 1976-1977 and 1977-1978 (Casselman and Scott 2003). In the late 1980s and early 1990s, the walleye population of the Bay of Quinte moved down the bay as spawning runs of alewife, an important prey species for walleye, diminished (Mills et al. 2003). Although large walleye have seasonal migrations between the Bay of Quinte and eastern Lake Ontario, this shift, along with the increased abundance of walleye, initiated their dispersion out of the lower Bay of Quinte into eastern Lake Ontario. This was accelerated in the early 1990s by increasing water transparency caused by dreissenid colonization (Casselman and Scott 2003). In the mid-1990s, walleye abundance increased in New York waters of Lake Ontario's eastern basin. This increase, which was also seen in the upper St. Lawrence River, likely reflected the dispersion of the Bay of Quinte stock (Mills et al. 2003). Coincident with this decrease, yellow perch abundance increased substantially throughout the Bay of Quinte at a time when the species was decreasing in the eastern basin of Lake Ontario (Mills et al. 2003).

Another important inshore species, yellow perch, were at record-setting high levels in north-eastern Lake Ontario in the late 1970s and early 1980s but declined precipitously in the mid-1980s (Mills et al. 2003). Among the many factors associated with these dynamics was a massive winter kill of alewives, significant predators of yellow perch larvae (Mason and Brandt 1996), in the late 1970s followed by a strong rebound in the 1980s. A shift in alewife distribution in the early 1990s boosted

yellow perch reproductive success, but it was followed by increased predation by double-crested cormorant that appears responsible for decreasing yellow perch abundance in eastern Lake Ontario in recent years (Burnett et al. 2002).

6.6 NEARSHORE FISH COMMUNITY IN THE VICINITY OF NINE MILE POINT

The temporal and spatial distribution of fishes in the vicinity of Nine Mile Point was monitored at varying levels of effort from 1969 through 1978 (TI 1979) using a variety of gear types, including gill nets, trawls, seines, and trap nets. Fish community structure varied seasonally during any given year, changing from a simple system in winter and early spring to a more complex and diverse community in late spring through the fall (TI 1979). Data indicated that the fish community in the Nine Mile Point vicinity was dominated by one or two species with a small number of other species in reduced numbers (TI 1979). Species diversity was highest in the spring due to an inshore movement of a number of species. During summer when alewives were most abundant, diversity was low. Diversity usually increased again in the fall, coinciding with the offshore movement of alewives (TI 1979).

Seventy-two fish species were collected from 1969 to 1978 in the vicinity of Nine Mile Point (TI 1979). During a typical year, alewives comprised a majority of the total catch, with rainbow smelt, spottail shiners, emerald shiners, centrarchids, yellow perch, and white perch accounting for the majority of the remaining catch (TI 1979). Seasonally, fish were collected in greatest numbers during the spring, coinciding with the shoreward migration of the two most abundant species, alewife and rainbow smelt. Abundances typically decline during the warmer summer months and rise during the fall, corresponding to increased catches of young of the year fish. Abundance patterns based on gill net data generally mimicked the patterns displayed for impingement catches at JAFNPP and NMPNS (TI 1979).

Yearly gill net catch data for rainbow smelt, white perch, and smallmouth bass in the Nine Mile Point vicinity displayed no significant changes among years (1969-1978: TI 1979). Alewife abundance oscillated, displaying highest numbers in 1974 and 1976 and declining through 1977 and 1978 (TI 1979). The yellow perch population declined slightly from 1977 through 1978. Data on gizzard shad indicated a generally increasing population in the Nine Mile Point vicinity through 1975 and a decline during 1977 and 1978, greatest concentrations were in the vicinity of plant thermal discharges during the fall. Salmonids appeared infrequently in gill net catches through the years and typically reflected stocking intensity for any given year (TI 1979).

No incidents of cold shock mortality due to plant shutdown at either JAFNPP or NMPNS were reported, nor were any rare, endangered, or threatened fish species collected (TI 1979). Comparison of temporal and spatial abundance based on catch per unit effort data as well as length-frequency distribution, age and growth, fecundity, gonad maturity, and diet analysis between experimental and control areas in the Nine Mile Point vicinity for 1969-1978 revealed no distinct alteration to the normal seasonal life cycle patterns of the nearfield fish community directly attributable to operations at JAFNPP or NMPNS (TI 1979).

6.7 ENTRAINMENT AT OR NEAR JAFNPP

The Power Authority of the State of New York (PASNY, now called the New York Power Authority, NYPA) and Niagara Mohawk Power Corporation (NMPC) began ecological studies in the vicinity of

Nine Mile Point in the late 1960s to evaluate potential effects of power station operations at Nine Mile Point (JAFNPP and NMPNS) on the near field aquatic ecosystems. The nearfield distribution of fish eggs and larvae was monitored weekly at depths ranging from 20 to 100 feet in the Nine Mile Point vicinity during April-December 1973-1979 (LMS 1983). Thermally influenced and control areas were sampled over a range of depths in order to characterize the temporal and spatial distribution of the ichthyofaunal community in the Nine Mile Point vicinity.

Egg collections, which included up to six species during any one year, were consistently dominated by alewife and rainbow smelt (TI 1979). Larval samples, also dominated by alewife, included up to 22 species in a given year. Alewife consistently dominated the ichthyoplankton community, other abundant species included rainbow smelt, white perch, sculpin, and tessellated darter (LMS 1977a, LMS 1977b, TI 1979). Although yellow perch, rainbow smelt, and *Morone* spp. (white bass and white perch) larvae were consistently present over the years, they and other species generally occurred either in low numbers or were collected infrequently during each year (TI 1979). These data indicate that significant spawning in the study area was limited to alewife and rainbow smelt, and that the Nine Mile Point area is not a major spawning habitat for the majority of the Lake Ontario fish community (TI 1979). During a review of Nine Mile Point studies, Williams et al. (1975, cited in TI 1979) indicated that the area does not contain desirable spawning and nursery sites because of extensive nearshore wave action and bedrock/rubble substrate.

The temporal distribution of eggs and larvae in the Nine Mile Point area is characterized by two basic spawning groups: Species typically spawning in the winter and early spring (e.g. burbot, *Coregonus* spp., rainbow smelt, yellow perch), and late spring and summer spawning species (e.g. alewife, white perch, carp; TI 1979). Eggs and larvae of the first group are most abundant during April through early June and larvae of the second group are most abundant in July and August.

Eggs and larvae were more abundant along the 20 foot than along the 40 foot depth contour and densities were usually lowest at the deeper (60, 80, 100 foot) stations (TI 1979). Older larvae consistently displayed a pattern of offshore migration to deeper waters. From June through August, when larvae were most abundant, both prolarvae and post yolk sac larvae were usually more abundant in surface than in mid-depth and bottom samples (TI 1979). Alewives usually accounted for more than 90 percent of the catches during this period. Alewife eggs were more abundant in night samples (generally near the bottom) while alewife larvae were more abundant during the night generally near the surface (TI 1979). Prior to the influx of alewives, rainbow smelt larvae were usually most abundant at night in the bottom strata (TI 1979). The vertical distribution pattern of rainbow smelt eggs was not consistent from year to year. No pattern was observed in the vertical distribution of yellow perch larvae (TI 1979).

Abundance of ichthyoplankton larvae and eggs from sampling conducted directly in the intake forebay at NMPNS Unit 1 was determined either weekly or twice per month from 1973-1978 (TI 1979). Generally, the species from the intake forebay reflected the Lake Ontario species composition, except that species occurring infrequently or on low numbers were often not observed in the intake forebay. The temporal abundance of eggs and larvae in intake samples was generally similar to temporal patterns observed in Lake Ontario samples. However, densities in intake samples were sometimes lower than corresponding densities in Lake Ontario nearfield samples, particularly larval densities in 1977 and 1978 (TI 1979). Also, the diversity of eggs and larvae was frequently lower in intake samples than in the nearshore Lake Ontario samples. Although 100% mortality of entrained ichthyoplankton in the intake samples was assumed for the purposes of impact evaluation, station

operation from 1973 to 1979 had a minimal impact on ichthyoplankton populations in the vicinity of Nine Mile Point (TI 1979). For example, cropping estimates for larvae indicated that only about 0.26% of the alewives and rainbow smelt in Lake Ontario that were available for entrainment during 1976 were actually entrained, assuming both NMPNS and JAFNPP were operating at full intake flow (TI 1979).

Initial studies of entrainment at Unit 1 of NMPNS conducted in the mid-1970s were summarized in (LMS 1983). The purpose of that summary was to use data from Unit 1 and JAFNPP to project potential impacts for Unit 2. For entrainment, the summary focused on the 1976 data, the first year that NMPNS Unit 1 and JAFNPP were both operational. The 1976 entrainment program at Unit 1 yielded a number of species, typified by burbot and *Coregonus* spp. in early spring, rainbow smelt in mid-spring, and alewife in late spring/summer. Abundance was highest during summer, attributable to a large alewife population. Rainbow smelt was the second most abundant fish entrained. Weekly average densities ranged from 0 to 34.4 eggs per cubic meter and 0 to 0.5 larvae per cubic meter for alewife. Corresponding densities for rainbow smelt were 0 to 0.15 eggs per cubic meter and 0 to 0.02 larvae per cubic meter (LMS 1983). Assuming full load and a maximum cooling-water flow rate at Unit 1 during the 1976 entrainment sampling program (i.e. 268,000 gallons per minute) up to 350 million alewife eggs and 4.9 million larvae would have been entrained during the respective periods of maximum weekly density. Maximum weekly numbers of entrained rainbow smelt would have been 1.5 million eggs and 205,000 larvae (NMPNS 2004).

LMS (1983) placed their predicted entrainment losses at the future Unit 2 plant in perspective by comparing them to populations in Lake Ontario. LMS (1983) estimated the standing stock of alewife in the U.S. waters of Lake Ontario in 1976 at 12.56 billion. Assuming a 1:1 sex ratio, this equates to 6.28 billion females. When the maximum weekly entrainment total of alewife eggs of 350 million is divided by the fecundity of alewife (26,272 eggs) the result is 13,322 females, which represents lost spawning capacity. When this number is divided by the Lake Ontario population of 6.28 billion female alewives, the estimated loss of the population females equates to 0.0002%. For alewife larvae, the peak weekly estimated number entrained of 4.9 million was compared to the estimated peak standing stock in Lake Ontario of 35 billion larvae and the entrainment loss represented 0.014%. Similar calculations for rainbow smelt yielded a loss of female standing stock due to egg entrainment of 0.00001% and a loss of larval standing stock of 0.025%. These calculations were based on the peak weekly entrainment during 1976, but even if all weeks were included, the proportional losses to standing stocks in Lake Ontario would be extremely small (NMPNS 2004).

Entrainment sampling at NMPNS was also conducted in 1997. Weekly day and night samples were collected from April through August (EA 1998). Seven species and two additional family groups were represented in the collection of eggs and larvae, however abundance was overwhelmingly dominated by alewife (EA 1998). Most alewife eggs and larvae were collected in July; larvae were more abundant than eggs in August. Total numbers of ichthyoplankton entrained at Unit 1 in 1997 were related to cooling water flow. It was estimated that 86.6 million ichthyoplankton were entrained during the April-August period, of which 77.9 million (90.7%) were alewife eggs and larvae, and a relatively few juveniles (EA 1998). Tessellated darter was second most abundant, with 3.6 million estimated entrained (4.2%), followed by threespine stickleback (2.4 million, 2.8%). Rainbow smelt, the second most entrained fish in the 1970s, was rare in the 1997 collections, representing only 0.1% of the total (EA 1998).

Entrainment of ichthyoplankton at NMPNS in 1997 was much reduced relative to the 1970s. As noted above, an estimated 350 million alewife eggs and 4.9 million larvae were entrained during their respective peak weeks in 1976. In contrast, 77.9 million alewife eggs and larvae were entrained during the entire season in 1997 (NMPNS 2004). Millions of rainbow smelt eggs and larvae were entrained in 1976, but they were rare in 1997. The principal reason for the difference in entrainment between 1976 and 1997 was the difference in lakewide abundance of alewife and rainbow smelt. The biomass of alewife and rainbow smelt in Lake Ontario is about one-half that estimated in the early 1980s (Stewart et al. 1999). These reductions are attributed to predation by stocked salmonids as well as changes in nutrient cycling brought about by invasive *Dreissena* mussels as discussed previously.

6.8 IMPINGEMENT AT JAFNPP

Impingement collections have been made annually at JAFNPP from 1975 through 1997 and again in 2004 (EA 2005). Impingement abundance is highest in the spring and peaks in May when approximately 35% of annual impingement occurs (EA 2005). The high abundance in spring coincides with the movement of fish to the shallow inshore areas to spawn. Migration inshore occurs when Lake Ontario temperatures warm in the spring to preferred species-specific spawning temperature ranges. Impingement begins to decrease in June as adult fish move offshore after spawning. Fish impingement increases again in the fall (Oct-Dec) when 21% of impingement occurs as YOY fish, particularly alewives and rainbow smelt, attain a size susceptible to impingement in the intake screens (EA 2005). The strong west and northwest winds typically encountered in fall and winter cause wave action that have resulted in short-term increases in impingement abundance at JAFNPP. Lifton and Storr (1977) found correlations between wind action and wave height and impingement at power plants in Lake Erie and Lake Ontario and hypothesized that wave induced turbulence and turbidity interfere with fish's ability to detect and avoid an intake structure.

Historically, the timing and duration of station outages for refueling and maintenance have a major influence on impingement abundance and species composition (EA 2005). During extended maintenance and/or refueling outages, the operation of the main circulating water pumps is generally reduced to one or two of the three existing pumps; occasionally none are in operation. The reduced flow through the intake generally results in a reduction in impingement during the outage. The timing of refueling outages during spring spawning migrations of alewives and rainbow smelt occurred in 1979, 1980, 1985, 1987, 1990, 1991, 1992, and April 1994. Outages that occurred in the late summer and fall when YOY are susceptible to impingement occurred in 1977, 1978, 1981, 1983, 1984, 1988, 1991, 1992, 1994, and 1996. The influence of station outages should be considered when interpreting patterns of historical impingement abundance (Table 6.2, 6.3), particularly when outages occur at times of seasonal movements of both alewife and rainbow smelt. Privatization, competition, and deregulation of nuclear power today compared to that of the 1980s and 1990s have led to an increase in plant efficiency and improved generation output by concentrating on reducing unplanned losses, minimizing the duration of planned outages, and exploring options to improve station output capability (EA 2005). These practices have minimized influences of reduced flow during outages on impingement studies. Only one outage occurred during 2004 (Refueling Outage 16) and was completed over the period 25 September through 24 October that resulted in only 19 percent of normal water volume pumped during that time.

Meteorological conditions cause changes in populations that may also be reflected in the impingement collections (EA 2005). Alewives have exhibited significant year-to-year fluctuations in

population size (Christie 1973, 1974, Scott and Crossman 1973, Elrod et al. 1979; O’Gorman and Schneider 1986, O’Gorman and Stewart 1999, Owens et al. 2003). Christie (1974) hypothesized that periodic die-offs of alewives in the spring might occur due to some combination of climatic conditions and the physical condition of individuals in the population. Data from impingement collections during 1976, the year prior to a severe winter mass alewife die-off, were extremely high compared to data collected since that time. During Winter/Spring 1977, Lake Ontario experienced a 60-75 percent loss of the adult alewife population, resulting in the virtual elimination of the 1976 year class. This event was reflected in impingement data when a 20-fold decrease was observed between 1976 and 1977 (Table 6.3). The estimated number of alewives impinged in 1976 (3,916,717, adjusted for screen efficiency) (LMS 1977b) accounted for 52 percent of the total estimated alewife catch from 1976 to 1997 and 2004. The exceptionally high alewife abundance during 1976, as compared to abundance since then, may be construed as an anomaly in a statistical sense. The interpretation of historical alewife abundance as a percent of all data should take these differences into consideration. Alewife abundance data from 1977 to 1997 and 2004 are more representative of abundance observed during the past two decades than data from 1976. With the inclusion of 1976 data, alewives have accounted for 59 percent of total impingement (based on dominant species) from JAFNPP compared to 43 percent when omitting 1976 data (EA 2005). Alewife impingement abundance has never approached the same level experienced in 1976. Since then, Lake Ontario winters resulted in no catastrophic die-offs of the magnitude recorded in 1976. Several smaller die-off events have been noted, e.g., 1983 and 1986 (O’Gorman et al. 1987).

Ross et al. (1993) demonstrated that a fish deterrence system (FDS) using high frequency broadband sound (122-128 kHz) at a source level of 190 decibels could reduce impingement of alewives at JAFNPP by as much as 87% when operating at full power and using the maximum cooling water flow rate. Ross et al. (1996) confirmed these results and estimated that the reduction in impingement of alewives over the period from April through July was 81%. These deterrent tests in spring 1991 (April-June) and 1993 (April-July) should be taken into account when interpreting historical trends in impingement. Another test using a reconfigured fish deterrence system in 1997 directly affected impingement abundance from April through mid-July so that 1997 data are not directly comparable except for general seasonal trends. Results suggested that the reconfigured system with eight integrated projector assemblies (IPAs) operating at 187 decibels measured at 1 meter from the source provided protection for alewives equivalent to the systems tested by Ross et al. (1993) with 20 transducers operating at 190 decibels at 1 meter from the source, and Ross et al. (1996) with 25 transducers operating at 190 decibels at 1 meter from the source (Dunning and Ross 1998). The FDS was in use during the 2004 impingement sampling program as well (EA 2005).

USGS and NYSDEC data from the Lake Ontario Forage Base Assessment Program show that adult alewife numbers continue to remain moderate in 2004 and have been relatively stable for the last several years (O’Gorman et al. 2005). Although abundance is considerably less than in the mid-1980s and early 1990s, the population seems to be stabilizing at a lower level as the carrying capacity of Lake Ontario has reduced. The process of food web disruption, mediated by dreissenid mussel invasion, may well have eroded lower trophic level support for the Lake Ontario alewife population to below that of the early 1990s (Mills et al. 2003, O’Gorman et al. 2005). The diet of alewives has shifted from the amphipod, *Diporeia*, to possum shrimp, *Mysis*, and is associated with dispersal of alewives to deeper areas of Lake Ontario (O’Gorman et al. 2000). The shift in diet seems to result in healthier, more robust fish due to lower alewife numbers, which provide more food for the fish that do survive. *Diporeia*, which was a major food source for alewife, has been almost completely

depleted following the proliferation of zebra and quagga mussels over the last decade as previously discussed. The R.E. Ginna Nuclear Power Plant and Nine Mile Point Nuclear Station (NMPNS) also report reduced impingement catches of alewife and rainbow smelt in recent years concurrent with reduced numbers in the Eastern Basin of Lake Ontario (NMPNS 2004).

Rainbow smelt are the second most abundant open water fish in Lake Ontario (Casselman and Scott 2003). Numbers and biomass of rainbow smelt fluctuated widely and without trend in U.S. waters of Lake Ontario during 1978-1998 (Mills et al. 2003). Rainbow smelt impingement abundance has been subject to fluctuations resulting from a variety of factors. As previously discussed, strong west or northwest winds with an associated increase in wave action result in short-term increases in impingement abundance (EA 2005). These conditions occur on Lake Ontario particularly in January, November, and December, and cause an increase in impingement of YOY rainbow smelt. In addition, rainbow smelt are subject to lake-wide population fluctuations, which appear to be caused in part by cannibalism of young smelt by adult smelt and by predation by the stocked salmonids on adult smelt (O'Gorman et al. 1990). When interpreting impingement data on rainbow smelt, lake-wide patterns in population fluctuations are difficult to ascertain due to the strong influence of meteorological conditions and plant outages which have occurred during sample collections. In impingement years 1995-1997, rainbow smelt numbers appeared to be fairly stable, however, estimated numbers of rainbow smelt impinged (based on total cooling water flow) for 2004 are the lowest on record since inception of impingement monitoring at JAFNPP (Table 6.3). Factors including the introduction of dreissenid mussels in the early 1990s and nutrient reductions in nearshore areas of Lake Ontario due to improved land use and sewage treatment practices have reduced lake productivity, affected associated reductions in smelt populations, and caused a shift in the distribution of smelt into deeper waters similar to that of the alewife (O'Gorman et al. 2000), where food is more prevalent, thus avoiding the JAFNPP intake structure altogether (EA 2005). Although rainbow smelt impingement numbers were very low for 2004, trawls performed by the USGS and NYSDEC in the same year showed the highest population index number for smelt since 1997 and 1998 (O'Gorman et al. 2005), indicating a strong recruitment year class for 2005.

Lakewide population estimates (U.S. waters) of alewife and rainbow smelt for 1982-1997 provided by Rochester Gas & Electric (2003) as presented in (NMPNS 2004) demonstrate that the proportion of the population lost to impingement at JAFNPP was quite low (Table 6.4). The greatest proportional impingement in any year for alewives was 0.018% in 1984, and for rainbow smelt was 0.027% in 1994.

The estimated impingement of alewives, rainbow smelt, threespine stickleback, white perch, yellow perch, smallmouth bass, salmonids, spottail shiner, gizzard shad, trout perch, tessellated darter, and sculpins, species of interest due to their significance as forage or sport fish, are shown for 1976-1997 (Table 6.3). Fluctuations in their abundance appear to be attributable primarily to natural fluctuations of individual populations and localized meteorological occurrences influencing the impingement process (EA 2005). Increases in smallmouth bass and white perch impingement abundance are most often influenced by short-term meteorological conditions previously described. Late fall and winter storms often cause large numbers of YOY of both species to be collected in the impingement samples. Impingement of smallmouth bass during 1988, 1990, 1993, and 1994 was influenced by such factors; storms in 1977, 1983, 1993, and 1996 affected white perch impingement (EA 1984, 1989, 1991, 1994; TI 1978). Increases in 2004 for white perch and yellow perch in January and December can be attributed to meteorological conditions. The January and December combined

numbers for white perch accounted for 50 of the total 71 specimens collected (70 percent), and yellow perch for those months accounted for 45 of the total 58 specimens collected (78 percent, EA 2005).

The population of yellow perch in Lake Ontario declined from the late 1970s through 1990, with only 1978 and 1985 assessment data indicating high abundance of yellow perch (O'Gorman et al. 1990). For those years, yellow perch impingement abundance estimates were highest in 1978; the JAFNPP outage in 1985 could have obscured any increase in yellow perch due to reduced impingement during the outage (EA 2005). Historically, yellow perch impingement abundance has demonstrated small fluctuations most likely influenced by meteorological events and extended outages.

Natural biological factors such as population size, migration patterns, schooling, and spawning behaviors, in conjunction with external environmental factors such as water temperatures, currents, and localized meteorological conditions, can play an important role in seasonal variations in species occurrence or absence in the near shore zone of Lake Ontario (EA 2005). Species composition has ranged from 26 to 54 species per year in the impingement collections at JAFNPP. The 35 species collected in 2004 are within the average range of historical diversity. It is conceivable that the reduction in population of alewives and the presence of dreissenid mussels may be affecting species composition and abundance in Lake Ontario and may be a few of the factors influencing the previously discussed lake-wide exponential increase in threespine stickleback as reflected in the impingement samples for 2004 and in the mid-1990s.

Historically, changes in fish populations in the vicinity of JAFNPP are the result of natural fluctuations (EA 2005). When changes are of a greater magnitude (as in a die-off of alewives), they can be detected in the annual estimates of fish impinged at JAFNPP. When fluctuations occur over long periods of time and are relatively small, they are difficult to differentiate from the influences of daily plant operations and meteorological occurrences, the two main influences upon the impingement process. No long-term trends in fish population abundance due to the impingement process at JAFNPP have been apparent (EA 2005)

Trends in impingement at the adjacent NMPNS Unit 1 are similar and dominated by one or more of three species: alewife, rainbow smelt, and threespine stickleback (NMPNS 2004). During 1972 to 1997 alewife dominated the impingement catch in most years. Rainbow smelt were most abundant in 1979, 1982, and 1989 and threespine stickleback dominated the impingement catch in 1978 and 1997 (NMPNS 2004) similar to trends observed at JAFNPP (Table 6.3). At NMPNS, highest impingement rates are usually evident during spring when alewife and rainbow smelt move inshore to spawn.

Although less abundant, a variety of other species have been impinged at NMPNS Unit 1 over the years including species of minnows (Cyprinidae), sculpins (*Cottus* sp.), catfish (Ictaluridae), trout perch and gizzard shad. Game fish such as smallmouth bass, white bass, yellow perch, white perch, lake trout, and walleye were also impinged, although in low numbers compared to alewife and rainbow smelt (NMPNS 2004).

6.9 BENEFITS OF “OFFSHORE” INTAKE VS SHORELINE

Nearshore areas in Lake Ontario (defined as < 15 m by Stewart et al. 1999 and < 27 m by Edsall and Charlton 1997) provide areas of permanent residence for some fishes, migratory pathways for anadromous fishes, and temporary feeding or nursery grounds for other species from the offshore waters. The nearshore areas of the Great Lakes are diverse physical habitats, exhibiting a range of

morphometric features, current velocities, substrates, and aquatic vegetation (Edsall and Charlton 1997). These features, combined with seasonal fluctuations in temperature, provide conditions optimum to most species of fish in the Great Lakes for at least a portion of their life cycle. Of 139 Great Lakes fish species reviewed by Lane et al. (1996a), all but six species—the deepwater ciscoes (*Coregonus hoyi*, *C. johanna*, *C. nigripinnis*, *C. reighardi*, *C. zenithicus*) and deepwater sculpin (*Myoxocephalus thompsoni*) typically use waters less than 10 m deep as nursery habitat; and even the latter has been captured from shallows in the St. Clair River delta (Leslie and Timmins 1991). Adults of many species occur over a range of depths, but 80 percent of fish species in the Great Lakes use nearshore areas for at least part of the year (Lane et al. 1996b). The resident fish community inhabiting nearshore zone varies with season. Dominant species that spend most of their life cycle in the nearshore zone include walleye, perch, white perch, gizzard shad, minnow species and sunfishes and American eel.

Fish species diversity and production in the nearshore waters are higher than in offshore waters (Edsall and Charlton 1997). Ichthyoplankton monitoring in the vicinity of the JAFNPP and NMPNS intake structures in the mid 1970's found higher fish egg and larval density along the shallowest (20 ft) depth contours than in deeper waters (40, 60, 80, and 100 foot contours TI 1979). Older, more developed post-yolk sac larvae were equally distributed over all five depth contours suggesting offshore movement as the larvae develop (TI 1979). Larvae of several species the study area, including rainbow smelt and alewife, move offshore as they mature (LMS 1975, TI 1978, TI 1979). Gill net sampling of adult fish in the Nine Mile Point area also found higher abundance at the shallowest (15 ft.) depth contour than in deeper sites (30, 40, 60 ft. depth contours, TI 1979).

The reduction in available nutrients over the past two decades, combined with the increased penetration of light has resulted in the return and increased growth of macrophyte beds in many littoral areas. Water clarity, measured by a Secchi disk, has increased by nearly 100% in Lake Ontario during the 1990's (3.1m to 6.7 m in summer, EPA 2003). Concurrently, submerged aquatic vegetation (SAV) in Lake Ontario has proliferated (Ontario Ministry of Environment and Energy 1995, Bin et al. 2004). SAV stabilizes sediments, reduces turbidity, and provides nursery habitat for numerous fish species (Nichols 1991). The abundance of young-of-the-year fishes is often higher in vegetated than in non-vegetated habitats (Keast et al. 1978, Holland and Huston 1984, Chubb and Liston 1986, Leslie and Timmins 1994;). Chubb and Liston (1986) reported that larval fish densities were usually 10 times to 100 times more abundant in the vegetated bayou of Pentwater Marsh, Lake Michigan, than in adjacent unvegetated bayou mouths or river channels. Of the 133 species examined by Lane et al. (1996a), the young-of-the-year of 77 species are moderately to strongly associated with aquatic vegetation. Vegetation is also an important component of adult habitat. Adults of nearly one-third of the fish species in the Great Lakes are strongly associated with SAV, while adults of one-quarter of the species are strongly associated with nearshore emergent vegetation (Lane et al. 1996b, Edsall and Charlton 1997).

The JAFNPP cooling water intake structure is located 900 feet offshore in approximately 7.3m (24 ft.) of water. Chambers and Kalff (1985) related the maximum depth of angiosperm growth (Z) in lakes worldwide to Secchi Depth (SD) with the following equation: $Z^{0.5} = 1.33 \log (SD) + 1.40$. Based on an average Secchi depth of approximately 6.0 m in nearshore portions of Lake Ontario that are exposed to the main lake (Hall et al. 2003), the maximum depth that SAV would grow in near Nine Mile Point is 5.9 m (19 ft). Therefore, the offshore location of the JAFNPP cooling water intake in 7.3 m of water is outside the likely depth range of SAV habitat in Lake Ontario. The maximum

depth of growth of 7.3 m estimated above corresponds with the maximum depth of SAV colonization observed by Bin et al. (2004).

6.9.1 Analysis of Ichthyoplankton and Fish Distributions Near the JAFNPP Intake

An analysis of historical ichthyoplankton, gill net, and bottom trawl data was used to evaluate whether fish abundances vary significantly with respect to distance from shore near Nine Mile Point, where the JAFNPP intake structure is located. The data examined were from sampling conducted in 1978, as presented in the report dated May 1979, prepared by TI (1979). The general approach was to apply analysis of variance (“ANOVA”) to compare catch per unit of effort among depth contours, since depth increases with increasing distance from shore.

Ichthyoplankton

Ichthyoplankton sampling in 1978 was conducted weekly during April through November and twice per month during December. Sampling stations were located along seven inshore-offshore transects, between 2.5 miles west of JAFNPP and 1.5 miles east of JAFNPP. Along each transect, stations were located at two or three depth contours ranging from 20 feet deep to 100 feet deep. Sampling during June through mid-September was conducted during two diel periods (daytime and nighttime), while sampling during April through May and mid-September through December was conducted only during the daytime. A total of 780 sets of three samples (near surface, mid-depth, and near bottom) were collected as shown in the following table.

Transect distance east or west of JAFNPP (miles, approx.)	Number of sets of 3 samples; by season, diel period, and depth contour (feet)														
	Apr-May, mid Sep - Dec					Jun - mid Sep					Jun - mid Sep				
	Day					Day					Night				
	20	40	60	80	100	20	40	60	80	100	20	40	60	80	100
2.5 west	22	22				15	15				15	15			
1.5 west	22	22				15	15				15	15			
1.0 west	22	22				15	15				15	15			
0.5 west			22	22	22			15	15	15			15	15	15
zero	22	22				15	15				15	15			
0.5 east	22	22				15	15				15	15			
1.5 east	22	22				15	15				15	15			

For the depth contour analysis JAFNPP used the mean densities (number per 1000 cubic meters) by sampling week, diel period, and depth contour from Appendix Tables E-1 and E-2 (total eggs), E-5 and E-6 (total yolk-sac larvae), and E-13 and E-14 (total post yolk-sac larvae) in TI (1978). This provided 260 values each for eggs, yolk-sac larvae, and post yolk-sac larvae (52 day or night periods for each of 5 depth contours).

Since the sampling design was unbalanced in that nighttime samples were only collected during part of the sampling year, the data were analyzed in two ways. The first design for the ichthyoplankton analyses used only June through mid-September data, so that every sampling week analyzed included both daytime and nighttime data. The data were log(x+1) transformed to better satisfy the normality

requirements for ANOVA. A three-way ANOVA was used (15 weeks * 2 diel periods * 5 depth contours) for each of the three early life stages.

The second design for the ichthyoplankton analyses used only daytime samples, but from the entire sampling season. The data were log(x+1) transformed to better satisfy the normality requirements for ANOVA. A two-way ANOVA was used (37 weeks * 5 depth contours) for each of the three early life stages.

Eggs exhibited a significant difference among depth contours in both the summer day-night ANOVA and the 9-month day-only ANOVA (Table 6-5). The highest egg densities were at the shallower (near-shore) depth contours. For the summer data, the average nighttime density at the 20-foot contour was by far the highest, while in the 9-month data, average densities were much higher at both the 20-foot contour and the 40-foot contour than at the three deeper contours (Figure 6-1).

Yolk-sac larvae showed a distinct and highly statistically significant depth gradient in both the summer day-night ANOVA and the nine-month day-only ANOVA (Table 6-5). The average density was highest inshore at the 20-foot depth contour and decreased with increasing depth and distance from shore (Figure 6-2).

Post yolk-sac larvae densities also varied significantly among depths (Table 6-5), but the pattern was not a distinct inshore-offshore difference as seen for eggs and yolk-sac larvae. The highest average post yolk-sac larvae densities were at shallow and deep contours, while the lowest averages were at intermediate depths (Figure 6-3).

Gill Nets

Gill net sampling in 1978 was conducted in two weeks per month during April through mid-December. Sampling stations were located along four inshore-offshore transects, between 1.5 miles west of JAFNPP and 1.5 miles east of JAFNPP. At all four transects, stations were located at the 15-foot, 30-foot, 40-foot, and 60-foot depth contours. A fifth depth contour (20 feet) was sampled at three of the four transects, but only on half the days and since the 20-foot data were not tabulated in the report appendix we did not analyze them. Gill nets were set during two diel periods in all sampling weeks, with two 12-hour daytime sets and two 12-hour nighttime sets in each sampling week. A total of 1,085 of 1,088 scheduled 12-hour sets were collected (excluding the 20-foot depth contour), as shown in the following table.

Transect distance east or west of FitzPatrick (miles, approx.)	Number of 12-hour sets, by diel period and depth contour (feet)							
	Day				Night			
	15	30	40	60	15	30	40	60
1.5 west	34	34	34	34	33	34	34	34
0.5 west	34	34	34	34	34	34	34	34
zero	34	34	34	34	34	34	33	34
1.5 east	34	34	34	34	34	34	33	34

The data used for the depth contour analysis for gill nets were the monthly average values of catch per unit of effort (CPUE=catch per 12-hour set) by transect and depth contour in Appendix Tables F-11 through F-15 of TI (1978). Those tables provided monthly average CPUE data combined across

the day and night sets for alewife, rainbow smelt, white perch, yellow perch, and smallmouth bass, which included four of the five most abundant species in gill net catches. Total catch was not tabulated in detail in TI (1978), so we used the CPUE for these five species combined for the analysis, a total of 144 values (9 months at 4 transects and 4 depth contours per transect). The data were $\log(x+1)$ transformed to better satisfy the normality requirements for ANOVA. A two-way ANOVA with replication was used (9 months * 4 depth contours, with the four transects serving as replication within each month/depth combination).

Gill net catches varied significantly among depth contours (Table 6-5). Catches were about three times higher at the 15-foot contour than at the other three depths sampled (Figure 6-4). The gill net catches at the 15-foot contour were significantly higher than at all of the three other depth contours. Catches at the 30-foot and 40-foot contours were not significantly different from each other.

Bottom Trawls

Bottom trawl sampling in 1978 was conducted in two weeks per month during April through December. Sampling stations were located along three inshore-offshore transects, between 1.5 miles west of JAFNPP and 1.5 miles east of JAFNPP. At each of the three transects, stations were located at the 20-foot, 40-foot, and 60-foot depth contours. Bottom trawls were taken during two diel periods (daytime and nighttime) in all sampling weeks, with the exception that all daytime trawling in the second December sampling week was cancelled due to weather. A total of 315 of 324 scheduled 15-minute tows were taken, as shown in the following table.

Transect distance east or west of FitzPatrick (miles, approx.)	Number of 15-minute tows, by diel period and depth contour (feet)					
	Day			Night		
	20	40	60	20	40	60
1.5 west	17	17	17	18	18	18
0.25 west	17	17	17	18	18	18
1.5 east	17	17	17	18	18	18

The data used for the depth contour analysis for bottom trawls were the average values of catch per unit of effort (CPUE=catch per 15-minute tow) by sampling week, diel period, and depth contour for all species combined in Appendix Table F-16 of the 1978 report. The second week of December was excluded from the analysis due to the missing daytime data for that week. The data were $\log(x+1)$ transformed to better satisfy the normality requirements for ANOVA. The analysis was a three-way ANOVA without replication (17 sampling weeks * 2 diel periods * 3 depth contours).

The average catch rate in bottom trawls was higher at the 60-foot depth contour than at the 20-foot and 40-foot contours (Figure 6-5), but the differences among the depths were not found to be significant (Table 6-5).

Comparisons Among Depths

After finding that ichthyoplankton densities and gill net CPUE were significantly related to depth, the pattern of decreasing abundance with increasing depth that was apparent in the graphs was further explored by multiple comparison tests comparing mean abundances among the depth contours.

Tukey's studentized range test was used to determine which depth contours were significantly different from each other (Table 6-6). For example, the mean density of yolk-sac larvae during the summer at the 20-foot depth contour was not significantly different from the mean at the 40-foot contour (Group A), but it was significantly higher than the mean densities at the 60-foot, 80-foot, and 100-foot contours. Mean density at 40 feet was not significantly higher than the 60-foot mean (Group B), but it was significantly higher than means at 80 feet and 100 feet. The means in Table 6-6 are expressed as geometric means because the ANOVAs and Tukey's tests were performed on $\log(x+1)$ transformed data.

In all seven data sets where Depth was a significant factor in the ANOVAs, the multiple comparisons tests showed that abundances were highest at the shallowest depth contour and were significantly higher than at least one of the deeper contours (Table 6-6). In summer, when ichthyoplankton densities were highest, all three life stages were significantly more abundant at 20 feet than at 60 feet, 80 feet, or 100 feet. Only at 40 feet were the summer ichthyoplankton densities close enough to the 20-foot densities to be statistically equal. The mean gill net $\log(x+1)$ CPUE was significantly higher at 15 feet than at all three of the deeper contours (Table 6-6).

The relationship between the shallowest contour and the deeper contours is summarized in Table 6-7 by comparing the abundance means calculated from the original untransformed densities and CPUEs. The largest percentage difference was for eggs in the summer, which were 95% less abundant at the deeper contours than at the 20-foot contour. The smallest percentage difference was for post yolk-sac larvae in summer samples, where the average density for the deeper contours was 19% less than the density at the 20-foot contour.

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

JAFNPP operates as described above pursuant to NYSDEC's 1996 determination, which remains effective, that JAFNPP's current configuration and operation comply with the BTA requirements of § 316(b). This determination was confirmed in a letter dated 1 March 1996 from P.Kolakowski NYSDEC to D. Dunning NYPA (former owner of JAFNPP).

JAFNPP'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 Section 6.0 (above) and in Appendix 1 (below).

8.0 SAMPLING PLAN FOR NEW FIELD STUDIES

8.1 IMPINGEMENT

JAFNPP proposes to obtain no new impingement data for JAFNPP. A recent annual impingement program was performed during January through December 2004, and the results were reported to NYSDEC as required by SPDES Permit No. NY 0020109 Section 10, CP-04.03 (EA 2005). Results from this 2004 impingement program will be used to assess compliance with the impingement mortality performance standard of the Phase II Regulations.

8.2 ENTRAINMENT

JAFNPP proposes a one-year entrainment sampling program for JAFNPP beginning in April and continuing through March 2007 designed to supplement comprehensive annual entrainment data obtained during the 1973-1979 studies described in Section 6.1 (above). JAFNPP may undertake a second year of entrainment sampling in 2007 to verify the results observed during 2006, if appropriate. An entrainment survival study may also be included in one or both years of planned work at JAFNPP if preliminary field observations during the first year suggest high survival of entrained ichthyoplankton. The goal of the proposed entrainment program is to estimate the seasonal and annual total abundance of fish eggs and larvae that become drawn into the offshore intake at JAFNPP and flow into the CWIS. The entrainment program will be documented in a project-specific Quality Assurance Plan (QAP) consistent with USEPA protocols (USEPA 2001). The QAP will describe the Standard Operating Procedures to be used for the field, laboratory, and data file preparation activities, and is included with this PIC as Appendix 3. The goal of the survival study would be to identify and delimit the actual effect of the operation of JAFNPP's CWIS on entrainable organisms and the benefit, if any, of application of these data to entrainment reductions.

The abundance of entrained fish eggs and larvae will be determined by sampling the intake flow in the JAFNPP CWIS. Sampling will begin in April 2006 and continue weekly through October 2006 for a total of 30 sampling weeks. Sampling will continue twice per month during November 2006 through March 2007 for an additional 10 sampling weeks. Continuing sampling during the late fall and winter periods when few or no entrainment of fish eggs or larvae are expected to be present is intended to define the beginning and end of the annual entrainment period. Entrainment sampling will be conducted on each sampling date as long as at least one CW pump is operating at the JAFNPP CWIS. Each weekly collection will occur on the same day in the week (e.g. Wednesday) and consist of one daytime sample and one nighttime sample. The intention is to separate the collection of daytime and nighttime entrainment samples symmetrically within the daytime and nighttime periods of each sampling date. Daytime is defined as occurring between one hour after meteorological sunrise and one hour before meteorological sunset as observed at the plant site. Nighttime is defined as occurring between one hour after meteorological sunset and one hour before meteorological sunrise as observed at the plant site.

Entrainment samples from the JAFNPP CWIS will be collected from two depths in the center of the common forebay: 14 feet below the water elevation and 20 feet below the water elevation, which is consistent with the depths sampled in the earlier studies (TI 1980). Therefore, the total number of entrainment samples for the 2006-2007 entrainment program at the JAFNPP CWIS will be 160 (2 depths x 2 diel periods x 40 dates), unless some samples cannot be collected due to plant outages.

Entrainment sampling at the JAFNPP CWIS will be conducted using an electric-powered "trash" pump with 3-inch intake and discharge hoses and a plankton net suspended in a tank. The net mesh is 0.500 mm Nitex. Earlier studies (TI 1980) deployed a 0.571 mm mesh net in the forebay of the JAFNPP CWIS for entrainment sampling, but this mesh size is no longer manufactured and recent nuclear safety standards preclude deploying nets in the forebay. Each entrainment pump sample will have a sample volume of at least 100 m³, as measured by a calibrated, in-line flow meter. The first entrainment sample will be randomly drawn from either 14 feet or from 20 feet below the water surface in the CWIS forebay, followed by the second sample drawn from the remaining unsampled depth. Pumping time is expected to be about 100 minutes to insure that the volume of each sample is at least 100 m³. Therefore, the total number of entrainment samples for the 2006 entrainment

program at the JAFNPP CWIS will be 160 (2 depths x 2 diel periods x 40 dates), unless some samples cannot be collected due to plant outages. All samples will be fixed at the time of collection in 4% buffered formalin and changed over to 80% ethanol within 24 hours. Rose Bengal will be added to stain the fish eggs and larvae and facilitate separating them from other material by sorting in the laboratory. Each sample jar will be labeled with a unique inventory number along with the date, time, and depth of collection.

In the laboratory, the two depth samples from each day or night collection on each sampling date will be combined into one composite sample for processing. Therefore, 60 composite samples will be processed in the laboratory for the 2006-2007 entrainment program at the JAFNPP CWIS, unless some samples cannot be collected due to plant outages. All fish eggs and larvae will be removed (sorted) from the total material collected in each composite sample, identified to the lowest possible taxonomic category (generally genus and species), and enumerated by life stage. Life stages will be defined as egg, yolk sac larvae, post yolk sac larvae, and juvenile. Samples with extremely high numbers of ichthyoplankton will be subsampled in the lab with Motoda plankton splitters according to established and statistically reliable protocols. In such cases, a minimum of 200 eggs and larvae will be sorted and identified from the subsample. For subsampling due to high detrital load when ichthyoplankton densities are low, high detrital load will be defined as more than 400 milliliters of settled volume of solids in the sample (detritus and plankton). If this occurs, a maximum of one-half of the sample will be sorted. A reference collection will be made for the species and life stages collected.

All laboratory sorting, fish identification, and enumeration will be subject to a standard and appropriate quality assurance/quality control review based on a Military Inspection Standard (MIL-STD) inspection plan derived from MIL-STD 1235 Single and Multiple Level Continuous Sampling Procedures and Tables for Inspection by Attributes to achieve a 10% Average Outgoing Quality Limit (AOQL), and a 1% AOQL for all data files, computations and reports. Please note that, for example, an AOQL of 1% means that the final data files will be certified through statistical inspection to document that less than one record (line of data) out of every 100 records will be in error. This level of quality meets or exceeds industry standards for impingement and entrainment studies. Computerized operational data files from JAFNPP will be obtained and used to extrapolate entrainment abundance (numbers per 100 m³) for each taxon and life stage up to diel, daily, weekly, monthly and total annual abundance based on the actual total circulating water flow for each sampling period.

8.3 LAKE ONTARIO SAMPLING TO DETERMINE INTAKE BASELINE CONDITIONS

In a letter from Mr. Roy A. Jacobson of NYSDEC to Mr. T.A. Sullivan of JAFNPP dated 22 June 2005, NYSDEC recognized that JAFNPP's offshore intake is different than the shoreline bulkhead intake used by USEPA to establish the Phase II Rule calculation baseline. Mr. Jacobson recommended that two years of studies commencing in 2006 would be required by NYSDEC to estimate the baseline impingement mortality and entrainment abundance for a hypothetical shoreline intake in the vicinity of Nine Mile Point. Accordingly, JAFNPP proposes a two-year program of Lake Ontario nearfield studies for JAFNPP beginning in April 2006 and continuing through October 2006. A second year of Lake Ontario sampling will be scheduled beginning in April 2007 and continuing through October 2007. Lake Ontario sampling will not be scheduled during the late fall and winter period of November through March due to unsafe conditions for small boats in the nine

Mile Point area of Lake Ontario. Data from April and October of each year will be extrapolated to these unsampled months.

The objective of this Lake Ontario sampling will be to obtain the data necessary to calculate the percentage reduction in impingement mortality and entrainment abundance due to the JAFNPP cooling water intake being located 900 feet offshore instead of being a shoreline bulkhead intake. The percentage reduction due to intake location will be defined as the ratio between the abundance, catch per unit of effort (CPUE), or density of fish from pairs of samples taken by the same gear and collection methods in the shoreline area of Nine Mile Point and in the vicinity of the JAFNPP intake. Calculating ratios from the fish samples taken by the same gear deployed at two different locations will eliminate the need to adjust the ratio for differences in gear efficiency, as would be the case if different gear were used in each location.

Sampling design, gear, and procedures for the Lake Ontario program will be consistent with the gear and procedures used in the earlier studies (TI 1980), except that hydroacoustic techniques will be added to the present study. Two transects perpendicular to shore will be established to coincide with two of the four transects established by TI (1980). Transect FITZ will be centered on the intake structure of JAFNPP, and is the same transect FITZ used by TI during the earlier studies. Transect FITZ-E will be located approximately 2000 ft. east of the JAFNPP intake. Transect FITZ represents the intake area, while transect FITZ-E is a nearfield control for the JAFNPP intake area that is not exposed to operation of the existing and permit-required fish deterrence system. Samples representative of the shoreline area of Nine Mile Point will be taken in Lake Ontario waters less than 10 feet of depth along each transect. Samples from the JAFNPP intake area of Nine Mile Point will be taken in Lake Ontario waters along the 25 foot depth contour along each transect, which is the depth contour where the JAFNPP intake is located. Therefore the following sampling stations will be designated for Lake Ontario studies to determine the impingement mortality calculation baseline:

A mathematical model will be developed and used to define the three-dimensional shape and boundaries of Hydraulic Zone of Influence (HZOI) or ‘withdrawal zone’ for the JAFNPP cooling water intake structure in Lake Ontario near Nine Mile Point. Once defined, the HZOI will be used to delimit a sampling station in Lake Ontario that is representative of the fish populations directly exposed to entrainment and impingement mortality at the JAFNPP CWIS. The HZOI determination will be made at least 30 calendar days prior to the onset of field sampling activities in April 2006 to allow the sufficient time to accommodate any sampling design or gear changes required to insure that fish are sampled within the HZOI.

8.3.1 Impingement Mortality Baseline

Hydroacoustics will be the primary sampling technique used to calculate the baseline adjustment ratio for impingement mortality at the JAFNPP CWIS. Arrays of digital, dual beam, elliptical transducers (facing 0°, 90°, 180, and 270° to each transect, or one continuously rotating transducer covering 360° in the horizontal plane) will be installed at fixed locations at the 10-foot and 25-foot contours along each of the two transects in the Nine Mile Point study area of Lake Ontario and used to provide continuous enumeration of fish abundance measured by signal (acoustic target) counting and fish biomass measured by echo integration during the April through October monitoring period of each year.

Species composition of adult and juvenile fishes quantified by hydroacoustics will be determined by sampling with sinking experimental gill nets deployed parallel to each contour as bottom sets at each station, but away from the transducer beams. Experimental gill nets will be 8 ft deep and consist of six 25-foot long panels of different mesh sizes randomly arranged in a linear sequence into one net 150 feet long. The gill nets will be made from treated multifilament mesh ranging in 0.5 inch increments from 0.5 up to 3.0 inches bar mesh. Gill net sets will be made twice per month from April through October of each year. Soak time will be 24 hours, with each gill net set deployed near sunset, tended approximately 12 hours later after sunrise, and retrieved near sunset on the following day. Therefore, for each month a total of 16 gill net samples will be collected (2 transects x 2 depth contours x 2 diel periods x 2 events per month), and there will be 112 total gill net samples (7 months x 16 samples per month) scheduled for completion during each year. All fish collected in each gill net sample will be identified to species, and total length (nearest millimeter) and wet weight (grams, $\pm 1\%$) will be recorded for a maximum of 50 individuals per species per sample. A project-specific reference collection will be made for each species and life stages collected, and all sampling activities will be performed under an approved Scientific Collector's Permit issued by NYSDEC for this study.

8.3.2 Entrainment Baseline

The baseline adjustment ratio for entrainment at the JAFNPP CWIS will be determined by comparing the density of ichthyoplankton in pairs of near-shore and near-intake samples collected with towed nets consistent with the gear and procedures used in earlier studies (TI 1979). If the HZOI is determined to be sufficiently small so that a 300 m³ plankton net tow cannot be taken primarily within the HZOI at the 25 ft. depth contour along transect FITZ, then Lake Ontario ichthyoplankton sampling will be performed by pump sampling using a 4-inch trash pump with a recessed impeller design capable of pumping at a rate of 250-300 gallons per minute (GPM) to collect 100 m³ samples.

Ichthyoplankton tows will be taken in the Nine Mile Point study area of Lake Ontario twice per month from April through October at each of the two transects and two depth contours sampled by gill nets. Surface tows will be taken at the 10-foot contour stations. Surface and mid-depth tows will be taken at the 25-foot contour stations during the daytime, and again during nighttime on the scheduled sampling dates. Daytime and nighttime will be defined as specified above (Section 8.2) for entrainment sampling. Ichthyoplankton tows will be taken with a 1m² Tucker trawl towed at a speed of 1 meter per second through the water. The Tucker trawl has a 1.0 m² net mouth opening and a 5:1 length to mouth ratio with a 0.500 mm mesh Nitex net. Earlier studies (TI 1980) deployed a 1.0 m diameter Hensen net with 0.571 mm Nitex mesh and a 6:1 length to mouth ratio for Lake Ontario ichthyoplankton sampling. The Tucker trawl proposed for this study has the advantage of a closing mechanism to collect discrete depth samples, and as discussed above for the entrainment net, the 0.571 mm Nitex mesh is no longer manufactured. The Tucker trawl has a closing device that uses a messenger to trigger a double-trip release mechanism that releases a weighted lead bar to close the mouth of the net and insure that each sample will be collected in each of the discrete depth strata. The closing mechanism will not be used when the Tucker trawl is deployed for a surface tow. Towing speed will be 1.0 m/sec for a duration of 5 minutes to insure an approximate 300 m³ sample, and tows will be made along each of the two depth contours parallel to shore. A flume-calibrated digital flowmeter (GO Model 2030R) will be placed slightly off-center in the mouth of the Tucker trawl to measure the distance (volume) of each tow. Tow depth will be determined in the field using a cosine function relating wire length and wire angle to sampling depth. The start and end of each towpath will be recorded using GPS. Samples will be fixed at the time of collection in 4% buffered formalin and

changed over to 80% ethanol within 24 hours. Rose Bengal will be added to stain the fish eggs and larvae and facilitate separating them from other material by sorting in the laboratory. Each sample jar will be labeled with a unique inventory number along with the date, time, and depth of collection. Therefore, for each month a total of 24 Tucker trawl samples will be collected (2 transects x 3 tows per transect x 2 events per month x 2 diel periods), resulting in a total of 168 ichthyoplankton samples collected during the 7-month period of April through October.

In the laboratory, each Lake Ontario ichthyoplankton sample will be processed separately from each depth and station. Therefore, 168 individual Tucker samples will be processed in the laboratory for the 2006 Lake Ontario ichthyoplankton sampling program at the JAFNPP CWIS, unless some samples cannot be collected due to inclement weather. The same number of samples will be scheduled for collected during 2007. Each Lake Ontario ichthyoplankton sample will be processed in the laboratory as described above in Section 8.2 for entrainment samples, and subjected to the same quality control standards and procedures.

9.0 LITERATURE CITED

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5. Operating and Maintenance Instructions for Jeffrey Traveling Water Screen, Sanitary #9-20-63-400
6. Operating Procedures (OP) and Abnormal Operating Procedures (AOP)
7. OP-04, Circulating Water System
8. OP-42, Service Water System
9. AOP-56, Traveling Screen and Trash Rack Differential Level
10. Drawings
11. FM-7A, -7C, Screenwell & Water Treating
12. FM-36A, Flow Diagram Circulating Water, System 36
13. FC-40D, -40E, -40F, -40H, -40J, Pumphouse & Screenwell Concrete Details
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15. FC-43B, -43C, -43D, -43E, Intake Structure

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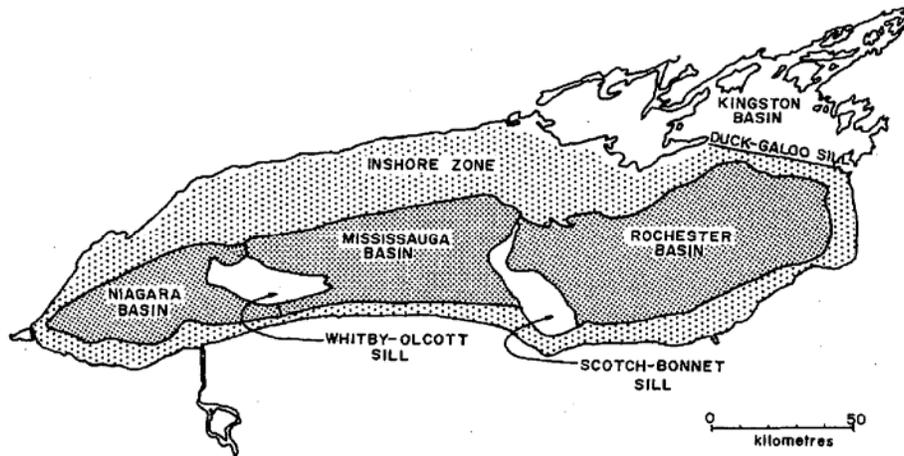


Figure 2-1. Major sedimentation basins of Lake Ontario (Flint and Stevens 1989).

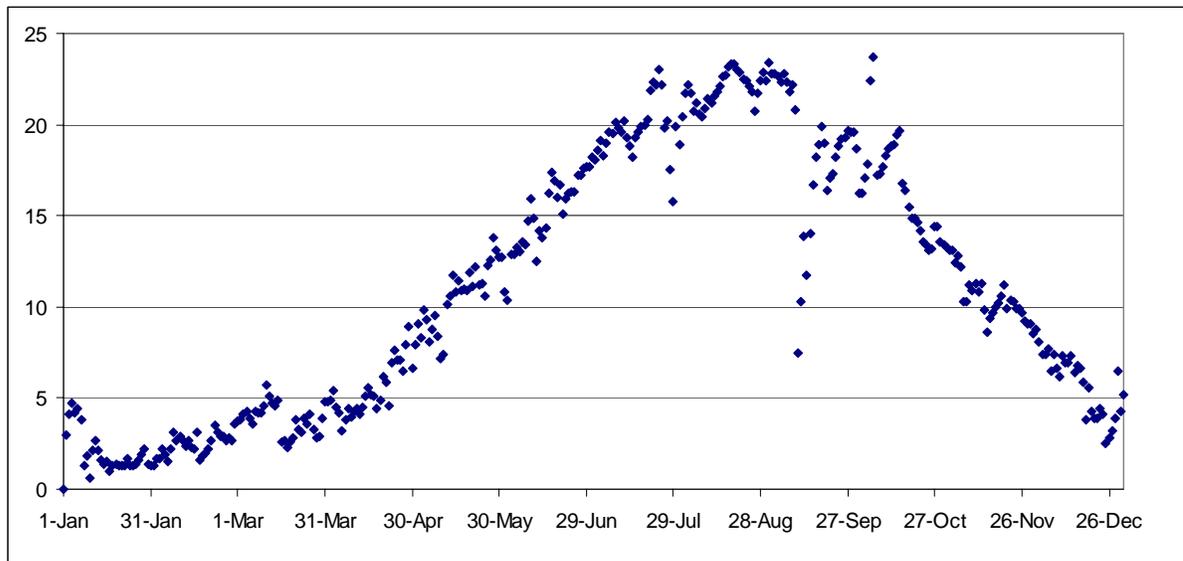


Figure 2-2. Lake Ontario daily water temperature (°C) measured in the circulating water intake flow from the James A. FitzPatrick Nuclear Power Plant, January through December 2004 (data from EA 2005).

Table 2-1. Monthly average intake water temperature (°C) at JAFNPP during 2004. Data from EA 2005.

Month	Average Temperature (°C)	Standard Deviation
Jan	2.0	1.1
Feb	2.5	0.6
Mar	3.8	0.9
Apr	5.5	1.4
May	10.6	1.7
Jun	15.3	2.0
Jul	19.7	1.5
Aug	22.1	0.9
Sep	18.3	3.8
Oct	16.3	2.8
Nov	10.4	1.2
Dec	5.7	1.6

**Table 4-1. FitzPatrick Nuclear Power Plant Monthly Average Condenser Cooling Water MGD for Jan 1998 through July 2005.
Calculation of Flow Reduction against baseline condition of continuous CWIS operations (service water excluded).**

	1998	1999	2000	2001	2002	2003	2004	2005	Average
January	495.6900	504.6000	506.4901	454.2921	493.0625	488.2720	447.0755	453.9835	480.4332
February	502.7000	512.7000	479.3599	453.8208	493.9866	452.0099	420.2277	456.3632	471.3960
March	513.0700	500.3200	538.3113	425.9037	485.2238	478.4039	444.0382	453.2311	479.8128
April	517.6000	545.6500	513.0458	518.3680	497.1974	518.3486	480.2595	460.1382	506.3259
May	499.4700	544.3200	544.3354	518.2845	497.6064	518.2023	484.1558	490.4343	512.1011
June	545.2900	570.2500	555.1464	518.2278	480.3366	518.3383	487.2176	518.3059	524.1391
July	583.4600	541.3900	570.4862	518.2109	500.8666	519.1052	488.7401	323.3892	505.7060
August	472.9000	596.2200	547.7166	518.1594	501.4326	489.8796	504.7053		518.7162
September	570.6200	586.2400	558.7290	518.0555	501.8552	518.1353	439.7184		527.6219
October	370.6600	490.7300	153.8457	518.2260	179.7645	518.1428	169.2936		342.9518
November	10.1300	488.2000	465.6749	518.2778	518.3568	518.2000	518.2936		433.8762
December	301.2100	533.4900	548.2760	518.2215	518.3007	501.2263	487.8342		486.9370
Yearly Average	448.5667	534.5092	498.4514	499.8373	472.3325	503.1887	447.6300	450.8351	480.7471
							Baseline Flow =		518.4
							Reduction from Baseline (2001-2004) =		7.3%

RED TEXT Flows include Service Water

Table 6-1. Selected water quality parameters of Lake Ontario, 1972-2000. Source: NMPNS 2004.

Parameter	1972^a	1978^b	1998-99^c	2000^d
pH	8.0	8.4	8.0	7.6
Total Alkalinity (mg/L)	72-90	94	92	83
Total Phosphorus (mg/L)	.01-.28	0.03	ND	ND
Total Dissolved Solids (mg/L)	107-186	202	ND	160
Total Nitrates (mg/L)	0.04-0.40	<0.18	ND	0.34
Turbidity	2-6 (JTU)	3.0 (NTU)	0.5 (NTU)	0.09 (NTU)

^a Source: U.S. Atomic Energy Commission. 1974

^b Source: Niagra Mohawk Power Corporation. 1985

^c Source: Heritage Power, LLC. 2000.

^d Source: Monroe County Water Authority 2001.

JTU= Jackson Turbidity Units

NTU= Nephelometric Turbidity Units

ND= no data available

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Table 6-2. Estimated impingement (based on flow), 1976-1997 and 2004. Estimated impingement numbers have been corrected for screen efficiency where applicable [i.e. Alewives, rainbow smelt, smallmouth bass, white perch, and yellow perch]. Source: EA 2005.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
1976	12,208	1,300	50,037	689,466	2,850,935	304,206	160,379	5,147	6,524	8,178	188,928	36,254	4,313,562
1977	19,526	5,068	13,813	50,490	119,725	15,910	152	223	15,560	32,428	29,711	30,837	333,443
1978	41,595	16,646	87,854	25,014	88,712	42,847	13,392	33,708	31,570	246	558	42,051	424,193
1979	13,436	9,115	8,362	5,629	14,453	1,675	219	227	18,132	30,649	46,209	96,123	244,229
1980	45,794	10,197	2,998	27,371	13,854	59,916	19,690	5,966	4,072	42,751	40,026	23,632	296,267
1981	6,169	8,046	17,572	44,405	34,936	35,879	55,165	116,356	49,081	153,223	2,378	4,050	527,260
1982	47,283	3,533	14,095	91,148	110,301	38,996	142,100	22,753	11,453	877	2,205	118,508	603,252
1983	4,826	1,421	3,945	9,832	51,562	2,739	832	4,945	15,071	2,870	1,277	16,674	115,994
1984	1,441	1,538	2,539	3,332	140,421	43,211	95,471	6,958	3,616	101	2,788	71,168	372,584
1985	16,065	6,486	0	20,715	186,113	117,628	53,100	22,900	31,458	2,716	128,768	10,020	595,969
1986	17,752	1,974	3,100	47,935	96,718	11,692	16,993	22,685	18,854	6,879	7,065	8,422	260,069
1987	42,959	912	103	5,775	55,500	7,494	8,936	9,127	3,437	6,570	4,349	19,220	164,382
1988	15,618	4,713	3,174	56,707	53,127	7,831	913	5,685	108	119	5,856	13,218	167,069
1989	8,521	3,732	1,136	32,120	196,640	217,552	17,628	735	985	22,166	11,122	2,699	515,036
1990	931	1,674	6,232	436	2,781	3,168	428	17,933	24,202	73,971	8,386	17,774	157,916
1991	7,597	2,183	2,022	60,703	27,755	12,887	1,993	1,296	521	565	13,097	2,675	133,294
1992	665	40	72	25	352	1,008	58	1,268	487	328	660	2,242	7,205
1993	2,120	7,271	883	5,760	7,668	4,885	1,663	1,148	1,117	6,121	379	2,074	41,089
1994	3,313	566	317	238	77,550	6,303	877	91,079	2,943	1,335	9,544	328	194,393
1995	16	0	2,550	31,134	26,918	51,889	7,516	10,212	253	2,361	2,635	22,468	157,952
1996	6,036	29,520	25,732	6,119	264,983	202,224	38,224	208	257	30,278	931	1,183,288	1,787,800
1997 ^a	127,004	955,468	81,274	22,849	29,410	8,968	439	526	612	490	2,337	692	1,230,069
2004 ^a	55,619	9,587	106,214	14,701	16,644	6,834	2,211	529	548	467	5,914	10,266	229,534
TOTAL	496,494	1,080,990	434,024	1,251,904	4,467,058	1,205,742	638,379	381,614	240,861	425,689	515,123	1,734,683	12,872,561

^a A full-scale fish deterrence system ran in its entirety for 1997 and 2004

Outages:

1976- No plant operating data
 1977- 22 Jun - 23 Sep
 1978- 17 Sep - 06 Dec
 1979- 16 Mar - 07Sep
 1980- 07 May - 13 Aug
 1981- 30 Oct - 31 Dec
 1982- 01 Jan - 09 Mar
 1983- 04 Jun - 02 Sep

1984- 16 Sep - 05 Nov
 1985- 16 Feb - 01 Jun
 1986- 15 Mar - 30 Mar; 29 Sep - 08 Oct
 1987- 16 Jan - 28 Apr
 1988- 28 Aug - 23 Nov
 1989- 16 Sep - 06 Oct
 1990- 01 Apr - 27 Jun
 1991- 09 Mar - 14 Apr; 08 May - 19 Aug; 28 Nov - 31 Dec
 1993- Several short duration outages

1994- 03 Apr - 04 May; 01 - 31 Dec
 1995- 01 Jan - 26 Mar; 31 May - 08 Jun; 06-12 Sep
 1996- 22 Feb - 06 Mar; 27 Oct - 11 Dec
 1997- Several short duration outages
 2004- 25 Sep - 24 Oct (Refueling Outage 16)

**James A FitzPatrick Nuclear Power Plant
 Proposal for Information Collection
 Submitted: January 31, 2006**

**Prepared In Consultation with:
 Enercon Services, Inc. and
 Normandeau Associates, Inc.**

Table 6-3. Total estimated impingement abundance (based on flow) for species of interest, 1976-1997. Source: EA 2005.

Year	Alewife ^a	Rainbow smelt ^a	Threespine stickleback	White perch ^a	Yellow perch ^a	Smallmouth bass ^a	Salmonids ^b	Spottail shiner	Gizzard shad	Trout perch	Tessellated darter	Sculpins
1976	3,916,717	282,373	95,883	8,436	3,770	521	159	11,683	16,732	12,183	6,708	
1977	187,305	107,134	4,442	13,353	1,526	555	94	5,970	10,931	1,550	953	
1978	67,991	81,480	222,837	6,739	10,076	1,170	49	6,459	15,468	3,479	2,157	3,425
1979	81,931	148,611	190	6,214	2,668	277	105	6,296	4,416	496	305	2,059
1980	171,465	85,049	85	6,019	1,750	231	65	2,077	14,017	2,545	1,539	2,893
1981	463,542	64,105	535	2,762	746	95	83	1,462	5,512	2,565	618	1,503
1982	350,003	255,749	792	2,590	1,236	980	190	3,440	1,055	1,600	420	2,417
1983	62,026	39,407	2,880	6,046	406	224	117	1,034	2,735	1,778	595	1,196
1984	273,931	85,708	1,373	2,384	530	253	193	2,953	4,058	2,794	4,496	1,327
1985	527,952	57,379	3,908	1,522	206	132	62	1,158	5,658	1,032	424	1,081
1986	176,972	71,039	1,880	1,453	274	141	184	3,172	1,346	2,144	460	1,556
1987	66,625	95,067	2,187	664	42	293	76	2,366	471	1,061	640	881
1988	111,468	26,351	2,288	2,759	465	2,268	141	3,977	3,712	1,221	1,668	4,916
1989	449,017	38,154	2,124	2,075	684	948	234	5,413	927	8,818	4,749	2,656
1990	15,156	110,848	845	2,210	156	576	110	3,809	26,173	524	2,738	1,117
1991	75,741	37,343	2,947	1,343	588	266	155	3,578	1,031	2,482	1,332	917
1992	1,312	2,179	78	53	198	64	14	282	40	180	986	1,043
1993	21,425	7,611	520	278	354	608	123	2,277	668	1,636	323	747
1994	74,552	97,643	3,209	517	192	1,202	79	5,569	42	7,755	652	1,076
1995	83,567	29,199	34,469	247	103	631	252	929	753	3,424	1,121	1,515
1996	346,593	29,436	1,392,763	559	436	359	224	4,662	26	6,923	916	948
1997 ^a	13,755	27,311	1,169,567	1,036	568	671	96	3,263	240	3,282	573	998
2004 ^a	16,796	1,527	201,563	481	403	1,106	146	534	263	923	68	1,393
TOTAL	7,555,842	1,780,703	3,147,365	69,740	27,377	13,571	2,966	82,363	116,274	70,395	34,441	35,664

^a Corrected for traveling screen efficiencies

^b A full scale fish deterrence system ran in its entirety for 1997 and 2004

Table 6-4. Annual percentages of Lake Ontario alewife and rainbow smelt impinged at JAFNPP.

Year	No. Impinged at JAFNPP		Lakewide Population*		Percent Impinged	
	Alewife	Rainbow smelt	Alewife	Rainbow smelt	Alewife	Rainbow smelt
1982	350,003	255,749	3,737,000,000	1,126,000,000	0.0094	0.0227
1983	62,026	39,407	4,484,000,000	1,188,000,000	0.0014	0.0033
1984	273,931	85,708	1,505,000,000	330,000,000	0.0182	0.0260
1985	527,952	57,379	3,150,000,000	2,080,000,000	0.0168	0.0028
1986	176,972	71,039	3,740,000,000	800,000,000	0.0047	0.0089
1987	66,625	95,067	1,860,000,000	4,370,000,000	0.0036	0.0022
1988	111,468	26,351	2,560,000,000	1,000,000,000	0.0044	0.0026
1989	449,017	38,154	3,514,000,000	2,095,000,000	0.0128	0.0018
1990	15,156	110,848	1,396,300,000	620,000,000	0.0011	0.0179
1991	75,741	37,343	2,723,000,000	1,066,000,000	0.0028	0.0035
1992	1,312	2,179	1,926,000,000	456,000,000	0.0001	0.0005
1993	21,425	7,611	2,888,800,000	1,383,000,000	0.0007	0.0006
1994	74,552	97,643	2,230,000,000	361,600,000	0.0033	0.0270
1995	83,567	29,199	2,293,000,000	2,650,000,000	0.0036	0.0011
1997	13,755	27,311	941,300,000	2,330,000,000	0.0015	0.0012

*Lakewide population estimates for U.S. Waters (Rochester Gas & Electric Corporation Unpublished) from NMPNS 2004.

Table 6-5. Analysis of variance tests of whether ichthyoplankton and fish abundances varied significantly among depth contours in the vicinity of Nine Mile Point in 1978.

Data Set	ANOVA Design	Significance ^a	
		Main Effects	Interactions
Eggs (day & night, summer only)	3-way	Depths *** Weeks *** Diel NS	Depth-Week NS Depth-Diel * Week-Diel NS
Eggs (day only, all 9 months)	2-way	Depths ** Weeks ***	None ^b
Yolk-sac larvae (day & night, summer only)	3-way	Depths *** Weeks *** Diel *	Depth-Week ** Depth-Diel * Week-Diel ***
Yolk-sac larvae (day only, all 9 months)	2-way	Depths *** Weeks ***	None ^b
Post yolk-sac larvae (day & night, summer only)	3-way	Depths *** Weeks *** Diel ***	Depth-Week * Depth-Diel NS Week-Diel ***
Post yolk-sac larvae (day only, all 9 months)	2-way	Depths *** Weeks ***	None ^b
Gill nets	2-way	Depths *** Months ***	Depth-Month**
Bottom trawls	3-way	Depths NS Weeks *** Diel ***	Depth-Week NS Depth-Diel NS Week-Diel **

^a NS = not significant (p>0.05)
 * = significant (p≤0.05)
 ** = highly significant (p≤0.01)
 *** = very highly significant (p≤0.001)

^b There was assumed to be no Depth-Week interaction for the 2-way ichthyoplankton ANOVAs, where there was no replication within each Depth-Week cell of the design

Table 6-6. Multiple comparison tests among depth contours for ANOVAs in which the main effect of depth was significant.

Data Set	ANOVA Design	Depth Contour	Tukey Grouping		Geometric Mean	
Eggs (day & night, summer only)	3-way	20	A		2.10	
			A			
		40	A	B	0.94	
				B		
		80	C	B	0.19	
			C	B		
		60	C	B	0.16	
			C			
		100	C		0.03	
Eggs (day only, all 9 months)	2-way	20	A		0.34	
			A			
		40	A	B	0.29	
			A	B		
		60	A	B	0.11	
			A	B		
		80	A	B	0.07	
				B		
		100		B	0.00	
Yolk-sac larvae (day & night, summer only)	3-way	20	A		7.46	
			A			
		40	A	B	4.92	
				B		
		60	C	B	2.76	
			C			
		80	C	D	1.63	
				D		
		100		D	0.90	
Yolk-sac larvae (Day only, all 9 months)	2-way	20	A		1.37	
			A			
		40	A	B	1.00	
			A	B		
		60	A	B	C	0.69
				B	C	
		80		B	0.56	
				C		
		100		C	0.34	

(continued)

Table 6-6. (Continued)

Data Set	ANOVA Design	Depth Contour	Tukey Grouping	Geometric Mean
Post yolk-sac larvae (day & night, summer only)	3-way	20	A	70.2
			A	
		40	A	63.5
			B	
		80	B	31.7
			B	
		60	B	29.2
			B	
		100	B	25.9
Post yolk-sac larvae (day only, all 9 months)	2-way	20	A	6.66
			A	
		40	A	5.85
			B	
		60	B	3.06
			B	
		80	B	3.03
			B	
		100	B	2.51
Gill nets	2-way	15	A	10.85
			B	
		40	B	4.31
			B	
		30	B	4.03
			C	
			C	
		60	C	2.84

Means with the same letter in the “Tukey Grouping” column are not significantly different from each other at the $\alpha = 0.05$ level of significance.

Table 6-7. Percentage differences of ichthyoplankton and gill net abundances for the mean of all deeper contours compared to the mean abundances for the shallowest depth contour.

Data Set	Shallowest Contour		Deeper Contours		Percent Difference
	Depth	Mean	Depths	Mean	
Eggs (day & night, summer only)	20	20.8	40, 60, 80, & 100	1.0	-95%
Eggs (day only, all 9 months)	20	1.1	40, 60, 80, & 100	0.4	-67%
Yolk-sac larvae (day & night, summer only)	20	31.3	40, 60, 80, & 100	8.6	-73%
Yolk-sac larvae (day only, all 9 months)	20	11.7	40, 60, 80, & 100	4.0	-66%
Post yolk-sac larvae (day & night, summer only)	20	178	40, 60, 80, & 100	145	-19%
Post yolk-sac larvae (day only, all 9 months)	20	60	40, 60, 80, & 100	41	-32%
Gill nets	15	17.1	30, 40, & 60	4.5	-74%

Contour depths are in feet. Mean abundances are number per 1000 cubic meters for ichthyoplankton and number per 12-hour set for gill nets. Percent difference = $100 * [(D - S) / S]$, where S = mean abundance at shallowest contour and D = mean abundance for all other depth contours combined.

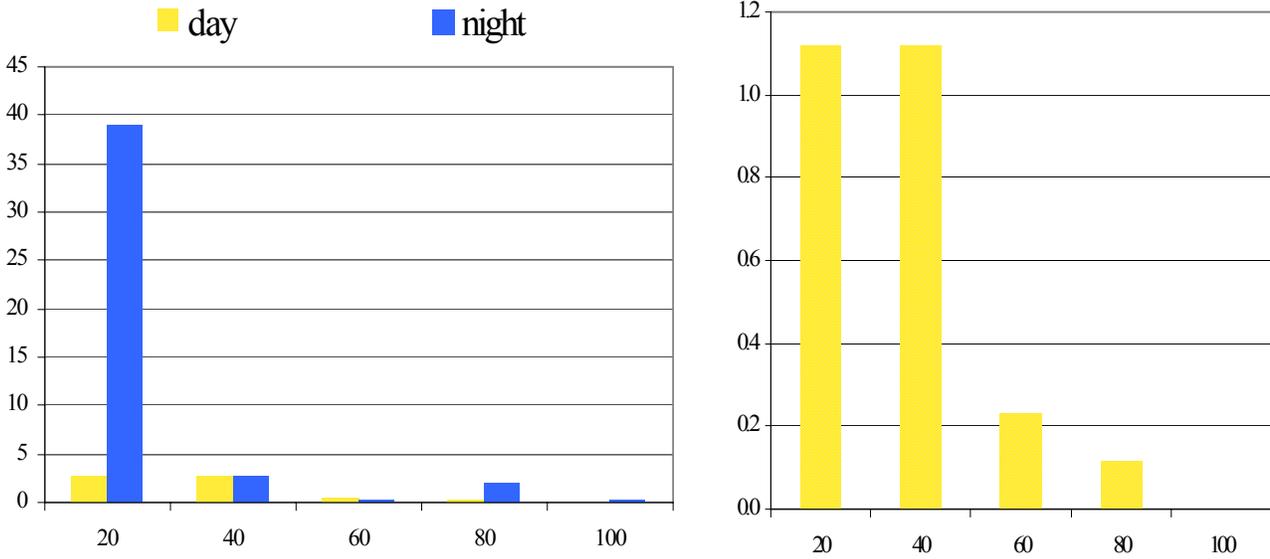


Figure 6-1. Average number of fish eggs per 1000 cubic meters near Nine Mile Point in 1978 at the 20-foot, 40-foot, 60-foot, 80-foot, and 100-foot depth contours (all species combined). Left graph: daytime and nighttime sampling, June through mid-September. Right graph: daytime sampling only, April-December.

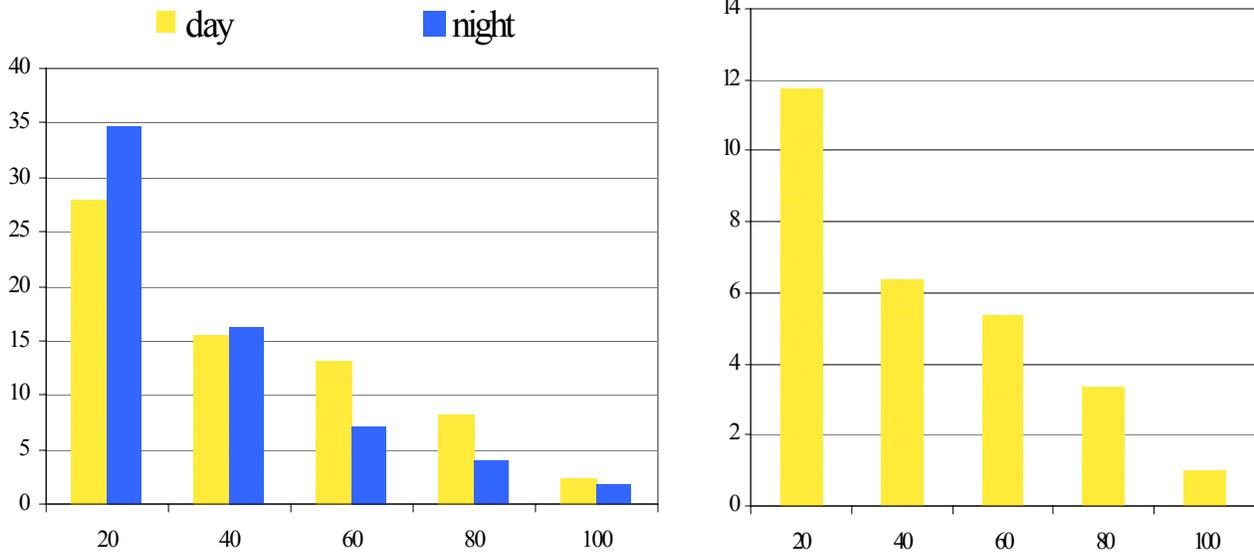


Figure 6-2. Average number of yolk-sac larvae per 1000 cubic meters near Nine Mile Point in 1978 at the 20-foot, 40-foot, 60-foot, 80-foot, and 100-foot depth contours (all species combined). Left graph: daytime and nighttime sampling, June through mid-September. Right graph: daytime sampling only, April-December.

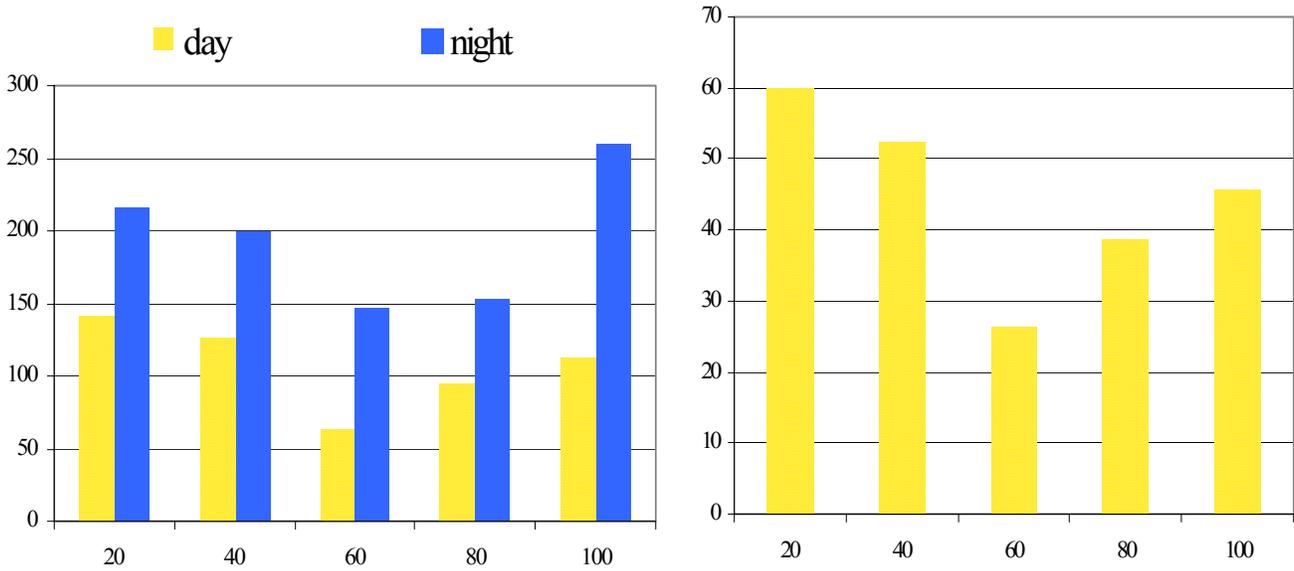


Figure 6-3. Average number of post yolk-sac larvae per 1000 cubic meters near Nine Mile Point in 1978 at the 20-foot, 40-foot, 60-foot, 80-foot, and 100-foot depth contours (all species combined). Left graph: daytime and nighttime sampling, June through mid-September. Right graph: daytime sampling only, April-December.

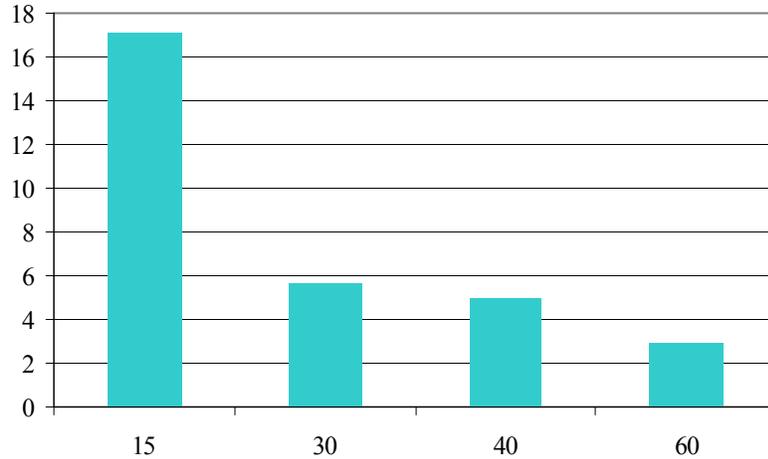


Figure 6-4. Average gill net catch per 12-hour set near Nine Mile Point in April through mid-December 1978 at the 15-foot, 30-foot, 40-foot, and 60-foot depth contours (dominant taxa of alewife, rainbow smelt, white perch, yellow perch, and smallmouth bass combined).

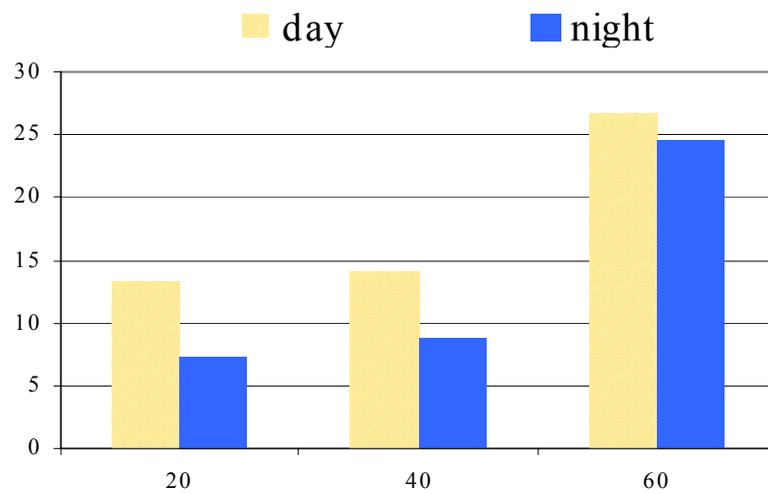


Figure 6-5. Average daytime and nighttime bottom trawl catch per 15-minute tow near Nine Mile Point in April through mid-December 1978 at the 20-foot, 40-foot, and 60-foot depth contours (all fish species combined).

APPENDIX 1

Reports and Relevant Agency Correspondence Regarding §316(b) at James A. Fitzpatrick Nuclear Power Plant (JAFNPP)

Reports Relevant Agency Correspondence

Letter from P.Kolakowski NYSDEC to D. Dunning NYPA, 1 March 1996

State Pollutant Discharge Elimination System (SPDES) Permit CP-04.03 for Entergy Nuclear Operations, Inc. James a. FitzPatrick Nuclear Power Plant, SPDES No. NY 002 0109, expiration date August 1, 2006.

January 24, 2005 Letter from Lynette M. Stark, Deputy Commissioner, New York Department of Environmental Conservation to Benjamin H. Grumbles, Assistant Administrator, USEPA , regarding determination of Best Technology Available for “existing facilities” in New York.

January 31, 2005 Letter from Denise Sheehan, Executive Deputy Commissioner, New York Department of Environmental Conservation to Mr. John G. Holsapple, Director of Environmental Energy Alliance of New York, regarding determination of Best Technology Available for “existing facilities” in New York.

March 14, 2005 Letter from Roy A. Jacobson, Unit Leader Steam Electric Unit, New York Department of Environmental Conservation to Mr. Michael Rodgers of Entergy Nuclear, regarding determination of Best Technology Available (BTA) 6 NYCRR §704.5 and 40 CFR §125-Subpart J (Phase II Rule) at FitzPatrick Nuclear Power Station.

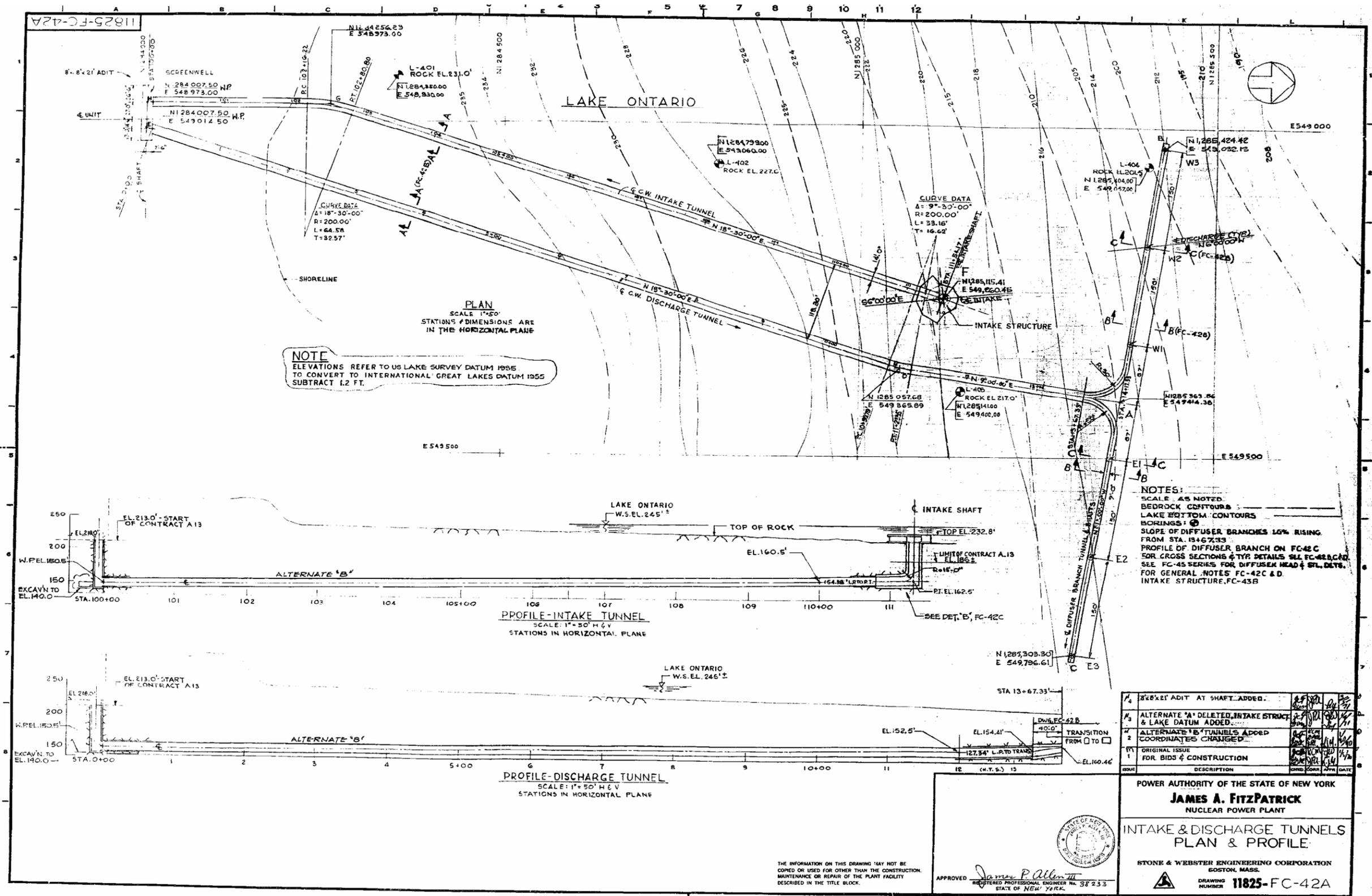
April 19, 2005 Letter from Mr. T.A. Sullivan, Site Vice President - JAF to Roy A. Jacobsen, Unit Leader Steam Electric Unit, New York Department of Environmental Conservation, regarding implementation of 6 NYCRR §704.5 and 40 CFR §125-Subpart J (Phase II Rule) at FitzPatrick Nuclear Power Station.

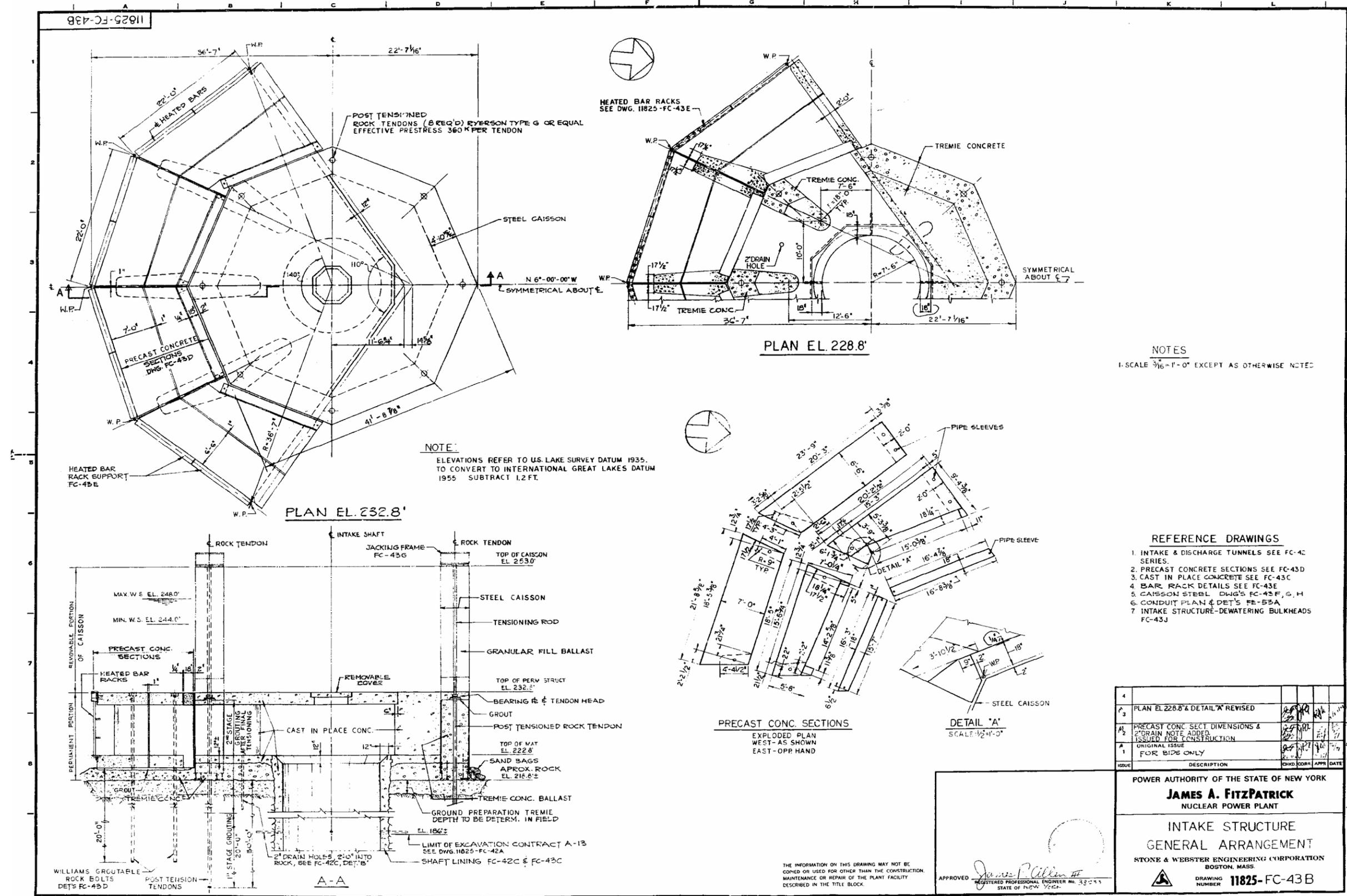
12 May 2005 Letter from Roy A. Jacobson, Unit Leader Steam Electric Unit, New York Department of Environmental Conservation to Mr. T.A. Sullivan, Site Vice President - JAF, regarding Best Technology Available (BTA) at FitzPatrick Nuclear Power Station.

22 June 2005 Letter from Roy A. Jacobson, Unit Leader Steam Electric Unit, New York Department of Environmental Conservation to Mr. T.A. Sullivan, Site Vice President - JAF, regarding implementation of 6 NYCRR §704.5 and 40 CFR §125-Subpart J (Phase II Rule) at FitzPatrick Nuclear Power Station.

APPENDIX 2

Drawings with Plan and Sectional Views of Intake Structure





NOTES
 1. SCALE 3/16" = 1'-0" EXCEPT AS OTHERWISE NOTED

- REFERENCE DRAWINGS
1. INTAKE & DISCHARGE TUNNELS SEE FC-42 SERIES.
 2. PRECAST CONCRETE SECTIONS SEE FC-43D
 3. CAST IN PLACE CONCRETE SEE FC-43C
 4. BAR RACK DETAILS SEE FC-43E
 5. CAISSON STEEL DWG'S FC-43F, G, H
 6. CONDUIT PLAN & DET'S FC-43A
 7. INTAKE STRUCTURE-DEWATERING BULKHEADS FC-43J

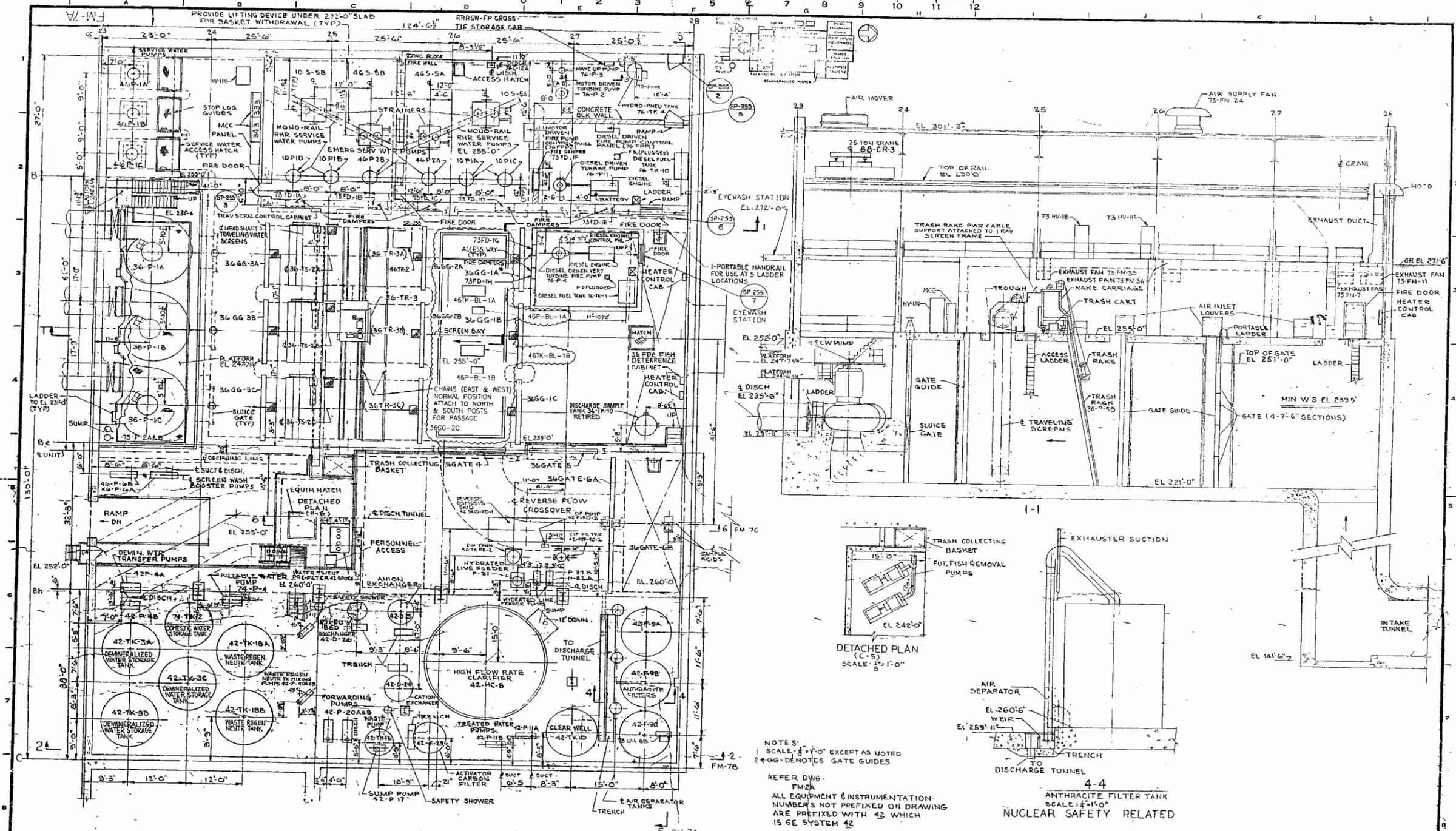
ISSUE	DESCRIPTION	CHKD	CDR	APPR	DATE
4	PLAN EL 228.8' & DETAIL 'A' REVISED				
3	PRECAST CONCR SECT DIMENSIONS & TORAIN NOTE ADDED				
2	ISSUED FOR CONSTRUCTION				
1	ORIGINAL ISSUE FOR BIDS ONLY				

POWER AUTHORITY OF THE STATE OF NEW YORK
JAMES A. FITZPATRICK
 NUCLEAR POWER PLANT

INTAKE STRUCTURE
 GENERAL ARRANGEMENT

STONE & WEBSTER ENGINEERING CORPORATION
 BOSTON, MASS

DRAWING NUMBER **11825-FC-43B**



REV	DATE	DESCRIPTION	BY	CHK	APP
29	11/14/00	AS BUILT PER DCR-97-139	...	...	...
25	11/14/00	AS BUILT PER MDD NO. FI-96-030	...	...	...
21	11/14/00	AS BUILT PER MDD NO. FI-91-149	...	...	...
24	11/14/00	AS BUILT PER DCR-97-414	...	...	...

REV	DATE	DESCRIPTION	BY	CHK	APP
31	11/14/00	INCORPORATED MOD. NO. M1-94-089	...	...	...
30	5/16/00	SCANNED AND REVISED FOR MOD NO M1-77-077	...	...	...

DWG		JAMES A. FITZPATRICK NUCLEAR POWER PLANT
CHK'D		
RESP. ENG.		
VERIFIED		
MACHINE LOCATION SCREENWELL & WATER TREATING PLAN & SECTION		
DATE		
SCALE	DWG NO	REV
	FM-7A	31
	SHEET OF	

APPENDIX 3

JAFNPP 2006 Entrainment Monitoring

Quality Assurance Plan and Standard Operating Procedures

January 2006

APPENDIX 3

QUALITY ASSURANCE PLAN AND STANDARD OPERATING PROCEDURES FOR ENTRAINMENT SAMPLING AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT LYCOMING, NEW YORK

(SPDES PERMIT NO. NY 0020109)

ENERGY NUCLEAR FITZPATRICK, LLC
James A FitzPatrick Nuclear Power Plant
277 Lake Road East
Oswego, New York 13126

Prepared In Consultation with



Enercon Services, Inc.
and
Normandeau and Associates, Inc.



R-20271.001

31 January 2006

Entrainment Sampling Quality Assurance Plan

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Entrainment Sampling Quality Assurance Plan

1.0 INTRODUCTION

Entergy Nuclear FitzPatrick, LLC (“Entergy”) owns and operates the James A. FitzPatrick Nuclear Power Plant (“JAFNPP”). JAFNPP is located on the southeastern shore of Lake Ontario approximately 7 miles (11 km) northeast of the city of Oswego, New York in Lycoming, New York. A one-year entrainment sampling program is proposed for JAFNPP beginning in April and continuing through October 2006 because the most recent and comprehensive annual entrainment data were obtained during the 1973-1979 studies described in the Proposal for information collection (PIC), and because the present fish community in the Nine Mile Point area of Lake Ontario may have changed since then. JAFNPP may undertake a second year of entrainment sampling in 2007 to verify the results observed during 2006 if appropriate. The goal of the proposed program is to estimate the seasonal and annual total abundance of fish eggs and larvae that become drawn into the offshore intake at JAFNPP and flow into the CWIS. This document is a project-specific Quality Assurance Plan (QAP) consistent with USEPA protocols (USEPA 2001) that describes the Standard Operating Procedures to be used for the field, laboratory, and data file preparation activities, and is included with the PIC as Appendix 3.

1.1 ORGANIZATION OF THIS DOCUMENT

Following a narrative description of the cooling water intake structure (CWIS) at JAFNPP (Section 2.0) are separate stand-alone Standard Operating Procedures (SOPs) for entrainment field (Section 3.0), and entrainment laboratory activities (Section 4.0). Within each of the two SOPs, subsections from the following list that are applicable to that SOP are included: sampling schedule and location, equipment, procedures, sample handling, data handling, quality control, reference collection, and instrument calibration and maintenance. Procedures for data processing, from receipt of completed data sheets to the final data files, are described in Section 5.0. A system for providing the appropriate training for project personnel is described in Section 6.0. Quality Assurance procedures are described in Section 7.0.

2.0 COOLING WATER INTAKE STRUCTURE DESCRIPTION

The CWIS at JAF is a submerged, shore-facing, remote intake with a total design intake flow of 388,600 gallons per minute (gpm). The CWIS is shared primarily by the Circulating Water (CW) and Service Water (SW) systems, and is located about 990 feet inland from the shoreline of Lake Ontario at coordinates N 43°31’37” and E76°23’49”. The top of the CWIS is at elevation 232.8 feet, approximately 14 feet beneath the lake surface, which typically varies from elevation 244.0 feet to 248.0 feet. The intake consists of four segmented shore-facing openings, each 22 feet wide and 8 feet high, feeding a 14 foot diameter D-shaped intake tunnel that runs beneath the lake bed approximately 1,150 feet to the offshore screenwell and pumphouse. The base mat of the CWIS is at elevation 222.8 feet, approximately four feet above the lake bottom elevation of 218.8 feet.

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Nine acoustical projector housings are symmetrically installed on top of the remote intake structure roof, located at elevation 232.8 feet, to provide for fish deterrence. The projectors can be removed for the winter months due to the ice packs possibly defacing the projector faces. The function and effectiveness of this system is discussed in detail in Section 5.1 (below) describing “Currently Implemented Technologies”.

There are two sets of bar racks, an internally heated bar rack at the remote intake, and a trash bar rack in the screenwell of the CWIS. The heated bar rack at the remote offshore intake consists of 3 inch by 2 inch rectangular vertical bars on 12 inch centers across each 22 foot by 8 foot intake opening, a total of 88 bars. The primary purpose for this heated bar rack is the prevention of intake clogging due to frazil ice and/or large debris. The bar rack heaters are energized anytime water temperature is $\leq 37^{\circ}\text{F}$ to prevent/remove ice formation. There are no installed systems to remove large debris from these racks with the plant operating, although original plant design provided “reverse flow” capability to backwash the remote intake racks when the plant is not at power. The design water velocity through the bar rack at the remote intake is 1.2 feet per second with all three circulating water pumps operating (fps; TI 1979).

The trash bar rack in the CWIS consists of three 12 foot wide vertical bar racks, one installed in front of each traveling water screen, retaining debris equal to or greater than 3.125 inches. A movable trash rake is used to clear away debris collected on the screenwell trash racks, capable of being manually traversed to service any of the three racks to remove debris. Permanent instrumentation monitors trash bar rack differential pressure, and Operations manually rakes trash off the racks when high differential pressure, i.e. debris loading, is indicated. If differential pressure is excessively high, ≥ 12 inches W.C., an alarm is annunciated in the control room and compensatory actions must be initiated.

The traveling water screens are furnished by Jeffrey Manufacturing Company of Columbus, Ohio, in accordance with Purchase Specification APO-36. Three 12 foot wide traveling screens, fabricated from No. 10 gauge semi-hard drawn copper wire with 3/8 inch clear openings, are situated between the trash racks and the pump intake sluice gates. Each screen has a design capacity of 125,000 gpm, is 12'-0" wide and 43'-4" high, and has a design approach velocity of 1.2 fps. The four speed, ranging from 10 fpm to 20 fpm, traveling screens retain debris 3/8 inches and dump it into a collecting trough. The steel trash trough has flanged ends for each screen section designed so that the flanged ends will mate for bolting when the screens are installed in place to form one continuous pitched trash trough mated to a trough extension. The bottom flange of each panel forms a trash shelf extending the entire width of the panel. The shelf design includes a substantial dredging leaf rake extending the width of each panel at the panel midpoint for refuse removal and is designed for minimum reduction of free area. This rake has tines to engage and raise moss and other lake vegetation. The carrying ledge portion of the lip is able to retain fish and is perforated to drain water. The panels are constructed and so attached to the chain that there is no opening larger than the screen cloth opening for debris to get through at the line of articulation along the sides or bottom when they are stationary or moving.

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Two 100% capacity (1 running, 1 standby) screen wash pumps take suction from the SW discharge header to provide backwash spray water for the traveling screens. The spray system utilizes non-clogging, wear resistant deflector type nozzles, designed to project overlapping fan shaped jets of spray water across the width of the screen so that all material picked up on the screen, trash shelf, and the special dredging leaf rake will be jetted off when the panels are ascending. Debris is jetted in a direction opposite the direction of flow of water in the intake channel. The design screen wash pumps spray flow rate is 720 gpm/screen, at a minimum of 80 psi gauge pressure. Water is sprayed on all screens simultaneously from two screen wash headers whenever the traveling screens are rotating.

The traveling screens and screen wash pumps are equipped with an automatic differential level control and can be operated manually or in automatic mode. When in the automatic mode, the screens and pumps will start when the screen wash pump discharge pressure is > 100 psig, and either of two conditions occur:

1. High screen differential level, 4 inches W.C., as sensed by level detectors across the screens.
2. 10-minute daily exercise timer is initiated.

Design debris loading conditions for the traveling screens correspond to 1.6 inches differential W.C. clean, up to 6 inches differential W.C. fully loaded. The traveling screens will automatically stop if the screen differential level is <2 inches W.C. for 10 minutes. An adjustable timer is included to insure that the screen will run for at least 1-1/3 revolutions after minimum level differential is attained to assure that debris is completely removed and not just lifted out of the water and allowed to dry on the panels. If any of the screens runs continuously for 30 minutes or if the differential level across the screens reaches 6 inches W.C., an alarm is sounded in the main control room. Per the CW Operating Procedure, OP-4, at least once per shift the traveling screens are operated, either in “automatic” mode, or manually in “continuous” mode.

The JAFNPP CWIS contains three vertical, mixed flow, dry pit type circulating water pumps. Each single speed intake pump has a rated 27 feet of total dynamic head (TDH), and a rated flow of 120,000 gallons per minute (GPM). The pump drivers are open, drip-proof, induction motors rated at 1,000 HP. During normal plant operation, all three CW pumps are operating with a combined design circulating water intake flow of 360,000 GPM (5.1×10^8) measured through the condensers.

3.0 ENTRAINMENT FIELD SOP

3.1 SAMPLING SCHEDULE AND LOCATION

Entrainment sampling at JAFNPP during 2006 is scheduled weekly during April through October and twice per month from November 2006 through March 2007 for a total of 40 sampling weeks. Each weekly collection consists of one daytime sample and one nighttime sample. The abundance of entrained fish eggs and larvae will be determined by sampling the intake flow in the JAFNPP CWIS. Sampling will begin in April 2006 and continue weekly through October 2006 for a total of 30 sam-

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pling weeks. Sampling will continue twice per month during November 2006 through March 2007 for an additional 10 sampling weeks. Entrainment sampling will be conducted on each sampling date as long as at least one CW pump is operating at the JAFNPP CWIS. Each weekly collection will occur on the same day in the week (e.g. Wednesday) and consist of one daytime sample and one nighttime sample. The intention is to separate the collection of daytime and nighttime entrainment samples symmetrically within the corresponding periods of each sampling date. Daytime is defined as occurring between one hour after meteorological sunrise and one hour before meteorological sunset as observed at the plant site. Nighttime is defined as occurring between one hour after meteorological sunset and one hour before meteorological sunrise as observed at the plant site. Entrainment samples from the JAFNPP CWIS will be collected from two depths in the center of the common forebay: 14 feet below the water elevation and 20 feet below the water elevation, which is consistent with the depths sampled in the earlier studies (TI 1980). Therefore, the total number of entrainment samples for the 2006 entrainment program at the JAFNPP CWIS will be 160 (2 depths x 2 diel periods x 40 dates), unless some samples cannot be collected due to plant outages.

3.2 EQUIPMENT

Collection gear for JAFNPP entrainment sampling consists of an electric-powered “trash” pump with 3-inch intake and discharge hoses and a plankton net suspended in a tank. The net mesh is 0.500 mm. The following additional equipment is required for entrainment field sampling:

- copy of SOP and copy of Health & Safety Plan
- flowmeter,
- data sheets, clipboard, and pencils,
- watch,
- flashlight,
- net washdown pump,
- sieve, plastic basin, and funnel,
- sample jars,
- formalin,
- rose bengal, and
- labels and waterproof markers.

3.3 PROCEDURES

3.3.1 Operation of the Electric Entrainment Sampling Pump

1. Check to insure the pump is connected to a power supply.
2. Remove the fill cap from the pump housing and fill the chamber with water to prime it.
3. Replace the fill cap.
4. Turn the power switch to on.

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5. Monitor the entrainment tank for water flow. If there is no flow within 90 seconds stop the pump, check for air leaks, re-prime, and repeat steps 2-5.
6. Once a continuous flow is obtained, observe the flow rate at the flow meter to verify that the flow rate is 250 gallons per minute ($\pm 10\%$).
7. Check the flow meter calibration as described in Section 3.3.2 below.
8. Install the sampling net and begin collecting the sample as described in Section 3.3.3 below.

To stop and secure the pump:

1. Turn the power switch to off.
2. Drain the pump hosing using the drain located at the bottom of the housing.
3. Leave the valve open.
4. Wipe off any water that is on the pump motor.
5. Drain the sampling tank and secure the flow meter.

3.3.2 Flow Meter Calibration

Prior to the first sample each month, measure the flow rate delivered by the sampling pump by filling to overflowing a calibration vessel of known volume (the sampling tank, which holds 268 gallons) and noting the time required to the nearest 0.1 second. During this test, the pump should be operating in the typical RPM range used for sampling. Record the flow rate (gpm) indicated on the flowmeter gauge during the calibration test. Calculate the observed flow rate as follows:

$$\text{calibration gpm} = \text{calibration gallons} / (\text{calibration seconds}/60)$$

Then calculate the percent error indicated by the calibration trial as follows:

$$\text{percent error} = 100 \times (\text{gauge gpm} - \text{calibration gpm}) / \text{calibration gpm}$$

The percent error can be positive or negative depending on whether the gauge gpm was larger or smaller than the calibration gpm. Record the results on the Entrainment Field Data Sheet, *including the minus sign* if the percent error was negative. If the absolute value of the percent error is less than 3% then no further action is necessary.

If the absolute value of the percent error is more than 3% then repeat the calibration trial two more times and average the three results, recording the results on the Entrainment Field Data Sheet. Keep the minus signs, if any, in calculating the average (if there are both positive and negative percent errors, they will partially cancel each other out). If the absolute value of the average percent error is less than 10% then no further action is necessary.

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If the absolute value of the average percent error is more than 10% then replace the flowmeter and return it to the manufacturer for servicing. If there is no replacement flowmeter available immediately, continue to collect samples with the one that failed calibration, but enter the code for “flow-meter problem” in the sample status box on the Entrainment Field Data Sheet. (It may be feasible to estimate the sample volume by comparing the duration to durations of samples with known volumes collected during similar tidal conditions.)

3.3.3 Sample Collection

Shortly before the scheduled start of the first (daytime) sampling period, randomly select the first sampling depth (either 14 feet or 20 feet) and lower the sampling pipe into position, check the entire entrainment sampling system, connect all piping, prime the pump, and set collection nets next to the tank. Install the Signet probe in the T valve and secure it in place, taking care to protect the sensor cables.

Start the pump and adjust the flow rate to approximately 250 gallons per minute (gpm).

Record the time that water begins to enter the sampling net and record the totalizer reading. Fill out the sample identification information at the top of the Entrainment Field Data Sheet (Section 3.5.1).

Check the flowmeter gauge periodically and adjust the pump throttle if necessary to maintain a pumping rate of about 250 gpm.

At times, clogging of the net mesh may make it necessary to switch to a clean net during a sample (possibly as frequently as every 20 minutes). To switch nets, move one net to the side, placing the other net under the flow, and remove the original net to collect a subsample without interrupting sample collection. If subsamples are collected in this way before the sample is completed, concentrate and preserve the sample material after each net switch in the same manner as described below for the completed sample. More than one subsample may be preserved in the same jar, but if multiple jars are used, label each one with the same sample number and indicate that multiple jars were used (e.g. “1 of __”).

Wait until the totalizer indicates 27,000 gallons to make sure that at least 100 cubic meters of water has been sampled before ending the sample. After the volume has reached at least 27,000 gallons, turn off the pump, and record the time and totalizer reading. At a pumping rate of 250 gpm, a sample will take a little over 1 hour and 45 minutes to complete.

When the sample is completed (and any time plankton nets are exchanged during a sample due to clogging), wash the sample (or subsample) into the cod end bucket using a washdown pump. Collect the sample material from the cod end bucket and place it in a labeled sample container. A 0.500 mm or finer sieve may be used to remove excess water from the sample before transferring it to the sample jar. Take care that none of the sample is spilled, and that the contents of the net and cod end bucket are completely rinsed into the sample container or sieve. Pouring the sample into the jar should always be done over a larger container in case some sample is spilled. Sample containers and cod end buckets that are open should be set down only in a container or bucket, just in case the sam-

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ple is spilled. Preserve the sample by adding sufficient formalin to make the final concentration 5% (50 mm of full-strength formalin per liter of sample).

Repeat the above procedures for three additional diel samples within the 24-hr collection period. The starting times of the four diel samples should be six hours apart. Reset the totalizer reading on the flowmeter to zero in between samples.

Before leaving the site, disconnect and drain the system (and drain the pump housing to prevent freezing during colder months).

3.4 SAMPLE HANDLING

Fill entrainment sample jars completely by addition of 5% formalin. Sample jars should be no more than 25% full of organisms and debris for adequate preservation. Label the jars externally with the sample number and the number of jars (e.g., 1 of 4, 2 of 4, etc.). Place an internal label in each jar giving the sample number.

3.5 DATA HANDLING

3.5.1 Data Sheets and Coding Instructions

A unique sample number is assigned to each JAFNPP entrainment collection. The sample number is a four-digit number that is a composite of sample type (2 for entrainment), week number (two digits), and diel period (one digit). Record the sample identification and status, collection times, flowmeter readings, and flowmeter calibration data on the Entrainment Field Data Sheet (Appendix A) according to the instructions below. Use the space for comments at the bottom of the data sheet to explain any problems or unusual circumstances. Use a separate data sheet for each sample.

Use the flowmeter calibration section of the Entrainment Field Data Sheet once per month, on the data sheet for the first entrainment sample of the month. Only one calibration trial may be necessary (Section 3.3.2).

VARIABLE	INSTRUCTIONS
Type	Precoded 2 for entrainment
Week	Enter week number within year (1-52). The week number corresponding to each sampling date is shown in Appendix C.
Diel	Enter the code for diel period: 1= daytime 2= nighttime
Status	Enter code for status of sample: 0 = void (no sample) 1 = valid sample

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VARIABLE	INSTRUCTIONS
	2 = sample is provisional due to flowmeter problem
Comments	If comments are written at the bottom of the data sheet, enter 1; if not, leave it blank
Start Month	Record the month that the 24-hr sampling event began (should be the same for all samples collected in the 24-hr period)
Start Day	Record the day that the 24-hr sampling event began (should be the same for all samples collected in the 24-hr period)
Start Hour	Record the hour that the 100-cubic-meter diel sample began, using 24-hr clock (0000-2359 hrs)
Start Minute	Record the minute that the 100-cubic-meter diel sample began, using 24-hr clock (0000-2359 hrs)
End Hour	Record the hour that a 100-cubic-meter diel sample (or a subsample) ended, using 24-hr clock (0000-2359 hrs)
End Minute	Record the minute that a 100-cubic-meter diel sample (or a subsample) ended, using 24-hr clock (0000-2359 hrs)
Gallons, end	Record the flowmeter reading for total gallons at the end of the sample
Gallons, start	Record the flowmeter reading for total gallons at the beginning of the sample
Gallons, difference	Subtract the starting flowmeter volume reading from the ending flowmeter volume reading
Gauge gpm	Record the pumping rate indicated by the flowmeter gauge to the nearest gallon per minute
Calibration seconds	Record the time to the nearest 0.1 seconds needed for the sampling pump to fill the calibration tank
Calibration gallons	Enter the calibration tank volume (268 gallons for the aluminum tank)
Calibration gpm	Calculate the observed pumping rate by dividing the calibration time by 60 then dividing that number into the calibration volume (record the result to the nearest gallon per minute)
Percent error	Calculate % error as described in Section 3.3.2 and record the result to the nearest 0.1% (keep the minus sign if it is negative)
Average % error	Calculate average % error as described in Section 3.3.2 and record the result to the nearest 0.1% (keep the minus sign if it is negative)

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3.5.2 Storage and Chain of Custody of Data Sheets

Check over all data sheets, to make sure they are completely and correctly filled out, and to be alert to any unusual or unexpected data values. Transport the original data sheets to the field office, file a photocopy of each data sheet there for safe keeping and QA/QC verification, and dispatch the originals to data center.

3.6 HAZARDOUS SUBSTANCES LOG

Maintain a log of the amounts of formalin brought on site. Include in each log entry the date, the name of person making the log entry, and the volume in gallons of formalin brought on site on that date (Appendix A). Make the log available for inspection as requested by JAFNPP's representatives. Provide the log to JAFNPP's Environmental Health and Safety department at the end of the project.

4.0 ENTRAINMENT LABORATORY SOP

4.1 SAMPLES TO BE ANALYZED

Entrainment sampling at JAFNPP during 2006 is scheduled weekly during April through October for a total of 30 sampling weeks. Sampling will continue twice per month during November 2006 through March 2007 for an additional 10 sampling weeks. Each weekly collection consists of samples from two depths collected during the daytime and again during nighttime. The total number of entrainment samples delivered to the laboratory for the 2006-2007 program will be up to 160 (2 depths x 2 diel periods x 40 dates), and possibly less if some samples cannot be collected due to plant outages. However, in the laboratory, the two depth samples from each day or night collection on each sampling date will be combined into one composite sample for processing. Therefore, 80 composite samples (40 weeks x 2 diel periods) will be processed in the laboratory for the 2006-2007 entrainment program at the JAFNPP CWIS, unless some samples cannot be collected due to plant outages.

4.2 EQUIPMENT

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

- Sorting pans
- Lights
- Magnifiers
- Dissecting microscopes
- Motoda plankton splitter
- Sieves
- Rose bengal
- Gridded Petri dishes
- Divided Petri dishes
- Jars, with lids

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- Forceps
- Pipettes
- Multitally counters
- Squirt bottles
- Lab data sheets
- Pencils
- Vials, with caps
- Vial labels
- Taxonomic literature
- Copy of SOP
- Ocular micrometers
- Millimeter rulers
- Masking tape
- Rubber bands
- Random number table

4.3 PROCEDURES

4.3.1 Sample Preparation

Two diel periods (daytime and nighttime) will be sampled on each sampling day in each of 30 consecutive weeks (April through October) plus an additional 10 weeks (November through March), and two depths (14 ft and 20 ft) will be sampled during each diel period. Once the entrainment samples have been received by the laboratory, the two depths sampled for each day and diel period should be paired up and combined to represent one depth-integrated sample. Each depth-integrated or composite sample will be analyzed as representative of the entrainment collection for the corresponding diel period. Therefore, 160 entrainment samples will be collected (40 weeks x 2 diel periods x 2 depths) and 80 composite samples (40 weeks x 2 diel periods) will be processed in the laboratory for the 2006-2007 entrainment program for the JAFNPP CWIS, unless some samples cannot be collected due to plant outages. All subsequent analysis described in this laboratory SOP will be of these depth-integrated or composite samples.

4.3.1.1 Subsampling Restrictions and Quotas

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

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

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4.3.1.2 Sample Splitting Sequence

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

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

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

4.3.1.3 Sample Splitting Technique

Perform all sample splitting using a Motoda splitter. The presence of filamentous algae or large items (including large juvenile fish, or older age classes) can interfere with the even distribution of material and organisms between the two chambers of the splitter. Therefore, to insure successful results, observe the following techniques: (1) Adjust sample dilution to be great enough to allow free mixing of the sample but not so great as to promote clumping due to over dilution. (2) Remove large fish and excessive amounts of filamentous algae before splitting, returning any adhering ichthyoplankton to the sample. (3) Pull apart remaining clumps of algae before splitting. (4) Scrutinize detritus and organisms during the splitting process to see that they appear equally distributed before making the final division. (5) Remix and split again if the two resulting portions of a division do not appear equal. If

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a sample has so much algae that it cannot be satisfactorily split, sort the entire sample, and if numbers of ichthyoplankton are high splitting may be performed after sorting. Large juveniles that are removed from the whole sample before splitting must be kept separate from ichthyoplankton sorted from the sample after splitting, and they must be labeled to show they represent the whole sample.

4.3.2 Sorting

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

- Samples may be stained with rose bengal to facilitate sorting.
- Pour the sample contents into a sieve with a mesh equivalent to, or finer than, 500 µm and rinse with water to remove the preservative.
- If the sample contains large numbers of eggs and larvae, prepare a subsample following the procedures in Section 4.3.1.
- Carefully wash the sample contents into a container making certain that nothing remains in the sieve. Pour portions of the sample from the container into a pan and examine them under a magnifying lens.
- Remove fish eggs, larvae, and juveniles from the sample using forceps, pipettes, and probes. Remove only those fragments that include the head.
- Maintain a combined total count for eggs and larvae that are removed from the sample (i.e., the combined total of eggs, yolk-sac larvae, post yolk-sac larvae, and juveniles).
- When sorting is completed, recheck the sample for organisms. After the sample has been rechecked, label vials containing the sorted organisms and place them in a box designated for sorted samples. Record the sorting results and date completed in a log.
- Carefully wash back the remaining sample contents into the original sample container, appropriately preserved, and return it to the storage area.
- If a sample is not completed by the end of the work day, it may be left unpreserved overnight if adequate precautions are taken to prevent it from drying out. No sample or part of a sample, however, should remain unpreserved for more than 24 hours.

4.3.3 Identification

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

- Obtain the sample vials containing the sorted organisms from the storage area and sign them out by initialing a status log.
- Rinse specimens free of preservative and submerge them in water in a Petri dish. Use a binocular microscope with an ocular micrometer to examine the specimens, and identify

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them to the lowest practical taxon (usually species) by referring to the literature, the reference collections, and by consulting with fellow identifiers.

- Determine the life stage of each specimen. Pertinent life stages for all larvae are defined and identified as follows:

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

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

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

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

Yearling or older: a fish at least one year old.

- Count the specimens of each life stage. Record the counts by species and stage on the lab data sheet (refer to Section 4.5.1 for coding instructions).
- From each sample, measure a maximum of 30 larvae of each fish species to the nearest 0.1 mm (total length) and record the measurements on the lab data sheet. If juvenile fish are present in the sample, they will be measured to the nearest 1.0mm (total length). If more than 30 larvae are present, randomize the selection of specimens for measuring by the following procedure. Spread them uniformly in a gridded container, select a starting point in the grid by means of a random number table, and then measure the first 30 measurable specimens encountered in a predetermined pattern commencing at the starting point. Every grid space must have an equal probability of being selected as the starting point, so that every specimen will have an equal probability of being included in the sub-sample.
- Place identified organisms in vials with an adequate amount of preservative for storage. Specimens may be removed for inclusion in the reference collection. For those removed, list the species, life stage, and numbers on the comments section of the form and note their removal on a tag retained inside the appropriate vial. Label all vials for a single sample, initial them and band them together. Record the number of vials for the sample on the data form. For reference collection procedures refer to Section 4.7.

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4.4 SAMPLE HANDLING

4.4.1 Sample Control

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

4.4.2 Chain of Custody Records

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

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

4.4.3 Preservation and Storage

Retain the original preservative (formalin solution) for reuse in preserving the residue of sorted samples, adding 5% formalin as needed to fill the sample jars. Store processed samples (i.e., detritus and organisms not removed from split samples) until sorting quality control checks are completed. Keep sorted ichthyoplankton in vials in a heated storage area until disposal is authorized (up to one year after submittal of data files to JAFNPP). Tape the tops of jars and vials to prevent loss of preservative by evaporation.

4.4.4 Disposal

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

4.5 DATA HANDLING

4.5.1 Data Sheets and Coding Instructions

Record ichthyoplankton counts and measurements on Entrainment Lab Count Data Sheets and Entrainment Lab Length Data Sheets (Appendix A). The Entrainment Lab Count Data Sheet is for count data for all taxa. The Entrainment Lab Length Data Sheet is for measurements of all species. Indicate in the upper right-hand corner of each data sheet how many pages there are for the sample (use “1 of 1” for a one-page sample, “1 of 2” and “2 of 2” for a two-page sample, etc.). Record also

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in the upper right-hand section of the first page the identifier’s initials, the date the sample was identified, and the number of vials.

4.5.1.1 Count Data

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

VARIABLE	INSTRUCTIONS
SAMPLE	Record the 4-digit sample number. Sample numbers will be in the range 2011 to 2524 (but not every number in that range is used).
CARD TYPE	Preprinted: L1
CATCH_CD	Enter 1 for valid non-empty sample or 2 for valid empty sample (data sheets are not required for void samples)
SPL_FACT	Enter 1.00 if the whole sample is analyzed; if the sample is subsampled record the ratio of the whole sample to the subsample (e.g., 8.00 for a 1/8 split)
TAXON	Enter the TAXON code from the Taxon Code List (Appendix B).
STAGE	Enter one of the following life stage codes: 0 = unknown 1 = eggs 2 = yolk-sac larvae 3 = post yolk-sac larvae 4 = young-of-the-year 5 = yearling or older
COUNT	Record the number of organisms of the indicated taxon and life stage in the sample (or subsample)
SPECIES NAME	Record the common name for the taxon

4.5.1.2 Measurement Data

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

VARIABLE	INSTRUCTIONS
SAMPLE	Record the sample number
Card Type	Preprinted: L2
Conversion Factor	Record the number of millimeters per division for the optical micrometer used to measure larvae
TAXON	Enter the taxon codes for other species measured on Entrainment Lab Length Data Sheets.

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VARIABLE	INSTRUCTIONS
FISH_ID	Preprinted: 1-30 for fish species
STAGE (or “STG.”)	Enter the life stage code for each larva measured (2, 3, 4, or 5 for fish species). Refer to the life stage code definitions used for count data (Section 4.3.3).
SCALE	Enter 6 if measurements are recorded in optical micrometer units; enter 7 if measurements are recorded directly in millimeters. (If optical micrometer units are recorded for a measurement, the actual length in millimeters will be obtained later by multiplying the measurement by the conversion factor.)
MEASUREMENT	Record the total length of larvae to the nearest 0.1 optical micrometer unit or to the nearest 0.1 mm. Juvenile fish are measured to the nearest 1.0 mm total length.

4.5.2 Storage and Chain of Custody of Data Sheets

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

4.6 QUALITY CONTROL

4.6.1 Tasks Subject to Quality Control

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

- sorting
- identification, life stage determination, and enumeration

4.6.2 Inspection Plans

Items are inspected using a quality control (QC) procedure derived from MIL-STD (military-standard) 1235B (single and multiple level continuous sampling procedures and tables for inspection by attributes) to achieve a 10 percent or better AOQL (Average Outgoing Quality Limit). The QC procedure used is the CSP-1 continuous sampling plan, which is conducted in two modes as follows:

- **Mode 1.** Reinspect one hundred percent of the samples until “i” consecutive samples pass.
- **Mode 2.** After “i” consecutive samples pass QC reinspection, randomly choose (using a random numbers table) the fraction “f” of the samples for reinspection. If any QC sample fails then return to Mode 1.

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For this application of CSP-1, $i=8$ and $f=1/7$, because the total number of samples analyzed by an individual is less than 500. It is important that QC inspections are performed as soon as possible after the original analysis; work-up of QC samples must not be postponed to be done in batches. Keeping the QC program as current as possible insures that problems are detected and remedied quickly, minimizing the additional number of samples that are analyzed before the problem is addressed.

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

Apply the QC plan on an individual processor basis, so that each person’s work is subjected to the QC plan independently of others, starting at 100% inspection.

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

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

4.6.3 Acceptance/Rejection Criteria

4.6.3.1 Sorting

A sample is considered defective if the sorter failed to remove 10 percent of the total organisms in the sample (or subsample). Percent error is calculated as follows (where “QC count” denotes the number missed by the sorter):

$$\% \text{ error} = 100\% \times \text{QC count} / (\text{sorter's count} + \text{QC count})$$

When the total count (sorter’s plus QC) is ≤ 20 , then the sample is considered defective only if the sorter missed more than two organisms.

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4.6.3.2 Identification

A sample is considered defective if an error of 10 percent or more is made in identifying, assigning a life stage, or counting any species. In determining whether a sample is defective, analyzer and QC results are compared within each taxon/life stage combination.

For each taxon (or for a life stage within a taxon) the percent error is calculated as follows (except where the QC count is ≤ 20 , the percent error is considered to be zero if analyzer and QC counts differ by no more than two organisms):

$$\% \text{ error} = 100\% \times \left| \frac{\text{analyzer count} - \text{QC count}}{\text{QC count}} \right|$$

A sample with a percent error of greater than or equal to 10% for any life stage for any taxon is considered defective.

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

$$\% \text{ error} = 100\% \times \left| \frac{\text{identifier count} - \text{resolution count}}{\text{resolution count}} \right|$$

$$\% \text{ error} = 100\% \times \left| \frac{\text{QC count} - \text{resolution count}}{\text{resolution count}} \right|$$

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

4.6.4 Quality Control Records

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

4.6.5 Quality Control Personnel

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

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

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4.7 REFERENCE COLLECTION

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

4.8 INSTRUMENT CALIBRATION

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

5.0 DATA PROCESSING

5.1 DATA ENTRY VERIFICATION AND DATA SHEET CHAIN OF CUSTODY

Provide a submittal form with each batch of data sheets submitted to the Technical Data Processing (TDP) department 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.

Key all data twice, resolving discrepancies between the two versions as they are flagged by the data verification program.

After data entry and verification are complete, transfer custody of the data sheets from TDP to the originators, where they are used in the error checking and quality control tasks, and finally stored in a project file. Document the transfer from TDP back to the originator by one or more submittal sheets containing the same information as those used to transfer custody to TDP. TDP is not required to maintain copies of the data sheets. After JAFNPP accepts the data files and final report, the original data sheets and paper copies of them may be discarded.

5.2 SYSTEMATIC ERROR CHECKS

Keyed data are 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.

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Additional checks scan the data for duplicate or missing observations. All records flagged by these programs are resolved, and corrections to both the data files and the data sheets are made as necessary. After error checking is complete, data files are subjected to quality control inspection (refer to Section 5.4).

5.3 DATA FILE FORMAT

Error checked data files are assembled into a SAS, Excel, or Microsoft Access database.

5.4 QUALITY CONTROL OF DATA FILES

Data files that have completed the systematic error checking process 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 $\geq 99\%$ 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.

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

6.0 TRAINING

In order to assure the standardization of field, laboratory, and data processing procedures, a two level system for training technicians is followed: 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.

*James A FitzPatrick Nuclear Power Plant
Proposal For Information Collection
Submitted: January 31, 2006*

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

7.0 QUALITY ASSURANCE

7.1 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 pre-conditions for the next step in processing or use, are 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

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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 Manager retains the original and sends a copy to the Action Addressee.

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

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

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

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

7.2 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.

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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 JAFNPP. 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 non-conformities, 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. A summary report of audit results, and follow-up corrective action will also be made available for JAFNPP review.

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APPENDIX A

Forms

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FITZPATRICK NUCLEAR POWER PLANT, 2006

Entrainment Lab Length Data Sheet

Sample

Card

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

Page ___ of ___

TAXON

STAGE

TAXON

STAGE

TAXON

STAGE

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

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

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

TAXON

STAGE

TAXON

STAGE

TAXON

STAGE

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

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

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

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FITZPATRICK NUCLEAR POWER PLANT, 2006
Entrainment Field Data Sheet

SAMPLE type week diel
2

status comments

DATE & TIME start month day

hour min
 start
 end

VOLUME gallons
 end
 start
 difference

CODES

- diel 1=0800-1400
- 2=1400-2000
- 3=2000-0200
- 4=0200-0800
- status 0=void, no sample
- 1=valid sample
- 2=flowmeter problem
- comments 1=yes
- blank=no

CALILBRATION

	trial 1	trial 2	trial 3
gauge gpm			
calibration seconds			
calibration gallons			
calibration gpm			
percent error			
average % error			

COMMENTS

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EXTRAORDINARY EVENT/NONCONFORMITY REPORT

EE/NC Report Number: _____ Date: _____ From: _____

Respond by (date): _____ Project No.: _____ Title: _____

Date closed: _____

ADDRESSEES:

QA: Project Mgr.: _____ Field Mgr.: _____ Lab Mgr.: _____ Technical Mgr.: _____ Others: _____

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

RECOMMENDATIONS FOR or CORRECTIVE ACTION TAKEN:

Signed: _____

ACTION ADDRESSEE RESPONSE:

CORRECTIVE ACTION COMPLETED: Date: _____ Signed: _____

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

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Appendix B

Fish Taxon Codes

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Appendix Table B-1. Taxon codes for fish species.

Taxon Code	Common Name
1	alewife
2	bay anchovy
3	American shad
4	bluefish
5	bluegill
6	brown bullhead
7	pumpkinseed
8	black crappie
9	common carp
10	American eel
11	goldfish
12	golden shiner
13	hogchoker
14	tessellated darter
15	banded killifish
16	emerald shiner
17	largemouth bass
18	mummichog
19	Atlantic menhaden
20	(use 59)
21	chain pickerel
22	blueback herring
23	white sucker
24	Atlantic silverside
25	rainbow smelt
26	smallmouth bass
27	shortnose sturgeon
28	spottail shiner
29	Atlantic sturgeon
30	striped bass
31	fourspine stickleback

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Appendix Table B-1 (Continued)

Taxon Code	Common Name
32	Atlantic tomcod
33	to be identified
34	white catfish
35	white perch
36	yellow perch
37	satinfm shiner
38	rock bass
39	northern pipefish
40	redbreast sunfish
41	Atlantic needlefish
42	crevalle jack
43	eastern silvery minnow
44	fallfish
45	weakfish
46	comely shiner
47	common shiner
48	mimic shiner
49	lookdown
50	unidentified clupeid
51	(use 50)
52	(use 60)
53	grass pickerel
54	lined seahorse
55	logperch
56	trout-perch
57	northern hog sucker
58	fathead minnow
59	unidentified cyprinid
60	unidentified <i>Morone</i>
61	redfin pickerel
62	tautog
63	fourbeard rockling

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Appendix Table B-1 (Continued)

Taxon Code	Common Name
64	striped cusk-eel
65	(use 96)
66	northern kingfish
67	spot
68	Atlantic moonfish
69	brook stickleback
70	unidentified sturgeon
71	scup
72	winter flounder
73	inland silverside
74	sea lamprey
75	gizzard shad
76	silver hake
77	striped mullet
78	threespine stickleback
79	brown trout
80	butterfish
81	white crappie
82	brook trout
83	northern pike
84	green sunfish
85	silver perch
86	northern puffer
87	eastern blacknose dace
88	bridle shiner
90	cutlip minnow
96	unidentified centrarchid
97	spotfin shiner
98	red hake
99	unidentifiable
100	central mudminnow
101	grubby

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Appendix Table B-1 (Continued)

Taxon Code	Common Name
102	eastern mudminnow
103	white bass
104	rough silverside
105	longear sunfish
106	summer flounder
107	longnose dace
108	creek chub
109	black bullhead
110	striped searobin
111	northern searobin
113	Atlantic croaker
114	longhorn sculpin
115	round herring
116	hickory shad
117	Atlantic herring
118	reef silverside
119	striped anchovy
120	conger eel
121	striped killifish
122	warmouth
123	bluntnose minnow
124	walleye
125	white mullet
126	yellow bullhead
127	channel catfish
128	pollock
129	seaboard goby
130	naked goby
131	yellowtail flounder
132	windowpane
133	spotted hake
134	unidentified searobin

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Appendix Table B-1 (Continued)

Taxon Code	Common Name
136	northern stargazer
137	American sand lance
138	fat sleeper
139	fourspot flounder
140	Atlantic mackerel
141	black sea bass
142	smallmouth flounder
143	rock gunnel
144	inshore lizardfish
145	unidentified mudminnow
146	silver lamprey
147	rainbow trout
148	rosyface shiner
149	unidentified <i>Esox</i>
150	unidentified gobiid
151	unidentified <i>Fundulus</i>
152	unidentified cyprinodontid
153	unidentified <i>Myoxocephalus</i>
154	unidentified cottid
155	unidentified pleuronectiform
156	unidentified pleuronectid
157	unidentified atherinid
158	unidentified <i>Menidia</i>
159	unidentified bothid
160	speckled wormeel
161	unidentified syngnathid
162	mackerel scad
163	unidentified <i>Ammodytes</i>
164	cunner
165	unidentified sciaenid
166	unidentified gadid

(continued)

Entrainment Sampling Quality Assurance Plan

Appendix Table B-1 (Continued)

Taxon Code	Common Name
167	flying gurnard
168	shield darter
169	gray snapper
170	Atlantic cod
171	sea raven
172	bigeye scad
173	striped burrfish
174	sheepshead
175	unidentified percid
176	spotfin mojarra
177	spotfin butterflyfish
178	unidentified gasterosteid
179	planehead filefish
180	Atlantic cutlassfish
181	pigfish
182	short bigeye
183	guaguanche
184	freckled blenny
185	unidentified tetraodontid
186	orangespotted filefish
187	marginated madtom
188	bluespotted cornetfish
189	black drum
190	northern sennet
191	scamp
192	cobia
193	least darter
194	unidentified percichthyid
195	scrawled cowfish
196	spotfin flyingfish
197	Gulf menhaden

(continued)

Entrainment Sampling Quality Assurance Plan

Appendix Table B-1 (Continued)

Taxon Code	Common Name
198	pugnose shiner
199	redfin shiner
200	sand shiner
201	swallowtail shiner
202	tiger muskellunge
203	goosefish
204	permit
205	freshwater drum
206	king mackerel
207	longnose gar
208	Spanish mackerel
209	highfin goby
210	unidentified sucker
211	unidentified labrid
212	blackcheek tonguefish
213	oyster toadfish
214	feather blenny
215	orange filefish
216	little skate
217	spiny dogfish
218	Atlantic seasnail
219	Gulf Stream flounder
220	spotted goatfish
221	brook silverside
222	harvestfish
223	pinfish
224	witch flounder
225	kokanee
226	ladyfish
227	radiated shanny
228	cusk
229	unidentified <i>Urophycis</i>

*James A FitzPatrick Nuclear Power Plant
Proposal For Information Collection
Submitted: January 31, 2006*

*Prepared In Consultation with:
Enercon Services, Inc. and
Normandeau Associates, Inc.*

Entrainment Sampling Quality Assurance Plan

Appendix Table B-1 (Continued)

Taxon Code	Common Name
230	American plaice
231	slimy sculpin
232	sheepshead minnow
233	unidentified blenny
234	unidentified skate
235	clearnose skate
236	weakfish/scup
237	haddock
238	rudd

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

APPENDIX 4

JAFNPP 2006 Lake Ontario Sampling

Quality Assurance Plan and Standard Operating Procedures

January 2006

APPENDIX 4

QUALITY ASSURANCE PLAN AND STANDARD OPERATING PROCEDURES FOR LAKE ONTARIO STUDIES AT JAMES A. FITZPATRICK NUCLEAR POWER PLANT LYCOMING, NEW YORK

(SPDES PERMIT NO. NY 0020109)

ENERGY NUCLEAR FITZPATRICK, LLC

James A FitzPatrick Nuclear Power Plant

277 Lake Road East

Oswego, New York 13126

Prepared In Consultation with



**Enercon Services, Inc.
and
Normandeau and Associates, Inc.**



R-20271.001

31 January 2006

Lake Ontario Studies Quality Assurance Plan

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APPENDIX A: Forms

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1.0 INTRODUCTION

Entergy Nuclear FitzPatrick, LLC (“Entergy”) owns and operates the James A. FitzPatrick Nuclear Power Plant (“JAFNPP”). JAFNPP is located on the southeastern shore of Lake Ontario approximately 7 miles (11 km) northeast of the city of Oswego, New York in Lycoming, New York. In a March 14, 2005 letter to Mr. Michael Rodgers of JAFNPP, Mr. Roy A. Jacobson, Jr. Steam Electric Unit Leader for the New York State Department of Environmental Conservation (“NYSDEC”), requested submission of information about JAFNPP consistent with the Phase II Regulations description of a Proposal for Information Collection (“PIC”), including:

- “identifying information previously submitted to the Department,
- need to update existing information, and
- need to collect new information or conduct monitoring studies.”

In a letter from Mr. Roy A. Jacobson of the NYSDEC to Mr. T.A. Sullivan of JAFNPP dated 22 June 2005, NYSDEC recognized that JAFNPP’s offshore intake is different than the shoreline bulkhead intake used by USEPA to establish the calculation baseline for the purpose compliance with the entrainment and impingement performance standards of the Phase II Regulations. Mr. Jacobson recommended that two years of studies commencing in 2006 would be required by NYSDEC to estimate the baseline impingement mortality and entrainment abundance for a hypothetical shoreline intake in the vicinity of Nine Mile Point.

Accordingly, JAFNPP proposes a two-year program of Lake Ontario nearfield studies for JAFNPP beginning in April 2006 and continuing through October 2007. The objective of this Lake Ontario sampling will be to obtain the data necessary to calculate the percentage reduction in impingement mortality and entrainment abundance due to the JAFNPP cooling water intake being located 900 feet offshore along the 25 foot depth contour instead of being a shoreline bulkhead intake. The percentage reduction due to intake location will be defined as the ratio between the abundance, catch per unit of effort (CPUE), or density of fish from pairs of samples taken by the same gear and collection methods in the shoreline area of Nine Mile Point and in the vicinity of the JAFNPP intake. Calculating ratios from the fish samples taken by the same gear deployed by the same methods at two different locations will eliminate the need to adjust the ratio for differences in gear efficiency, as would be the case if different gear were used in each location.

This document is a project-specific Quality Assurance Plan (QAP) consistent with USEPA protocols (USEPA 2001) that describes the Standard Operating Procedures to be used for the field, laboratory, and data file preparation activities for work to be performed in Lake Ontario in the vicinity of the JAFNPP intake structure, and is included with the PIC as Appendix 4.

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1.1 ORGANIZATION OF THIS DOCUMENT

Following a narrative description of the cooling water intake structure (CWIS) at JAFNPP (Section 2.0) are separate stand-alone Standard Operating Procedures (SOPs) for defining the hydraulic zone of influence (Section 3.0), the impingement mortality calculation baseline (Section 4.0), and the entrainment calculation baseline (Section 5.0). Within each of the two sampling SOPs, subsections from the following list that are applicable to that SOP are included: sampling schedule and location, equipment, procedures, sample handling, data handling, quality control, reference collection, and instrument calibration and maintenance. Procedures for data processing, from receipt of completed data sheets to the final data files, are described in Section 6.0. A system for providing the appropriate training for project personnel is described in Section 7.0. Quality Assurance procedures are described in Section 8.0.

2.0 COOLING WATER INTAKE STRUCTURE DESCRIPTION

The CWIS at JAF is a submerged, shore-facing, remote intake with a total design intake flow of 388,600 gallons per minute (gpm). The CWIS is shared primarily by the Circulating Water (CW) and Service Water (SW) systems, and is located about 990 feet inland from the shoreline of Lake Ontario at coordinates N 43°31'37" and E76°23'49". The top of the CWIS is at elevation 232.8 feet, approximately 14 feet beneath the lake surface, which typically varies from elevation 244.0 feet to 248.0 feet. The intake consists of four segmented shore-facing openings, each 22 feet wide and 8 feet high, feeding a 14 foot diameter D-shaped intake tunnel that runs beneath the lake bed approximately 1,150 feet to the offshore screenwell and pumphouse. The base mat of the CWIS is at elevation 222.8 feet, approximately four feet above the lake bottom elevation of 218.8 feet.

Nine acoustical projector housings are symmetrically installed on top of the remote intake structure roof, located at elevation 232.8 feet, to provide for fish deterrence. The projectors can be removed for the winter months due to the ice packs possibly defacing the projector faces. The function and effectiveness of this system is discussed in detail in Section 5.1 (below) describing "Currently Implemented Technologies".

There are two sets of bar racks, an internally heated bar rack at the remote intake, and a trash bar rack in the screenwell of the CWIS. The heated bar rack at the remote offshore intake consists of 3 inch by 2 inch rectangular vertical bars on 12 inch centers across each 22 foot by 8 foot intake opening, a total of 88 bars. The primary purpose for this heated bar rack is the prevention of intake clogging due to frazil ice and/or large debris. The bar rack heaters are energized anytime water temperature is $\leq 37^{\circ}\text{F}$ to prevent/remove ice formation. There are no installed systems to remove large debris from these racks with the plant operating, although original plant design provided "reverse flow" capability to backwash the remote intake racks when the plant is not at power. The design water velocity through the bar rack at the remote intake is 1.2 feet per second with all three circulating water pumps operating (fps; TI 1979).

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The JAFNPP CWIS contains three vertical, mixed flow, dry pit type circulating water pumps. Each single speed intake pump has a rated 27 feet of total dynamic head (TDH), and a rated flow of 120,000 gallons per minute (GPM). The pump drivers are open, drip-proof, induction motors rated at 1,000 HP. During normal plant operation, all three CW pumps are operating with a combined design circulating water intake flow of 360,000 GPM (5.1×10^8) measured through the condensers.

3.0 DEFINITION OF THE HYDRAULIC ZONE OF INFLUENCE

3.1 OBJECTIVE

A mathematical model will be developed and used to define the three-dimensional shape and boundaries of Hydraulic Zone of Influence (HZOI) or ‘withdrawal zone’ for the JAFNPP cooling water intake structure (CWIS) in Lake Ontario near Nine Mile Point. Once defined, the HOZI will be used to delimit a sampling station in Lake Ontario that is representative of the fish populations directly exposed to entrainment and impingement mortality at the JAFNPP CWIS.

3.2 MATHEMATICAL MODELING

A mathematical model of the Hydraulic Zone of Influence (HZOI) for the cooling water intake structure (CWIS) will be prepared using computational flow dynamics (CFD) software, FLOW 3D. This software has been approved and applied as safety related for the Nuclear Regulatory Commission. Using existing electronic intake drawings and topographic information collected for the site, construction of a three-dimensional model of the CWIS and its immediate vicinity will be used estimate the HZOI, approach velocities, and appropriate sampling areas, within the entire water column while providing a graphic representation for these estimates when applied under normal or median atmospheric and operational conditions. Early stage development of the CFD model may be used in later stages of the CDS development as an evaluation tool to predict regulatory performance of the CWIS. Evaluation of appropriate operational or technological modifications may utilize this same modeling process for performance comparison and/or cost benefit analysis.

The HZOI for the plant’s CWIS and subsequent biological sampling area will be determined by

1. Defining a coarse CFD grid using an existing CAD model of the off-shore intake structure
2. Applying reasonable (non-zero) influence boundaries to the CFD problem definition
3. Mapping existing lake bottom topographic information
4. Incorporating available basic bathymetric data and median water level
5. Running the CFD calculation
6. Generating a graphic representation of the results
7. Determining an estimated Hydraulic Zone Of Influence

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8. Report the results for use to support biological sampling boundaries

This report will be prepared and submitted for review by the permitting authority at least 30 calendar days prior to the start of Lake Ontario sampling (Sections 4.0 and 5.0 below) so that the results can be used to establish the final sampling design.

4.0 IMPINGEMENT MORTALITY CALCULATION BASELINE

4.1 OBJECTIVE

JAFNPP proposes a two-year program of Lake Ontario nearfield studies for JAFNPP beginning in April 2006 and continuing through October 2007 with the objective of obtaining the necessary data describing juvenile and adult fish abundance to calculate the percentage reduction in impingement mortality due to the JAFNPP cooling water intake being located 900 feet offshore along the 25 foot depth contour instead of being a shoreline bulkhead intake. Data from April and October of each year will be extrapolated to the unsampled months. The percentage reduction due to intake location will be defined as the ratio between the abundance, catch per unit of effort (CPUE), or density of fish from pairs of samples taken by the same gear and collection methods in the shoreline area of Nine Mile Point and in the vicinity of the JAFNPP intake. Calculating ratios from the fish samples taken by the same gear deployed at two different locations will eliminate the need to adjust the ratio for differences in gear efficiency, as would be the case if different gear were used in each location.

4.2 SAMPLING DESIGN

Sampling design, gear, and procedures for the Lake Ontario juvenile and adult fish program will be consistent with the gear and procedures used in the earlier studies (TI 1980), except that hydroacoustic techniques will be added to the present study. Two transects perpendicular to shore will be established to coincide with two of the four transects established by TI (1980). Transect FITZ will be centered on the intake structure of JAFNPP, and is the same transect FITZ used by TI during the earlier studies. Transect FITZ-E will be located approximately 2000 ft. east of the JAFNPP intake. Transect FITZ represents the intake area, while transect FITZ-E is a nearfield control for the JAFNPP intake area that is not exposed to operation of the existing and permit-required fish deterrence system. Samples representative of the shoreline area of Nine Mile Point will be taken in Lake Ontario waters less than 10 feet of depth along each transect. Samples from the JAFNPP intake area of Nine Mile Point will be taken in Lake Ontario waters along the 25 foot depth contour along each transect, which is the depth contour where the JAFNPP intake is located. Therefore the following sampling stations will be designated for Lake Ontario studies to determine the impingement mortality calculation baseline:

- **FITZ-10** = Lake Ontario near shore water column at the 10 ft. depth contour immediately inshore from the JAFNPP intake,

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- **FITZ-25** = three dimensional sampling area in the Lake Ontario water column around the JAFNPP intake structure at the 25 ft. depth contour defined as the hydraulic zone of influence (HZOI) according to the criteria and methods specified in Section 3.0 above,
- **FITZ-E10** = Lake Ontario near shore water column at the 10 ft. depth contour along a transect established 2000 ft. to the east of the JAFNPP intake and perpendicular to the shoreline, and
- **FITZ-E25** = Lake Ontario water column at the 25 ft. contour along a transect established 2000 ft. to the east of the JAFNPP intake and perpendicular to the Lake Ontario shoreline.

Each Lake Ontario sampling station will be designated by GPS coordinates determined in the field prior to the start of sampling.

4.3 HYDROACOUSTICS FISH ENUMERATION

Hydroacoustics will be the primary sampling technique used to calculate the baseline adjustment ratio for impingement mortality at the JAFNPP CWIS. Arrays of digital, dual beam, elliptical transducers (facing 0°, 90°, 180, and 270° to each transect, or one continuously rotating transducer covering 360° in the horizontal plane) will be installed at fixed locations at the 10-foot and 25-foot contours along each of the two transects in the Nine Mile Point study area of Lake Ontario and used to provide continuous enumeration of fish abundance measured by signal (acoustic target) counting and fish biomass measured by echo integration during the April through October monitoring period of each year.

4.4 GILL NET SAMPLING TO DETERMINE FISH SPECIES COMPOSITION

Species composition of adult and juvenile fishes quantified by hydroacoustics will be determined by sampling with sinking experimental gill nets deployed parallel to each contour as bottom sets at each station, but away from the transducer beams. Gill net sets will be made twice per month from April through October of each year. Soak time will be 24 hours, with each gill net set deployed near sunset, tended approximately 12 hours later after sunrise, and retrieved near sunset on the following day. Therefore, for each month a total of 16 gill net samples will be collected (2 transects x 2 depth contours x 2 diel periods x 2 events per month), and there will be 112 total gill net samples (7 months x 16 samples per month) scheduled for completion during each year. All fish collected in each gill net sample will be identified to species, and total length (nearest millimeter) and wet weight (grams, ±1%) will be recorded for a maximum of 50 individuals per species per sample. A project-specific reference collection will be made for each species and life stages collected, and all sampling activities will be performed under an approved Scientific Collector's Permit issued by NYSDEC for this study.

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4.4.1 Gill Net Specifications

Experimental gill nets will be 8 ft deep and consist of six 25-foot long panels of different mesh sizes randomly arranged in a linear sequence into one net 150 feet long. The gill nets will be made from treated multifilament mesh ranging in 0.5 inch increments from 0.5 up to 3.0 inches bar mesh. The gill nets (Gear Code = 130) are sinking type constructed of multifilament nylon netting that is double selvage top and bottom. Webbing is pre-shrunk and heat set. The knots must hold without slipping. The float line is 3/8" braided poly foam and the bottom line is be 1/4" lead' core line. Hanging twine is #9 spun nylon and the twine is trimmed to avoid tangling. Panels are seamed together. Brail lines are 8 ft. long. Each hanging knot is double hitched. The thread is white in color. The specifications for mesh in each panel are as follows:

Panel Number	Panel Length Feet	Bar Mesh	
		Netting Size (in.)	Twine Size
1	25	0.5	#210/2
2	25	1.0	#69
3	25	1.5	#104
4	25	2.0	#104
5	25	2.5	#139
6	25	3.0	#139

4.4.2 Condition and Repair of Nets and Equipment

All nets and equipment are inspected prior to each use and must be found to be operable and in good repair. Any deficiencies or problems that would compromise the sampling effort or the safety of individuals conducting the sampling *must be corrected prior* to deployment or use. Extra and duplicate gear must be available at the site in case the gear are damaged beyond repair or gear are lost.

4.4.3 Invalid Samples

The following conditions invalidate a sample:

- Vandalism of stationary gear such as gill nets.
- Excessive clogging by debris.
- Twisted net due to strong currents, wave action, or improper set,
- failure to retrieve the net after the soak time (± 2 hours) due to weather conditions,
- Hang-downs on bottom structures,
- Improper deployment of net, or
- Excessive damage to net or loss of net.

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Should any of these above conditions occur, the collection is invalid. This is noted on the field data sheet by assigning a **USE_CODE** of **5** (void) and providing a written comment to explain why the sample is considered void. All void samples must be repeated. All valid samples are assigned a **USE_CODE** of **1**.

4.4.4 Field Equipment Checklist

Review the field equipment check list to be sure all of the required boat and sampling equipment is onboard and in good working order prior to leaving the office.

4.4.4.1 Standard Boat Equipment Onboard the Sampling Vessel

- Navigational charts
- Two oars
- Two anchors (one mushroom and one Danforth)
- GPS
- Fathometer
- First-aid kit
- One life jacket per person
- One set of rain gear per person
- Rubber boots
- Fire extinguisher
- 20 m of 1.1-cm nylon rope
- Hand-held or navigational compass
- Hand-held light
- Flares
- 2.5-gal. garbage pail

4.4.4.2 General Sampling Equipment

- Nylon towline or winch cable, metered snapping blocks, messengers, and trip mechanism
- Sampling gear (when using nets have two cups per net)
- Watch or stopwatch
- 30 m of 1.1-cm nylon rope
- Flowmeters (mechanical G.O. Model 2030R for Tucker trawl)
- Safety line (30 m of 1.1-cm nylon rope with attached float)
- 1-L wide mouth plastic container per net sample
- 25-cm diameter plastic funnel
- 100-ml plastic graduated cylinder
- One data sheet per sample

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- One sample label per sample
- One shipping label per sample
- Indelible black marker (Sharpie)
- Pencils
- Field notebook
- 100% formalin buffered with borax. Add 100 ml per 1 liter sample jar for 10% final solution of buffered formalin

4.4.4.3 Water Quality Instrumentation (as needed)

- Dissolved-oxygen/temperature meter
- Pocket thermometer

4.4.5 Gill Net Deployment Procedures

One gill net is deployed at each station, and all stations are fished concurrently. The end of the gill net is attached to a 6' spreader bar to alleviate the problem of net rolling in waves or fast current. A bridle 10' long connects the spreader to the anchor. Nets are set parallel to the shore with adequate floats for the conditions. Soak time will be 24 hours, with each gill net set deployed near sunset, tended approximately 12 hours later after sunrise, and retrieved 24 hours later near sunset on the following day.

Drop one weighted end of the net over the bow of the boat, and when the weighted end is firmly in place on the bottom, back the boat away parallel to shore while feeding out the rest of the net. Straighten and tighten the net as necessary to avoid twists and ensure weighted ends are firmly in place. Document all sampling activities (set time, date, location, gear only) on a field data sheet. Use one data sheet per gear and station. Have a second individual review data sheets for legibility of writing, completeness, and accuracy before proceeding to the next station.

At the end of the first approximately 12 hour period of soak time (set), retrieve each net and transfer the captured fish to a wash tub or live well. Begin retrieving the net at one end removing entangled fish as the net is worked into the boat. Reset the net for the next approximately 12 hour set. After the second set, retrieve the net again and remove the fish as before.

Process all fish caught (identify, count, measure length, measure weight). Document sampling activities (retrieval time, date, location, physical-chemical data, investigators, etc.) on the field data sheet. Have a second individual review the completed data sheets for legibility, completeness and accuracy before proceeding to the next station.

4.4.6 Handling of Fish

Remove all fish from the net as soon as possible. Place fish in a fresh bucket of river water or a live well before processing begins. Work carefully, but quickly to reduce stress to the fish. Release alive fish as soon as possible. Some of the cyprinids and other smaller fish can be difficult to identify in

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the field. These small specimens may require preservation and closer examination under a laboratory setting. A voucher collection of all fish species will be established. Avoid holding fish longer than needed. All dead fish must be disposed of in accordance with all applicable laws, codes or regulations.

4.4.7 Enumeration

Identify and count all fish from samples to the species level. Measure (total length to the nearest mm) and weigh (to the nearest 1%) all fish from each sample. If there are more than 50 fish of any one species in a sample, then a representative subsample of 50 fish of that species will be measured and weighed.

4.4.8 Rare and Endangered Species

Any rare, threatened, endangered, or species of special concern (Table 4-1) is handled with special care, and returned to the water alive after being identified, measured to the nearest mm, and weighed to the nearest gram. Lake sturgeon is the species most likely to be encountered. Any animals that are dead at the time of capture are transported to the laboratory, frozen, and saved for the New York State Department of Environmental Conservation (NYSDEC) for the duration of the collector's permit. Inform the JAFNPP project manager and NYSDEC of the capture of any rare, threatened, endangered, or species of special concern.

Table 4-1. Endangered and Threatened Fishes in New York State.

Endangered Species	
Common Name	Scientific Name
Round whitefish	<i>Prosopium cylindraceum</i>
Pugnose shiner	<i>Notropis anogenus</i>
Eastern sand darter	<i>Ammocrypta pellucida</i>
Bluebreast darter	<i>Etheostoma camurum</i>
Gilt darter	<i>Percina evides</i>
Deepwater sculpin	<i>Myoxocephalus thompsoni</i>
Threatened Species	
Common Name	Scientific Name
Lake Sturgeon	<i>Acipenser fulvescens</i>
Mooneye	<i>Hiodon tergisus</i>
Lake clubsucker	<i>Erimyzon sucetta</i>
Mud sunfish	<i>Acentharchus pomotis</i>
Longear sunfish	<i>Lepomis megalotis</i>

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4.4.9 Postsampling Procedures

- Clean all sampling gear.
- Dismantle all mechanisms (i. e. trip releases, flowmeters, plankton cups, safety line).
- Remove all gear from the boat and place in a storage area or perform necessary preventive maintenance or repairs.
- Remove all samples, aquatic forms, and log books, and transfer them to the laboratory.
- Wash the boat and trailer.
- Inspect the boat hull and trailer and remove any clinging aquatic vegetation to prevent transfer to another water body.
- If sampling in waters with a known zebra mussel population, follow the zebra mussel transfer prevention procedures described in Section 4.4.10 below.
- Arrange the stored samples in order according to gear type, site, station; and date and log them with the appropriate data in the log book.

4.4.10 Zebra Mussel Transfer Prevention Procedures

Normandeau is concerned about the potential of our activities to transport or introduce zebra mussels or other nuisance organisms due to our sampling in numerous water bodies, and we take precautions to help prevent this from occurring. Zebra mussels can be transported by boats by at least two methods. Settled zebra mussels can be transported on the surfaces of boats, trailers and sampling gear. Zebra mussel larvae and juveniles can be transported in bilge water, the outboard motor lower unit and cooling systems or any recessed area that may retain water. The primary method used to decontaminated surfaces that may harbor settled zebra mussels is desiccation. Parking a boat and trailer in full sunlight at temperatures greater than 70°F for 24 hours should be sufficient to decontaminate all exposed surfaces. If the temperature is less than 70°F, the boat and trailer are left in the sunlight for a minimum of five days to desiccate any zebra mussels. If logistic considerations prevent dry storage of the boat and trailer prior to its next use, the boat, trailer and sampling gear are pressure washed with water at temperatures greater than 140°F. This can be accomplished at most self-service car washes using the high pressure rinse setting. All surfaces, including nets and other sampling gear are thoroughly sprayed with the high-pressure hot water to remove settled zebra mussels. All vegetation and debris entangled on vehicles, trailers and boats is removed.

Areas that cannot be reached with the high-pressure water gun, such as bilges, are exposed to a chlorine solution with a concentration of 5 ppm (about 10 ml of Clorox bleach in 5 gallons of water). The chlorine solution is introduced to the bilge for at least ten minutes and then flushed out with clean tap water. Chlorine decontamination is not conducted where the chlorine solution may run directly into a receiving body of water. Sampling gear can be rinsed in the chlorine solution to remove zebra mussels. To prevent settling in outboard motors, or inadvertent transport, outboard motor cooling systems and lower units are decontaminated by flushing with tap water. This procedure not only reduces the risk of inadvertent transport, but also reduces the risk of engine damage caused by

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entrained mussel larvae that may have metamorphosed and begun to foul the interior parts of the engine. The 5 ppm chlorine solution is used to clean all sample bottles, meter probes and other devices before they are used in a different location.

4.5 DATA CODING INSTRUCTIONS

Coding instructions for each card type are given below. One data sheet is completed for each gill net set or Tucker trawl tow. All entries should be made neatly with only one symbol per data block. The individual whose initials are entered on the data sheet is responsible for assuring the legibility of all entries.

4.5.1 Coding for Header Information

<u>VARIABLE NAME</u>	<u>INSTRUCTIONS</u>
TASK CD	Preprinted 14
SAMPLE	Preprinted
GEAR	Gill Nets = 130; Tucker trawl = 065
YEAR	Record year 2006 or 2007

4.5.2 Source Card Type S1

Source card type S1 is used to record field sampling information.

NOTE: N/A = not applicable, therefore not recorded.

<u>VARIABLE NAME</u>	<u>INSTRUCTIONS</u>
SOURCE CARD TYPE	Preprinted S1
DATE	Record date (Mo/Day) of sample collection. Record set day for gill nets.
TIME	Record set time for gill nets on the first date of deployment or start time for tucker trawl tows using 24-hour clock (HHMM).
LOCATION:	
MILE	N/A
SITE	N/A
STATION	Enter appropriate code for Field Station FITZ-10 = 1 FITZ-25 = 2 FITZ-E10 = 3 FITZ-E25 = 4
N S	N/A
DURATION	For towed net samples record the duration of tow in decimal minutes
PULL TIME	For each gill net record time the gear was removed from water to terminate the fishing effort using 24-hour clock.

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<u>VARIABLE NAME</u>	<u>INSTRUCTIONS</u>
SET TIME	For each gill net record time the gear was set in the water to begin the fishing effort using 24-hour clock.
DEPTH_ SAM RIV	Record sampling depth in feet Record lake depth at sampling station in feet
TOW_ SPD DIR	Record tow speed over bottom for Tucker trawls Record tow direction from GPS if Tucker trawl (0 to 360)
WAVE HT	Enter code for estimated wave height: 1 = calm to 1 /2 ft 2 = light chop (>1/2 ft to 1 ft) 3 = heavy chop (>1 ft to 2 ft) 4 = large waves (>2 ft)
BOTM TYP	Enter code for bottom type: 1 = sand 2 = mud 3 = vegetation 4 = debris 5 = brick 6 = gravel less than 3" 8 = mussel/oyster bed 9 = other
VESSEL CD	N/A
BEACH	N/A
USE_CODE	Enter appropriate use code: 1 = no sampling problems 5 = sampling problems, no fish were caught, i.e. void
GEAR NAR	N/A
SAM NAR	N/A
INITIALS	Record employee number of individual responsible for sample collection (crew leader)
COMMENTS	Record any pertinent information not recorded elsewhere on back of sheet. Check comments block if comments may affect data interpretation
ENG RPM	N/A
TOW DIST	Record Tucker trawl tow distance from GPS

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4.5.3 Source Card Type Q1

Source card type Q1 is used to record water quality data.

NOTE: N/A = not applicable to present task, therefore not recorded.

<u>VARIABLE NAME</u>	<u>INSTRUCTIONS</u>																						
SOURCE CARD TYPE	Preprinted Q1																						
BOTL NO	Record water quality sample bottle number (if used)																						
H2O TEMP	Record the temperature to the nearest 0.1°C at both surface and bottom																						
DO	Record the dissolved oxygen to the nearest 0.1 ppm at both surface and bottom																						
pH	N/A																						
COND	N/A																						
DEPTH WQ	Record depth (in feet) at which the water quality measurement was taken																						
SECCHI DEPTH	N/A																						
AIR TEMP	Record air temperature to the nearest 1°C at time of sample collection																						
CLOUD COVER	Enter code for cloud cover at the time of sample collection: <table border="0"> <thead> <tr> <th>CODE</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr><td>0</td><td>0-9%</td></tr> <tr><td>1</td><td>10-19%</td></tr> <tr><td>2</td><td>20-29%</td></tr> <tr><td>3</td><td>30-39%</td></tr> <tr><td>4</td><td>40-49%</td></tr> <tr><td>5</td><td>50-59%</td></tr> <tr><td>6</td><td>60-69%</td></tr> <tr><td>7</td><td>70-79%</td></tr> <tr><td>8</td><td>80-89%</td></tr> <tr><td>9</td><td>90-100%</td></tr> </tbody> </table>	CODE	DESCRIPTION	0	0-9%	1	10-19%	2	20-29%	3	30-39%	4	40-49%	5	50-59%	6	60-69%	7	70-79%	8	80-89%	9	90-100%
CODE	DESCRIPTION																						
0	0-9%																						
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5	50-59%																						
6	60-69%																						
7	70-79%																						
8	80-89%																						
9	90-100%																						
PRECIPITATION	Enter code to describe the precipitation status at the time of sample collection: <table border="0"> <thead> <tr> <th>CODE</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr><td>0</td><td>None</td></tr> <tr><td>1</td><td>Light Rain</td></tr> <tr><td>2</td><td>Heavy Rain</td></tr> <tr><td>3</td><td>Snow</td></tr> </tbody> </table>	CODE	DESCRIPTION	0	None	1	Light Rain	2	Heavy Rain	3	Snow												
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0	None																						
1	Light Rain																						
2	Heavy Rain																						
3	Snow																						
WIND SPEED	Enter code for wind speed based on the Beaufort scale <table border="0"> <thead> <tr> <th>CODE</th> <th>MPH</th> <th>WATER SURFACE</th> <th>LAND</th> </tr> </thead> <tbody> </tbody> </table>	CODE	MPH	WATER SURFACE	LAND																		
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<u>VARIABLE NAME</u>	<u>INSTRUCTIONS</u>																				
	<table border="0"> <tr> <td>1</td> <td>0-7</td> <td>Smooth/small wavelets</td> <td>Leaves rustle, wind on</td> </tr> <tr> <td>2</td> <td>8-11</td> <td>Lg. wavelets, scattered whitecaps</td> <td>Leaves & twigs in constant motion, flag waving</td> </tr> <tr> <td>3</td> <td>12-16</td> <td>Small waves, frequent whitecaps</td> <td>Raises dust & loose paper, sm. Branches moving</td> </tr> <tr> <td></td> <td>17-24</td> <td>Medium crested waves, many whitecaps foam,</td> <td>Small trees begin to sway</td> </tr> <tr> <td></td> <td>25-35</td> <td>Large waves, foam, blown spray</td> <td>Whole trees in motion, why are you out here???</td> </tr> </table>	1	0-7	Smooth/small wavelets	Leaves rustle, wind on	2	8-11	Lg. wavelets, scattered whitecaps	Leaves & twigs in constant motion, flag waving	3	12-16	Small waves, frequent whitecaps	Raises dust & loose paper, sm. Branches moving		17-24	Medium crested waves, many whitecaps foam,	Small trees begin to sway		25-35	Large waves, foam, blown spray	Whole trees in motion, why are you out here???
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	25-35	Large waves, foam, blown spray	Whole trees in motion, why are you out here???																		
WIND DIRECTION	Enter code for direction from which the wind is blowing																				
	<table border="0"> <tr> <th>CODE</th> <th>DESCRIPTION</th> </tr> <tr> <td>0</td> <td>No wind</td> </tr> <tr> <td>1</td> <td>North</td> </tr> <tr> <td>2</td> <td>South</td> </tr> <tr> <td>3</td> <td>East</td> </tr> <tr> <td>4</td> <td>West</td> </tr> </table>	CODE	DESCRIPTION	0	No wind	1	North	2	South	3	East	4	West								
CODE	DESCRIPTION																				
0	No wind																				
1	North																				
2	South																				
3	East																				
4	West																				
CURRENT SPEED	N/A																				
INSTRUMENTATION I.D. NUMBERS:	Record the identification numbers for the temperature, dissolved oxygen meter and fish weight scales used to obtain the Source data for this sample. These numbers should cross-reference the QC calibration logs for the instruments.																				

4.5.4 Source Card Type R1

Source card type R1 is used to record the type and number of jars which contain biological sample(s).

NOTE: N/A = not applicable to present task,

<u>VARIABLE NAME</u>	<u>INSTRUCTIONS</u>
SOURCE CARD TYPE	Preprinted R1
NO. OF JARS SUS RECP	N/A
LW	Record number of jars containing fish for length/weight determination
ID	Record number of jars containing fish for identification and enumeration
NO YRL STOM	N/A

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4.5.5 Source Card Type F1

Source card type F1 is used to record species identification, count, weight and condition data for fish processed in the field.

NOTE: N/A = not applicable to present task, therefore not recorded.

<u>VARIABLE NAME</u>	<u>INSTRUCTIONS</u>										
COMMENTS	Record any pertinent information not recorded elsewhere (only check if comments may affect data interpretation)										
SOURCE CARD TYPE	Preprinted F1										
TAXON	Enter appropriate taxon code from taxon list (Appendix B).										
FISH ID	Record consecutive FISH_ID for each fish from which a measurement was taken.										
LENGTH	Record total length to the nearest mm for each fish identified.										
WEIGHT	Record the weight of each fish measured to the nearest gram.										
SEX	Enter the appropriate code for sex of the fish if it can be determined upon external examination (or internal examination if the fish is dead). Blank = not determined 1 = male 2 = female										
SEX_COND	Enter the appropriate code for the sexual condition of the fish if it can be determined upon external examination (or internal examination if the fish is dead) Blank = not determined										
	<table border="0"> <thead> <tr> <th>CODE</th> <th>DESCRIPTION</th> </tr> </thead> <tbody> <tr> <td>1 RIPE:</td> <td>Adult in spawning condition - gonads well developed, but no milt or eggs extruded upon application of pressure to gonadal area. Will spawn in current season.</td> </tr> <tr> <td>2 RIPE & RUNNING:</td> <td>Adult prepared to spawn immediately; expulsion of eggs or milt from body with little provocation.</td> </tr> <tr> <td>3 PARTIALLY SPENT:</td> <td>Sexual products partially discharged gonads somewhat flaccid as opposed to the firmness of a developing gonad. Genital aperture usually inflamed, some hemorrhaging present.</td> </tr> <tr> <td>4 SPENT:</td> <td>Applied to adult specimens at completion spawning activity. The sexual products have been discharged-genital aperture usually inflamed and hemorrhaging present. The gonads have the appearance of deflated sacs,</td> </tr> </tbody> </table>	CODE	DESCRIPTION	1 RIPE:	Adult in spawning condition - gonads well developed, but no milt or eggs extruded upon application of pressure to gonadal area. Will spawn in current season.	2 RIPE & RUNNING:	Adult prepared to spawn immediately; expulsion of eggs or milt from body with little provocation.	3 PARTIALLY SPENT:	Sexual products partially discharged gonads somewhat flaccid as opposed to the firmness of a developing gonad. Genital aperture usually inflamed, some hemorrhaging present.	4 SPENT:	Applied to adult specimens at completion spawning activity. The sexual products have been discharged-genital aperture usually inflamed and hemorrhaging present. The gonads have the appearance of deflated sacs,
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<u>VARIABLE NAME</u>	<u>INSTRUCTIONS</u>
	the ovaries usually containing a few leftover eggs (in a state of re-adsorption) and the testes have some residual sperm. Ovarian wall becomes leathery.
	5 IMMATURE: A specimen which is either male or female, but too young to spawn (sub-adult). Transparent or pinkish gonads, not developed.
	6 RESTING: Applies to adult fish with underdeveloped gonads.
	7 DEVELOPING (INDETERMINATE): Applicable to sub-ripe fish heading into spawning season. Testes are opaque and reddish to reddish-white. Ovaries may appear orange and eggs visible to the naked eye, granular, and whitish to orange-reddish. May or may not spawn.
	8 MATURE.
	9 NOT REQUIRED; NOT EXAMINED.
A_D	Enter appropriate alive/dead code for fish at time of capture: 1 = alive 2 = dead
INJURY TYPE	Enter code for type of external injury observed on each fish. Blank = none 1 = gash 2 = crushed 3 = scale loss 4 = hemorrhage 5 = fin rot 6 = body fungus 7 = skeletal deformities 8 = lesions or ulcers 9 = lamprey wound 10 = tumor(s) 11 = blindness 12 = emaciated 13 = parasites 14 = other anomaly 15 = multiple injuries (list in comments)
INJURY LOCATION	Enter code for the location of the predominant external injury on each

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<u>VARIABLE NAME</u>	<u>INSTRUCTIONS</u>
	fish.
	Blank = none
	1 = head
	2 = opercle(s)
	3 = eyes
	4=body
	5 = caudal peduncle
	6 = tail fin
	7 = dorsal fin
	8 = anal fin
	9 = pectoral fin(s)
	10 = pelvic fin(s)

4.6 STORAGE AND CHAIN OF CUSTODY OF DATA SHEETS

Check over all data sheets, to make sure they are completely and correctly filled out, and to be alert to any unusual or unexpected data values. Transport the original data sheets to the field office, file a photocopy of each data sheet there for safe keeping and QA/QC verification, and dispatch the originals to data center.

4.7 REFERENCE COLLECTION

Make sure that each taxon and life stage identified in the Lake Ontario juvenile and adult fish program is represented in a project-specific reference collection at the biology laboratory. Develop this reference collection by removing specimens from JAFNPP samples and storing them sample containers in a designated area. If available, include several (up to ten) specimens per taxon, displaying a variety of sizes. Label the sample containers with the scientific name, date of capture, capture location, and a reference collection catalog number. The catalog number identifies a card containing more detailed sampling information, identifier, comments, etc. File the cards alphabetically by family, genus, and species.

5.0 ENTRAINMENT ABUNDANCE CALCULATION BASELINE

5.1 OBJECTIVE

The baseline adjustment ratio for entrainment at the JAFNPP CWIS will be determined by comparing the density of ichthyoplankton in pairs of near-shore and near-intake samples collected with towed nets consistent with the gear and procedures used in earlier studies (TI 1979). If the HZOI as defined in Section 3.0 (above) is determined to be sufficiently small so that a 300 m³ plankton net tow cannot

*James A FitzPatrick Nuclear Power Plant
Proposal For Information Collection
Submitted: January 31, 2006*

*Prepared In Consultation with:
Enercon Services, Inc. and
Normandeau Associates, Inc.*

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be taken primarily within the HZOI at the 25 ft. depth contour along transect FITZ, then this SOP will be changed to indicate that Lake Ontario ichthyoplankton sampling will be performed by pump sampling using a 4-inch trash pump with a recessed impeller design capable of pumping at a rate of 300 gallons per minute (GPM) to collect 100 m³ samples. Any modifications to this section of the SOP resulting from the outcome of the HZOI study will be provided to the permitting authority at least 30 calendar days prior to the scheduled start of the ichthyoplankton field sampling.

5.2 SAMPLING DESIGN

Sampling design, gear, and procedures for the Lake Ontario ichthyoplankton program will be consistent with the gear and procedures used in the earlier studies (TI 1980), except as modified by the outcome of the HZOI evaluation (Section 3.0 above). Two transects perpendicular to shore will be established to coincide with two of the four transects established by TI (1980). Transect FITZ will be centered on the intake structure of JAFNPP, and is the same transect FITZ used by TI during the earlier studies. Transect FITZ-E will be located approximately 2000 ft. east of the JAFNPP intake. Transect FITZ represents the intake area, while transect FITZ-E is a nearfield control for the JAFNPP intake area that is not exposed to operation of the existing and permit-required fish deterrence system. Samples representative of the shoreline area of Nine Mile Point will be taken in Lake Ontario waters less than 10 feet of depth along each transect. Samples from the JAFNPP intake area of Nine Mile Point will be taken in Lake Ontario waters along the 25 foot depth contour along each transect, which is the depth contour where the JAFNPP intake is located. Therefore the following sampling stations will be designated for Lake Ontario studies to determine the entrainment abundance calculation baseline:

- **FITZ-10** = Lake Ontario near shore water column at the 10 ft. depth contour immediately inshore from the JAFNPP intake,
- **FITZ-25** = three dimensional sampling area in the Lake Ontario water column around the JAFNPP intake structure at the 25 ft. depth contour defined as the hydraulic zone of influence (HZOI) according to the criteria and methods specified in Section 3.0 above,
- **FITZ-E10** = Lake Ontario near shore water column at the 10 ft. depth contour along a transect established 2000 ft. to the east of the JAFNPP intake and perpendicular to the shoreline, and
- **FITZ-E25** = Lake Ontario water column at the 25 ft. contour along a transect established 2000 ft. to the east of the JAFNPP intake and perpendicular to the Lake Ontario shoreline.

Ichthyoplankton samples will be taken in the Nine Mile Point study area of Lake Ontario twice per month and approximately two weeks apart from April through October at each of the two transects and two depth contours defined above. Both daytime and nighttime samples will be collected, and the intention is to separate the collection of daytime and nighttime ichthyoplankton samples symmetrically within the daytime and nighttime periods of each sampling date. Daytime is defined as occurring between one hour after meteorological sunrise and one hour before meteorological sunset

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as observed at the plant site. Nighttime is defined as occurring between one hour after meteorological sunset and one hour before meteorological sunrise as observed at the plant site. Surface tows will be taken at the 10-foot contour stations. Surface and mid-depth tows will be taken at the 25-foot contour stations. Therefore, for each month a total of 24 ichthyoplankton samples will be collected (2 transects x 3 samples per transect x 2 diel periods x 2 events per month), and a total of 168 ichthyoplankton samples scheduled for collection during the seven month period of April through October of each year. All sampling activities will be performed under an approved Scientific Collector's Permit issued by NYSDEC for this study.

5.3 SAMPLING GEAR AND DEPLOYMENT

Ichthyoplankton tows will be taken with a 1m² Tucker trawl (GEAR = 065) towed at a speed of 1 meter per second through the water. If the HZOI as defined in Section 3.0 (above) is determined to be sufficiently small so that a 300 m³ plankton net tow cannot be taken primarily within the HZOI at the 25 ft. depth contour along transect FITZ, then pump sampling will replace towed net samples. The Tucker trawl has a 1.0 m² net mouth opening and a 5:1 length to mouth ratio with a 0.500 mm mesh Nitex net. Earlier studies (TI 1980) deployed a 1.0 m diameter Hensen net with 0.571 mm Nitex mesh and a 6:1 length to mouth ratio for Lake Ontario ichthyoplankton sampling. The Tucker trawl proposed for this study has the advantage of a closing mechanism to collect discrete depth samples, and as discussed above, the 0.571 mm Nitex mesh is no longer manufactured.

The Tucker trawl has a closing device that uses a messenger to trigger a double-trip release mechanism that releases a weighted lead bar to close the mouth of the net and insure that each sample will be collected in each of the discrete depth strata. The closing mechanism will not be used when the Tucker trawl is deployed for a surface tow. Towing speed will be 1.0 m/sec for a duration of 5 minutes to insure an approximate 300 m³ sample, and tows will be made along each of the two depth contours parallel to shore. A flume-calibrated digital flowmeter (GO Model 2030R) will be placed slightly off-center in the mouth of the Tucker trawl to measure the distance (volume) of each tow. Tow depth will be determined in the field using a cosine function relating wire length and wire angle to sampling depth. The start and end of each towpath will be recorded using GPS. Samples will be fixed at the time of collection in 4% buffered formalin and changed over to 80% ethanol within 24 hours. Rose Bengal will be added to stain the fish eggs and larvae and facilitate separating them from other material by sorting in the laboratory. Each sample jar will be labeled with a unique inventory number along with the date, time, and depth of collection.

5.4 SAMPLING PROCEDURES

5.4.1 Equipment Preparation

- Check gear to see if it is damaged or operable, note its condition in the log book, and make repairs if necessary.

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- Check the materials list for required materials and check the boat to be sure that all mechanical systems are operable and note in the log book the condition of systems.
- Load in onboard storage areas all sampling materials and forms required.
- Consult the equipment checklist in Section 4.4.4 (above) to insure that all materials have been loaded.

5.4.2 Tucker Trawl Tows

- Establish a position on-station using the GPS.
- Record the appropriate field data in the Header and S1 portion of the field data sheet (Sections 4.5.1 and 4.5.2 above).
- Obtain and record in-situ water quality data in the Q1 portion of the field data sheet (Section 4.5.3 above).
- Secure the tucker trawl to the towing cable and record the flowmeter starting point.
- Attach the plankton collection cup and safety line.
- Read and record bottom depth using a boat fathometer.
- Load the double trip-release mechanism, being certain to operate net with proper release cable.
- Deploy the trawl and safety line with the boom lowered to proper towing position. Maintain sufficient tension (0.5 m/sec) so the net will not foul.
- When the net is at the proper depth [approximately 3:1 cable length to water; in deep water (>30 m) length of cable x cosine of wire angle = net depth (Kramer et al, 1972)], prepare for tow.
- Attain and maintain a tow speed of 1 m/sec, adjusting the cable length when necessary to keep the net at the desired depth.
- Drop the messenger, opening the net. Start the timer and record the time and velocity.
- Tow the net at 1 m/sec for the prescribed tow duration (5 minutes).
- When the tow is complete, release the messenger to close the net, and retrieve the gear, maintaining a forward direction and sufficient tension to avoid fouling the gear.
- Secure the nets aboard, record flowmeter readings, and wash the net from the outside to concentrate the sample in the collection cup.
- Detach the collection cup and transfer the sample to a 1 liter plastic container. Fix with 10% buffered formalin; for fish eggs and larvae add rose bengal dye.
- Prepare a field label and place inside the container with the sample. Seal the container, affixing the sample number to the exterior.
- Record the number of jars from this sample for delivery to the lab on the R1 portion of the field data sheet (Section 4.5.4 above).
- Transfer the sample container(s) to an onboard storage area.

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- Rinse net, cup, and flowmeter and clean the net by towing it through the water without the cup. Repeat all of the preceding steps for each tow.

5.5 DATA CODING INSTRUCTIONS

Data coding for Tucker trawl tows should follow the coding instructions for each card type given in Section 4.5 above. One data sheet is completed for each Tucker trawl tow. The Header, and Card Types S1, Q1, and R1 are completed for each Tucker trawl tow. The F1 card type is not completed for each Tucker trawl tow. All entries should be made neatly with only one symbol per data block. The individual whose initials are entered on the data sheet is responsible for assuring the legibility of all entries.

6.0 ICHTHYOPLANKTON LABORATORY SOP

6.1 SAMPLES TO BE ANALYZED

Ichthyoplankton samples will be taken with a Tucker trawl equipped with 1.0 m² net mouth opening and a 5:1 length to mouth ratio with a 0.500 mm mesh Nitex net, providing a sample of approximately 300 m³. Sampling will occur in the Nine Mile Point study area of Lake Ontario twice per month and approximately two weeks apart from April through October of 2006 and again during 2007 at each of the two transects and two depth contours. Both daytime and nighttime samples will be collected on each scheduled sampling date. Surface tows will be taken at the 10-foot contour stations. Surface and mid-depth tows will be taken at the 25-foot contour stations. Therefore, for each month a total of 24 ichthyoplankton samples will be collected (2 transects x 3 samples per transect x 2 diel periods x 2 events per month), and a total of 168 ichthyoplankton samples scheduled for collection during the seven month period of April through October of each year.

6.2 EQUIPMENT

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

- Sorting pans
- Lights
- Magnifiers
- Dissecting microscopes
- Motoda plankton splitter
- Sieves
- Rose bengal
- Gridded Petri dishes
- Divided Petri dishes

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- Jars, with lids
- Forceps
- Pipettes
- Multitally counters
- Squirt bottles
- Lab data sheets
- Pens
- Vials, with caps
- Vial labels
- Taxonomic literature
- Copy of SOP
- Ocular micrometers
- Millimeter rulers
- Masking tape
- Rubber bands
- Random number table

6.3 PROCEDURES

6.3.1 Sample Preparation

Check the sample container and labels against the field data sheet to be sure the numbers are consistent. Then determine if the sample will be processed completely or if it will require subsampling.

6.3.1.1 Subsampling Restrictions and Quotas

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

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

6.3.1.2 Sample Splitting Sequence

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

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

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

6.3.1.3 Sample Splitting Technique

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

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6.3.2 Sorting

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

- Samples may be stained with rose bengal to facilitate sorting.
- Pour the sample contents into a sieve with a mesh equivalent to, or finer than, 500 µm and rinse with water to remove the preservative.
- If the sample contains large numbers of eggs and larvae, prepare a subsample following the procedures in Section 4.3.1.
- Carefully wash the sample contents into a container making certain that nothing remains in the sieve. Pour portions of the sample from the container into a pan and examine them under a magnifying lens.
- Remove fish eggs, larvae, and juveniles from the sample using forceps, pipettes, and probes. Remove only those fragments that include the head.
- Maintain a combined total count for eggs and larvae that are removed from the sample (i.e., the combined total of eggs, yolk-sac larvae, post yolk-sac larvae, and juveniles).
- When sorting is completed, recheck the sample for organisms. After the sample has been rechecked, label vials containing the sorted organisms and place them in a box designated for sorted samples. Record the sorting results and date completed in a log.
- Carefully wash back the remaining sample contents into the original sample container, appropriately preserved, and return it to the storage area.
- If a sample is not completed by the end of the work day, it may be left unpreserved overnight if adequate precautions are taken to prevent it from drying out. No sample or part of a sample, however, should remain unpreserved for more than 24 hours.

6.3.3 Identification

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

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

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

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

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

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

Yearling or older: a fish at least one year old.

- Count the specimens of each life stage. Record the counts by species and stage on the lab data sheet (refer to Section 4.5.1 for coding instructions).
- From each sample, measure a maximum of 30 larvae of each fish species to the nearest 0.1 mm (total length) and record the measurements on the lab data sheet. If juvenile fish are present in the sample, they will be measured to the nearest 1.0mm (total length). If more than 30 larvae are present, randomize the selection of specimens for measuring by the following procedure. Spread them uniformly in a gridded container, select a starting point in the grid by means of a random number table, and then measure the first 30 measurable specimens encountered in a predetermined pattern commencing at the starting point. Every grid space must have an equal probability of being selected as the starting point, so that every specimen will have an equal probability of being included in the subsample.
- Place identified organisms in vials with an adequate amount of preservative for storage. Specimens may be removed for inclusion in the reference collection. For those removed, list the species, life stage, and numbers on the comments section of the form and note their removal on a tag retained inside the appropriate vial. Label all vials for a single sample, initial them and band them together. Record the number of vials for the sample on the data form. For reference collection procedures refer to Section 4.7.

6.4 SAMPLE HANDLING

6.4.1 Sample Control

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

6.4.2 Chain of Custody Records

The chain of custody documentation begins with the field office providing a list with the following information for each sample in a shipment delivered to the laboratory facility: sample collection date,

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sample collection time, sample identification number, and number of jars. Upon receipt of the samples, a laboratory representative verifies that all jars of all samples on the list are present, then signs and dates the chain of custody document.

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

6.4.3 Preservation and Storage

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

6.4.4 Disposal

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

6.5 DATA HANDLING

6.5.1 Data Sheets and Coding Instructions

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

6.5.1.1 Count Data

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

VARIABLE

INSTRUCTIONS

SAMPLE	Record the 4-digit sample number. Sample numbers will be in the range 2011 to 2524 (but not every number in that range is used).
--------	--

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<u>VARIABLE</u>	<u>INSTRUCTIONS</u>
CARD TYPE	Preprinted: L1
CATCH_CD	Enter 1 for valid non-empty sample or 2 for valid empty sample (data sheets are not required for void samples)
SPL_FACT	Enter 1.00 if the whole sample is analyzed; if the sample is subsampled record the ratio of the whole sample to the subsample (e.g., 8.00 for a 1/8 split)
TAXON	Enter the TAXON code from the Taxon Code List (Appendix B).
STAGE	Enter one of the following life stage codes: 0 = unknown 1 = eggs 2 = yolk-sac larvae 3 = post yolk-sac larvae 4 = young-of-the-year 5 = yearling or older
COUNT	Record the number of organisms of the indicated taxon and life stage in the sample (or subsample)
SPECIES NAME	Record the common name for the taxon

6.5.1.2 Measurement Data

Record measurement data for all fish species on one or more Lab Length Data Sheets according to the following instructions.

<u>VARIABLE</u>	<u>INSTRUCTIONS</u>
SAMPLE	Record the sample number
Card Type	Preprinted: L2
Conversion Factor	Record the number of millimeters per division for the optical micrometer used to measure larvae
TAXON	Enter the taxon codes for each species measured on Lab Length Data Sheets.
FISH_ID	Preprinted: 1-30 for fish species
STAGE (or “STG.”)	Enter the life stage code for each larva measured (2, 3, 4, or 5 for fish species). Refer to the life stage code definitions used for count data (Section 6.5.1.1).
SCALE	Enter 6 if measurements are recorded in optical micrometer units; enter 7 if measurements are recorded directly in millimeters. (If optical micrometer units are recorded for a measurement, the actual length in millimeters will be obtained later by multiplying the measurement by the conversion factor.)
MEASUREMENT	Record the total length of larvae to the nearest 0.1 optical micrometer unit or to the nearest 0.1 mm. Juvenile fish are measured to the nearest 1.0mm total length.

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6.5.2 Storage and Chain of Custody of Data Sheets

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

6.6 QUALITY CONTROL

6.6.1 Tasks Subject to Quality Control

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

- sorting
- identification, life stage determination, and enumeration

6.6.2 Inspection Plans

Items are inspected using a quality control (QC) procedure derived from MIL-STD (military-standard) 1235B (single and multiple level continuous sampling procedures and tables for inspection by attributes) to achieve a 10 percent or better AOQL (Average Outgoing Quality Limit). The QC procedure used is the CSP-1 continuous sampling plan, which is conducted in two modes as follows:

- **Mode 1.** Reinspect one hundred percent of the samples until “i” consecutive samples pass.
- **Mode 2.** After “i” consecutive samples pass QC reinspection, randomly choose (using a random numbers table) the fraction “f” of the samples for reinspection. If any QC sample fails then return to Mode 1.

For this application of CSP-1, $i=8$ and $f=1/7$, because the total number of samples analyzed by an individual is less than 500. It is important that QC inspections are performed as soon as possible after the original analysis; work-up of QC samples must not be postponed to be done in batches. Keeping the QC program as current as possible insures that problems are detected and remedied quickly, minimizing the additional number of samples that are analyzed before the problem is addressed.

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

Apply the QC plan on an individual processor basis, so that each person’s work is subjected to the QC plan independently of others, starting at 100% inspection.

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

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

6.6.3 Acceptance/Rejection Criteria

6.6.3.1 Sorting

A sample is considered defective if the sorter failed to remove 10 percent of the total organisms in the sample (or subsample). Percent error is calculated as follows (where “QC count” denotes the number missed by the sorter):

$$\% \text{ error} = 100\% \times \text{QC count} / (\text{sorter's count} + \text{QC count})$$

When the total count (sorter's plus QC) is ≤ 20 , then the sample is considered defective only if the sorter missed more than two organisms.

6.6.3.2 Identification

A sample is considered defective if an error of 10 percent or more is made in identifying, assigning a life stage, or counting any species. In determining whether a sample is defective, analyzer and QC results are compared within each taxon/life stage combination.

For each taxon (or for a life stage within a taxon) the percent error is calculated as follows (except where the QC count is ≤ 20 , the percent error is considered to be zero if analyzer and QC counts differ by no more than two organisms):

$$\% \text{ error} = 100\% \times | \text{analyzer count} - \text{QC count} | / \text{QC count}$$

A sample with a percent error of greater than or equal to 10% for any life stage for any taxon is considered defective.

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

$$\% \text{ error} = 100\% \times \left| \frac{\text{identifier count} - \text{resolution count}}{\text{resolution count}} \right|$$

$$\% \text{ error} = 100\% \times \left| \frac{\text{QC count} - \text{resolution count}}{\text{resolution count}} \right|$$

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

6.6.4 Quality Control Records

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

6.6.5 Quality Control Personnel

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

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

6.7 REFERENCE COLLECTION

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

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6.8 INSTRUMENT CALIBRATION

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

7.0 DATA HANDLING

7.1 DATA ENTRY VERIFICATION AND DATA SHEET CHAIN OF CUSTODY

Provide a submittal form with each batch of data sheets submitted to the Technical Data Processing (TDP) department 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.

Key all data twice, resolving discrepancies between the two versions as they are flagged by the data verification program.

After data entry and verification are complete, transfer custody of the data sheets from TDP to the originators, where they are used in the error checking and quality control tasks, and finally stored in a project file. Document the transfer from TDP back to the originator by one or more submittal sheets containing the same information as those used to transfer custody to TDP. TDP is not required to maintain copies of the data sheets. After JAFNPP accepts the data files and final report, the original data sheets and paper copies of them may be discarded.

7.2 SYSTEMATIC ERROR CHECKS

Keyed data are 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 are resolved, and corrections to both the data files and the data sheets are made as necessary. After error checking is complete, data files are subjected to quality control inspection (refer to Section 7.4 below).

7.3 DATA FILE FORMAT

Error checked data files are assembled into a SAS, Excel, or Microsoft Access database.

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7.4 QUALITY CONTROL OF DATA FILES

Data files that have completed the systematic error checking process 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 $\geq 99\%$ 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.

Lot Size	Sample Size	Number of Failures	
		Accept If \leq	Reject If \geq
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

8.0 TRAINING

In order to assure the standardization of field, laboratory, and data processing procedures, a two level system for training technicians is followed: 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

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special training will be required to participate in tasks, as set forth by the Program Manager.

9.0 QUALITY ASSURANCE

9.1 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, are 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 Manager 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.

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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.

9.2 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 JAFNPP. 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

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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 non-conformities, 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. A summary report of audit results, and follow-up corrective action will also be made available for JAFNPP review.

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Appendix A

Forms

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TASK CD				SAMPLE				GEAR				YEAR			
1	4														

S1		DATE														TIME				LOCATION			N/S		DURATION	
		MO		DAY																						

TIME		DEPTH				TOW_		WAVE_HT		DIR		VESL_CD		BEACH		USE_CODE		GEAR		SAM		INIT		COMMENTS	
PULL		RIV		SAM		SPD		DIR		WAVE_HT		VESL_CD		BEACH		USE_CODE		GEAR		SAM		INIT		COMMENTS	
SET																									

ENGINE_RPM

TOW_DIST

Q1		WATER QUALITY											
BOTL_N		H ₂ O_TEMP		DO		pH		COND		DEPTH_WQ			
SURFACE													
BOTTOM													

R1		N_JARS				N YRL STOM	
SUS RECP		LW		ID			

SECCHI DEPTH (m)

AIR TEMP (°C)

CLOUD COVER (%)

PRECIPITATION

WIND SPEED

WIND DIRECTION

CURRENT SPEED

INSTRUMENTATION I.D. NUMBERS:

TEMP/D.O. _____

CONDUCTIVITY _____

pH _____

WEIGHT SCALES _____

SLRS-5-94a

COMMENTS: _____ QC _____

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FITZPATRICK NUCLEAR POWER PLANT, 2006

Ichthyoplankton Lab Length Data Sheet

Sample Card

Stage Codes: 0 = unknown

2 = yolk sac larvae

3 = post yolk sac larvae

4 = post yolk sac larvae

5 = yearling or older

Page ___ of ___

TAXON STAGE

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

TAXON STAGE

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

TAXON STAGE

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

TAXON STAGE

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

TAXON STAGE

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

TAXON STAGE

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

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EXTRAORDINARY EVENT/NONCONFORMITY REPORT

EE/NC Report Number: _____ Date: _____ From: _____

Respond by (date): _____ Project No.: _____ Title: _____

Date closed: _____

ADDRESSEES:

QA: Project Mgr.: _____ Field Mgr.: _____ Lab Mgr.: _____ Technical Mgr.: _____ Others: _____

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

RECOMMENDATIONS FOR or CORRECTIVE ACTION TAKEN:

Signed: _____

ACTION ADDRESSEE RESPONSE:

CORRECTIVE ACTION COMPLETED: Date: _____ Signed: _____

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

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APPENDIX B

Fish Taxon Codes

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Appendix Table B-1. Taxon codes for fish species.

Taxon Code	Common Name
1	alewife
2	bay anchovy
3	American shad
4	bluefish
5	bluegill
6	brown bullhead
7	pumpkinseed
8	black crappie
9	common carp
10	American eel
11	goldfish
12	golden shiner
13	hogchoker
14	tessellated darter
15	banded killifish
16	emerald shiner
17	largemouth bass
18	mummichog
19	Atlantic menhaden
20	(use 59)
21	chain pickerel
22	blueback herring
23	white sucker
24	Atlantic silverside
25	rainbow smelt
26	smallmouth bass
27	shortnose sturgeon
28	spottail shiner
29	Atlantic sturgeon
30	striped bass
31	fourspine stickleback

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Appendix Table B-1 (Continued)

Taxon Code	Common Name
32	Atlantic tomcod
33	to be identified
34	white catfish
35	white perch
36	yellow perch
37	satinfish shiner
38	rock bass
39	northern pipefish
40	redbreast sunfish
41	Atlantic needlefish
42	crevalle jack
43	eastern silvery minnow
44	fallfish
45	weakfish
46	comely shiner
47	common shiner
48	mimic shiner
49	lookdown
50	unidentified clupeid
51	(use 50)
52	(use 60)
53	grass pickerel
54	lined seahorse
55	logperch
56	trout-perch
57	northern hog sucker
58	fathead minnow
59	unidentified cyprinid
60	unidentified <i>Morone</i>
61	redfin pickerel
62	tautog
63	fourbeard rockling

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Appendix Table B-1 (Continued)

Taxon Code	Common Name
64	striped cusk-eel
65	(use 96)
66	northern kingfish
67	spot
68	Atlantic moonfish
69	brook stickleback
70	unidentified sturgeon
71	scup
72	winter flounder
73	inland silverside
74	sea lamprey
75	gizzard shad
76	silver hake
77	striped mullet
78	threespine stickleback
79	brown trout
80	butterfish
81	white crappie
82	brook trout
83	northern pike
84	green sunfish
85	silver perch
86	northern puffer
87	eastern blacknose dace
88	bridle shiner
90	cutlip minnow
96	unidentified centrarchid
97	spotfin shiner
98	red hake
99	unidentifiable
100	central mudminnow
101	grubby

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Appendix Table B-1 (Continued)

Taxon Code	Common Name
102	eastern mudminnow
103	white bass
104	rough silverside
105	longear sunfish
106	summer flounder
107	longnose dace
108	creek chub
109	black bullhead
110	striped searobin
111	northern searobin
113	Atlantic croaker
114	longhorn sculpin
115	round herring
116	hickory shad
117	Atlantic herring
118	reef silverside
119	striped anchovy
120	conger eel
121	striped killifish
122	warmouth
123	bluntnose minnow
124	walleye
125	white mullet
126	yellow bullhead
127	channel catfish
128	pollock
129	seaboard goby
130	naked goby
131	yellowtail flounder
132	windowpane
133	spotted hake
134	unidentified searobin

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Appendix Table B-1 (Continued)

Taxon Code	Common Name
136	northern stargazer
137	American sand lance
138	fat sleeper
139	fourspot flounder
140	Atlantic mackerel
141	black sea bass
142	smallmouth flounder
143	rock gunnel
144	inshore lizardfish
145	unidentified mudminnow
146	silver lamprey
147	rainbow trout
148	rosyface shiner
149	unidentified <i>Esox</i>
150	unidentified gobiid
151	unidentified <i>Fundulus</i>
152	unidentified cyprinodontid
153	unidentified <i>Myoxocephalus</i>
154	unidentified cottid
155	unidentified pleuronectiform
156	unidentified pleuronectid
157	unidentified atherinid
158	unidentified <i>Menidia</i>
159	unidentified bothid
160	speckled wormeel
161	unidentified syngnathid
162	mackerel scad
163	unidentified <i>Ammodytes</i>
164	cunner
165	unidentified sciaenid
166	unidentified gadid

(continued)

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Appendix Table B-1 (Continued)

Taxon Code	Common Name
167	flying gurnard
168	shield darter
169	gray snapper
170	Atlantic cod
171	sea raven
172	bigeye scad
173	striped burrfish
174	sheepshead
175	unidentified percid
176	spotfin mojarra
177	spotfin butterflyfish
178	unidentified gasterosteid
179	planehead filefish
180	Atlantic cutlassfish
181	pigfish
182	short bigeye
183	guaguanche
184	freckled blenny
185	unidentified tetraodontid
186	orangespotted filefish
187	margined madtom
188	bluespotted cornetfish
189	black drum
190	northern sennet
191	scamp
192	cobia
193	least darter
194	unidentified percichthyid
195	scrawled cowfish
196	spotfin flyingfish
197	Gulf menhaden

(continued)

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Appendix Table B-1 (Continued)

Taxon Code	Common Name
198	pugnose shiner
199	redfin shiner
200	sand shiner
201	swallowtail shiner
202	tiger muskellunge
203	goosefish
204	permit
205	freshwater drum
206	king mackerel
207	longnose gar
208	Spanish mackerel
209	highfin goby
210	unidentified sucker
211	unidentified labrid
212	blackcheek tonguefish
213	oyster toadfish
214	feather blenny
215	orange filefish
216	little skate
217	spiny dogfish
218	Atlantic seasnail
219	Gulf Stream flounder
220	spotted goatfish
221	brook silverside
222	harvestfish
223	pinfish
224	witch flounder
225	kokanee
226	ladyfish
227	radiated shanny
228	cusck
229	unidentified <i>Urophycis</i>

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Appendix Table B-1 (Continued)

Taxon Code	Common Name
230	American plaice
231	slimy sculpin
232	sheepshead minnow
233	unidentified blenny
234	unidentified skate
235	clearnose skate
236	weakfish/scup
237	haddock
238	rudd

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