



October 16, 2014

VIA ELECTRONIC FILING

Ms. Kimberly D. Bose
Secretary
Federal Energy Regulatory Commission
888 First Street, NE
Washington, DC 20426

Re: FirstLight Hydro Generating Company, FERC Project Nos. 2485 and 1889
Revised Study Plan 3.3.20 Entrainment of American shad ichthyoplankton at the Northfield
Mountain Pumped Storage Project

Dear Secretary Bose:

On September 3, 2014, the Federal Energy Regulatory Commission (Commission) replied to the Northfield Ichthyoplankton study dispute and adopted the revised study plan that US Fish and Wildlife Service (USFWS), FirstLight and the Commission drafted together. The Commission requested that FirstLight finalize a detailed study plan, consult with USFWS, Massachusetts Division of Fish and Wildlife, New Hampshire Department of Fish and Game and Vermont Agency of Natural Resources. In addition to these agencies, FirstLight consulted with Trout Unlimited, The Nature Conservancy, National Marine Fisheries Service, and the Connecticut River Watershed Council. As requested FirstLight finalized the detailed study plan and consulted with the above stakeholders. The finalized detailed study plan with comments incorporated can be found below as Attachment A. The response to comments can be found as Attachment B.

If you have any questions, or need additional information, please feel free to contact me.

Sincerely,

A handwritten signature in black ink, appearing to read "John Howard".

John Howard

[Attachment A](#): *Study Plan 3.3.20 Entrainment of American Shad Ichthyoplankton at the Northfield Mountain Pumped Storage Project*

[Attachment B](#): *Response to Agency Comments*

John S. Howard

Director FERC Compliance, Hydro

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Attachment A: Study Plan 3.3.20 Entrainment of American Shad Ichthyoplankton at the Northfield Mountain Pumped Storage Project.

General Description of Proposed Study

The purpose of this study is to quantify entrainment of American shad ichthyoplankton at the Northfield Mountain Pumped Storage Project (Northfield Mountain Project).

On February 21, 2014, the Federal Energy Regulatory Commission (FERC) issued its second Study Plan Determination Letter (SPDL). On March 13, 2014, the United States Fish and Wildlife Service (USFWS) filed a notice of study dispute relating to the SPDL's determination not to require FirstLight to conduct ichthyoplankton sampling in the vicinity of the Northfield Mountain Project intake (tailrace) to quantitatively determine the level of entrainment of early life stages of American shad. Following the USFWS's letter, the following activities occurred relative to the study dispute:

- On March 26, 2014, a conference call was held with FirstLight, USFWS and FERC to discuss the notice of study dispute.
- On March 28, 2014, FirstLight filed with FERC information relative to Northfield Mountain Project Pumping.
- On March 31, 2014 FERC issued a Notice of Dispute Resolution Panel Meeting and Technical Conference.
- On April 1, 2014, a conference call was held with FirstLight, USFWS and FERC to further discuss the study dispute.
- On April 3, 2014, FirstLight filed with FERC two reports from the 1990s relevant to the Study Dispute Panel's consideration of the dispute.
- On April 7, 2014, FirstLight filed with FERC "Comments and Information of FirstLight Hydro Generating Company Regarding Notice of Study Dispute" relating to USFWS's exercise of Federal Power Act section 18 authority as it pertains to the study dispute.
- On April 8, 2014, the Study Dispute Panel held its meeting at the Northfield Mountain Project Visitors Center.
- On April 8, 2014, following the study dispute panel meeting, a meeting was held with FirstLight, USFWS and FERC to discuss the possibility of a mutually agreeable solution that would alleviate the need for a Director's determination on the study dispute.
- On April 14, 2014, FirstLight filed with FERC drawings and photographs of the Northfield Mountain Project relevant to study methodology discussed by FirstLight, USFWS, and FERC.
- On April 15, 2014, FirstLight filed with FERC Dye testing information conducted at the Northfield Mountain Project.
- On April 22, 2014, a conference call was held with FirstLight, USFWS and FERC to further discuss a mutually agreeable study plan.
- On May 1, 2014, the USFWS filed a Response to the FirstLight's April 7, 2014 filing.
- On May 2, 2014, the USFWS filed with FERC a conceptual framework for assessing ichthyoplankton entrainment at the Northfield Mountain Project. In addition, in a separate May

2, 2014 letter to FERC, USFWS stated that if FERC accepts the proposed study plan framework and requires FirstLight to conduct the study, USFWS will consider the dispute resolved.

- On May 2, 2014, FirstLight filed with FERC a letter supporting USFWS's proposed study.
- On May 2, 2014, FERC suspended the Dispute Resolution Panel.

Study Goals and Objectives (18 CFR § 5.11(d)(1))

Goal: Quantify entrainment of American shad ichthyoplankton into the Northfield Mountain Project during pump-back operation in a manner that will allow evaluation of temporal differences in larval density throughout the pumping cycle and the effects of the number of units pumping on entrainment rate.

Study Objectives:

- Calculate the number of American shad eggs and larvae entrained at the Northfield Mountain Project;
- Estimate the loss of adult and juvenile shad equivalents based on shad egg and larvae entrainment at the Northfield Mountain Project;
- Compare entrainment rates with one through four units pumping; and
- Determine the temporal distribution of entrainment within the prevailing pumping period.

Resource Management Goals of Agencies/Tribes with Jurisdiction over Resource (18 CFR § 5.11(d)(2))

The Connecticut River Atlantic Salmon Commission (CRASC) developed A *Management Plan for American Shad in the Connecticut River* in 1992. Management objectives in the plan that relate to the requested study include: (1) achieving and sustaining an adult population of 1.5 to 2 million individuals entering the mouth of the Connecticut River annually and (2) maximizing outmigrant survival for juvenile shad.

In addition, the Atlantic States Marine Fisheries Commission's Amendment 3 to the Interstate Fishery Management Plan for Shad and River Herring (ASMFC 2010) has a stated objective of maximizing the number of juvenile recruits emigrating from freshwater stock complexes.

Existing Information and Need for Additional Information (18 CFR § 5.11(d)(3))

Prior entrainment studies conducted at the Northfield Mountain Project include an entrainment study targeting egg, larval and juvenile American shad in 1992 (LMS, 1993). The studies were conducted to evaluate the impacts of the Project operation on American shad in the Connecticut River. Specific methods used in these studies included entrainment netting, and mark/recapture to investigate the probability of entrainment.

Results demonstrated seasonally-influenced entrainment rates of pre-juvenile life stages of American shad. The LMS (1993) study also suggested the possibility of a temporal component regarding rates of entrainment; however the study methodology was not designed to produce reliable inferences regarding sub-daily variations in entrainment rates. Additionally, the LMS (1993) study made certain assumptions that may have resulted in higher than actual entrainment rates (e.g., shad eggs and larvae in the river channel are evenly mixed throughout the water column and the Northfield Mountain Project intakes draw water evenly from the water column). A study that would directly sample the intake water, rather than the

river channel, multiple times during a pumping cycle could be used to evaluate varying entrainment rates on a sub-daily basis.

Other data sources filed with FERC during the study dispute period in 2014 include:

- March 28 filing: Northfield Mountain Project Pumping Information for May, June and July during the years 1991-1993 and 2011-2013, and hourly pumping records for the same period.
- April 3 filing: This included the following two reports:
 - “*Northfield Mountain Pumped Storage Project 1990 Field Sampling Program.*” The draft report, dated February 1991, was prepared by Harza Engineering Company for Northeast Utilities Service Company.
 - “*Impact of the Northfield Mountain Pumped Storage Facility on Atlantic Salmon and American Shad.*” The draft report, dated March 1993, was prepared by Lawler, Matusky & Skelly Engineers for Northeast Utilities Service Company.
- April 14 filing: Drawings and photographs of the Northfield Mountain Project.
- April 15 filing: Analysis of Dye Dispersion into Branches of the Northfield Mountain Project.

Project Nexus (18 CFR § 5.11(d)(4))

Factors that influence entrainment at hydroelectric projects include the size and depth of the intakes, the hydraulic capacity and configuration of the turbines, the velocity of water as it enters the intake relative to fish swim speeds, the location of the intake relative to fish habitat, and the characteristics of fish species present in the study area.

American shad broadcast spawn in congregations and fertilized eggs drift downstream until hatching. Shad are known to spawn upstream and downstream of the Northfield Mountain Project. Because early life stages of shad are non- or barely-motile, they are unable to avoid project intakes, and thus may be susceptible to entrainment.

The economic feasibility of pumped storage projects is highly dependent upon the daily timing of operations. Therefore, an entrainment study that allows for a more comprehensive evaluation of temporal variations of shad larval/egg entrainment within pumping cycles may be useful to better understand if and how operations of the project may affect shad larval/egg entrainment rates.

Methodology (18 CFR § 5.11(b)(1), (d)(5)-(6))

Sampling of ichthyoplankton entrainment at Northfield Mountain Project would be implemented by sampling water within the cooling water system of the Northfield Mountain Project as described below. The sampling of power plant cooling water intakes is an accepted sampling approach, to determine entrainment rates of ichthyoplankton.

Task 1. Entrainment Sampling

Sampling Frequency

The service water system inside the Northfield Mountain powerhouse will be sampled in the period of May 15 through July 31, 2015. Sampling will begin once 5,000 shad have passed through the Turners Falls Gatehouse fishway, or May 21, whichever comes first. Sampling will cease once no shad eggs or larvae are captured in three concurrent weeks of sampling, or by July 31, whichever comes first. Once per week samples will be collected every 2 hours during a pumping cycle. Sample collection will be initiated 30 minutes after the pumping cycle begins to ensure the water is well mixed.

In addition, pumpback operations will be manipulated to specifically sample entrainment with 1, 2, 3, and 4 pumps running. Four pumping scenarios will be sampled as follows:

- Scenario 1: 1 pump operational (Unit 2)
- Scenario 2: 2 pumps operational (Unit 2 and one other)
- Scenario 3: 3 pumps operational (Unit 2 and two others)
- Scenario 4: All 4 pumps operational (Unit 2 and three others)

This sampling will occur over the expected peak of egg and larval density (June 1 through June 28). An attempt will be made to schedule the Scenario-sampling in as short a time period as possible. Sampling will be randomized or scheduled if possible such that scenarios are not run in a sequence of an increasing or decreasing number of pumps. During this “peak” period, an attempt will also be made to collect data during three separate pumping cycles where pumping of 1, 2 or 3 units is held constant over the entire pump cycle (e.g., 11pm to 7am).

In addition, if any daytime pumping (9 am to dusk) or uncommon nighttime pumping (dusk to 9pm) hours are scheduled to occur during the sampling period, to the extent possible (given pumping scheduling decision lead time), samples will be collected during these times. These samples will be in addition to the planned regular weekly samples.

System Design and Collection Method

Entrainment sampling will be accomplished by tapping off of existing piping that supplies cooling water from the Connecticut River to the station. The goal is to sample a minimum of 150 gpm (gallons per minute) of flow. PVC and rubber piping, a digital flow meter, a 1,000-liter plastic tank, and a 0.333 mm mesh plankton net will be utilized to construct the sampling system. The objective will be to filter approximately 100-200 cubic meters of intake water for each sample. Intake cooling water will be diverted through a four-inch diameter flexible hose to an entrainment sampling tank. An inline Signet® digital flow meter will be mounted in the hose to record the volume of water sampled. The hose’s discharge will be directed into a conical 0.333 mm mesh plankton net suspended in a 1,000 liter plastic tank. The plastic tank is designed with an overflow system. The objective is to filter at least 100 cubic meters of intake water per sample. Once sufficient volume is obtained, the net will be removed from the sampling tank and its contents will be rinsed down into the cod-end collection jar with fresh water. The sample jar will be removed from the plankton net and the contents preserved with a 10% formalin solution. All jars will be appropriately labeled and transported back to Kleinschmidt’s sorting facility for sorting, enumerating and organism identification. At the beginning of each entrainment sampling event, the following water quality information will be measured and recorded: temperature, dissolved oxygen, pH, and conductivity. In addition, data on Northfield Mountain Project operations including which unit and the number of units operating, unit output and the Turners Falls Impoundment elevation at the Northfield Mountain Project tailrace will be recorded.

Sample Validation

To validate that larval densities in the service water pipe are representative of densities in the intake tunnel, a paired sampling of both service water pipe and the intake/tailrace channel will be collected at the start of the study. Ichthyoplankton samples will be collected in the intake/tailrace channel with weighted 60-cm diameter paired bongo nets with 0.333 mm mesh deployed from a boat. The bongo nets will be towed in a straight line starting at the intake tailrace obliquely, from bottom to surface, for approximately six minutes or until at least 100 cubic meters of river water is sampled. General Oceanics flowmeters will be suspended in the center of each net to measure the volume of river water filtered during each tow. Once the target volume is obtained, the nets will be hauled onto the boat and the contents from the nets

with the highest volume from each tow will be rinsed down with water into the cod-end collection jars. The samples will be preserved with a 10% formalin solution in appropriately labeled jars and transported back to the sorting room, analyzed. A minimum of three replicate samples under three different pumping conditions (i.e., 1, 2 and 3 units pumping), ideally on different days, will be collected at each of the two locations. The purpose being to confirm that the Unit 2 cooling water pipe represents the tailrace tunnel water regardless of number of units pumping.

Sampling will begin 30 minutes after pumping begins or 30 minutes after a change in pumping scenarios. Densities of American shad eggs and larvae in the two sets of samples will be compared. If differences are found, a correction coefficient for entrainment calculations will be developed.

Task 2. Sample Processing

Ichthyoplankton samples will be sorted with the aid of a dissecting microscope. Larvae and eggs will be removed from the samples, identified to the lowest practical taxonomic category, and enumerated. Larvae and eggs of blueback herring, and American shad in the Connecticut River are not easily distinguishable. However alewives are not found in this area of the Connecticut River, and blueback herring numbers are very low, therefore any herring eggs or larvae will be identified as American shad.

A quality control program designed to ensure that the Average Outgoing Quality Limit for ichthyoplankton sorting and identification is greater than 90% will be followed. To accomplish this, one ichthyoplankton sample from each series of ten samples processed by a single individual will be randomly selected to be re-sorted. No one will be allowed to perform a QA/QC on his or her own samples. The person checking the sample (the QA/QC-er) will re-process the sample to determine what percentage of both larvae and eggs was missed, if any. If the percentage missed in either category is equal to or greater than 10 percent, the following QA/QC procedure will be followed until a “passing” QA/QC was obtained: Starting with samples sorted prior to the failed QA/QC, samples were re-sorted in sequential order, working back, until a ‘passing’ QA/QC is obtained (i.e., Number found by QA/QC-er is less than 10% of total eggs or larvae in the sample). The process will be repeated with subsequently sorted samples, sequentially until a passing QA/QC is obtained. Any larvae or eggs found during the QA/QC process will be added to the totals on the corresponding data sheet and included in the entrainment estimates.

All sorting and field data will be entered into a Microsoft Access database. All data entered will be verified for accuracy against the original data sheets prior to commencement of analyses, which are described below.

Task 3. Ichthyoplankton Data Analysis Methods

Raw data will be provided to USFWS in digital format.

Entrainment Estimates

Entrainment of American shad eggs and larvae will be estimated based on the extrapolation of raw counts using a volumetric ratio and summing of weekly estimates derived from samples. The daily service water volume will be calculated based on daily average flow rates (MW generated converted to cfs) obtained from Northfield Mountain Project personnel. An estimate for each day not sampled will be calculated by multiplying the average entrainment density (number of larvae/eggs per m³ of service water) for the

sampled night by the volume of water pumped on each day not sampled. All daily estimates will then be summed to generate a total for the larvae and eggs of each species entrained.

Equivalent Adult Estimates

The numbers of entrained fish larvae and eggs will be converted into adult equivalents to determine population impact. Adult equivalent losses (AELs) are estimates of the number of entrained organisms removed from the population that otherwise would have survived to some future age, or age of equivalence. To estimate AELs, the estimates of American shad larvae and eggs are multiplied by the survival fraction at a given lifestage:

$$AEL = \sum_{j=1}^n S_{i,A} N_i$$

where:

N_i = number of fishes lost at stage i ; and

$S_{i,A}$ = fraction of fishes expected to survive from stage i to the stage of equivalence.

Survival rates of early lifestages are often expressed on a lifestage-specific basis so that the fraction surviving from any particular lifestage to adulthood is expressed as the product of survival fractions for all lifestages through which a fish must pass before reaching adulthood (j_{max} = the stage immediately prior to the age of equivalence):

$$S_{i,A} = \prod_{j=i}^{j_{max}} S_j$$

Survival fraction data for all lifestages of American shad entrained will be compiled using survival fractions from Savoy and Crecco (1988).

Ichthyoplankton Densities

Egg and larval sample densities will be determined by dividing the number of American shad eggs and larvae by life stage (egg, yolk-sac larvae, post yolk-sac larvae) in each sample by the sample volume. The densities will then be standardized to the number of larvae per 500 m³. Densities by life stage will be analyzed by date, time, and number of units pumping.

Level of Effort and Cost (18 CFR § 5.11(d)(6))

The cost for this study would be \$60,000 to \$70,000. Costs will be related to equipment, sampling and processing of the ichthyoplankton samples, analysis of data, and production of a final report.

Schedule

The sampling will occur in 2015. Should anomalous conditions prevail (operational and/or environmental), the study may need to be repeated in 2016.

Literature Cited

- Atlantic States Marine Fisheries Commission. 2010. Amendment #3 to the Interstate Fishery Management Plan for Shad and River Herring (American Shad Management). Washington, D.C.
- Cook, T.C., E.P. Taft, S.V. Amaral, F.C. Winchell & R.A. Marks. 1994. Strobe Light Demonstration: Northfield Mountain Pump Storage Project. Alden Research Laboratories. Report to Northeast Utilities Service Company.
- Connecticut River Atlantic Salmon Commission. 1992. A Management Plan for American Shad in the Connecticut River. Sunderland, MA
- EPA (Environmental Protection Agency). 2004. Regional Analysis Document for the Final Section 316(b) Phase II Existing Facilities Rule. Part H: The Inland Region. EPA-821-R-02-003. February 2004.
- Lawler, Matusky, and Skelly Engineers (LMS). (1993). *Northfield Mountain Pumped Storage Facility: 1992 American shad studies*. Prepared for the Northeast Utilities Service Company, Berlin, CT: Author.
- Northeast Utilities Service Company (NUSCO). (1999). The Effect of a Guide Net on the Movement of Radiotagged Atlantic Salmon (*Salmo salar*) Smolts at the Intake of the Northfield Mountain Pump Storage Facility, Connecticut River, 1998. Report.
- Savoy, T.F. and V.A. Crecco. 1988. The timing and significance of density-dependent and density-independent mortality of American shad, *Alosa sapidissima*. *Fishery Bulletin* 86(3): 467-482.

Attachment B: Response to Agency Comments

**Response to Comments on Study Plan 3.3.20 Entrainment of American Shad
Ichthyoplankton at the Northfield Mountain Pumped Storage Project.**

Comment 1:

USFWS recommends the following changes to the agreed upon sampling schedule:

1. Compress the “testing” schedule to a four week period (e.g., June 1 through June 28) rather than the proposed six week period.
2. Within that narrower window, try (to the extent possible) to have the pumping scenario tests occur as close together as possible (to minimize temporal changes to variables that could affect entrainment).
3. Continue to collect regular weekly samples in addition to the pump test samples in order to assure that a “normal” pumping cycle is gathered each week through the peak of the run (this will add four samples).
4. Collect an additional three samples under constant pumping conditions over the entire pumping cycle (to determine if time of day affects entrainment).

Response:

1. FirstLight agrees to attempt to compress the testing schedule
2. FirstLight agrees to attempt to compress the pumping scenario tests
3. FirstLight agrees to collect the weekly sample reflecting project operations during one night and collect the pumping scenario samples on a subsequent night during the four week testing period.
4. Constant pumping conditions will occur during the weekly sample collections and these samples can be used to determine if time of day affects entrainment. USFWS request would add an additional 12 plankton samples that would need to be sorted and processed.

Comment 2:

Why will only one net of the pair be collected? What will determine which one is saved? Recommend collecting both but processing one.

Response:

FirstLight would save the sample with the highest volume of water and this is now documented in the study plan. When the 10% formalin solution (preservative) is added to the plankton sample, the sample then becomes hazardous waste. FL is trying to avoid generating unnecessary hazardous waste.

Comment 3:

The purpose being to confirm that the Unit 2 cooling water pipe represents the tailrace tunnel water regardless of number of units pumping.

Response:

This language added to the study plan.

Comment 4:

This assumes that the single weekly sampling event represents an entire week; that the entrainment rate on the sample day is the same for that entire week.

Response:

This is an EPA approved entrainment estimate process.

Comment 5:

This would work only if there is a linear relationship between the number of pumps and entrainment.

Response:

USEPA (2014) correlates flow reductions to impingement and entrainment reductions in a linear fashion.

Reference: US EPA. 2014. Technical Development Document for the Final Section 316(b) Existing Facilities Rule. EPA-821-R-14-002. May 2014

Comment 6:

We've already commented that there are river-specific survival estimates that could and should be used for the CT River.

Response:

FirstLight agrees to use Savoy and Crecco (1988) survival fractions and has documented this in the study plan.

Comment 7:

This paragraph was in the conceptual framework: *Pending 2015 study plan results, modeling of juvenile shad abundance estimates in 2016 may be appropriate. Additionally, upon review of this study's results and the results of Study 3.3.9 Two-Dimensional Modeling of the Northfield Mountain Pumped Storage Project Intake/Tailrace Channel and Connecticut River Upstream and Downstream of the Intake/Tailrace, it may be appropriate to study the vertical distribution and abundance of early life stage shad (eggs and larvae) in the vicinity of the Northfield Mountain intake in 2016.*

Response:

FirstLight would like to limit this study to ichthyoplankton and there is already an extensive study plan that specifically addresses juvenile American shad, *Study Plan 3.3.3 Evaluate Downstream Passage of Juvenile American Shad.*