UNITED STATES OF AMERICA
BEFORE THE
FEDERAL ENERGY REGULATORY COMMISSION

TransCanada Hydro Northeast Inc.	**)**	**Project No. 1892**
	)	**(Wilder)**
	)	**Project No. 1855**
	)	**(Bellows Falls)**
	)	**Project No. 1904**
	)	**(Vernon)**

REQUEST FOR REHEARING OF TRANSCANADA HYDRO NORTHEAST INC. OF STUDY PLAN DETERMINATION

Pursuant to Section 313(a) of the Federal Power Act ("FPA") (16 U.S.C. § 825*l*(a)) and Rule 713 of the Federal Energy Regulatory Commission's ("FERC" or "Commission") Rules of Practice and Procedure (18 C.F.R. § 385.713), TransCanada Hydro Northeast Inc. ("TransCanada"), licensee and potential applicant for new licenses for the Wilder Hydroelectric Project No. 1892 ("Wilder"), the Bellows Falls Hydroelectric Project No. 1855 ("Bellows Falls"), and the Vernon Hydroelectric Project No. 1904 ("Vernon") (collectively, "Projects") hereby requests rehearing of the Study Plan Determination for Aquatic Studies – Wilder, Bellows Falls and Vernon Hydroelectric Projects ("SPD") issued by the Commission's Director of the Office of Energy Projects ("Director") on February 21, 2014.[1]

As discussed herein, the Director's SPD required TransCanada to perform a "new study," the Vernon Hydroacoustic Study. The inclusion of this new study in the SPD was in error, arbitrary and capricious, and unsupported by substantial evidence. TransCanada respectfully requests that the Commission on rehearing (i) find that the Vernon Hydroacoustic

[1] Order No. 2002-A clarified that once the Director makes a study plan determination pursuant to 18 C.F.R. § 5.13(c), that determination may then be appealed to the Commission in a request for rehearing pursuant to Rule 713 of the Commission's Rules of Practice and Procedure (18 C.F.R. § 385.713). *Hydroelectric Licensing Under the Federal Power Act*, Order No. 2002-A, 106 FERC ¶ 61,037, at P 17 (2004). *See also Duke Power*, 117 FERC ¶ 61,303, at P 12 (2006).

Study would not provide additional information useful to the Commission or state and federal mandatory conditioning agencies in order to craft license conditions for the Vernon Project, and (ii) because hydroacoustic technology is not a generally accepted practice within the scientific community to achieve the objectives stated in the SPD and because of the exponential increase in costs in exchange for limited information, eliminate the Vernon Hydroacoustic Study from the SPD.

STATEMENT OF ISSUES

Pursuant to Rule 713(c) of the Commission's Rules of Practice and Procedure (18 C.F.R. § 713(c)), TransCanada states that the matter raised herein presents the following issue:

> Whether the Director acted arbitrarily and capriciously and contrary to the study criteria set forth in Section 5.9(b) of the Commission's regulations when he required TransCanada to develop and conduct the Vernon Hydroacoustic Study. 16 U.S.C. § 825*l*(b); 18 C.F.R. § 5.9(b)(1)-(7); *City of Centralia v. FERC*, 213 F.3d 742, 748 (D.C. Cir. 2000); *Bangor Hydro-Electric Co. v. FERC*, 78 F.3d 659, 663 (D.C. Cir. 1996).

BACKGROUND

The Wilder, Bellows Falls, and Vernon Projects are located on the Connecticut River in New Hampshire and Vermont. The current licenses for these projects expire on April 30, 2018. On October 31, 2012, TransCanada initiated the integrated licensing process ("ILP") pursuant to Part 5 of the Commission's regulations (18 C.F.R. Part 5) by submitting to FERC Notices of Intent ("NOI") to seek new licenses for these projects, and separate Pre-Application Documents ("PAD") for each project.[2] As part of the ILP, TransCanada is required to consult

[2] In addition to the NOIs and PADs filed by TransCanada for the Wilder, Bellows Falls, and Vernon Projects, FirstLight Hydro Generating Company ("FirstLight") is the licensee of the Turners Falls Hydroelectric Project No. 1889 and the Northfield Mountain Pumped Storage Project No. 2485, which are also located on the Connecticut River downstream of the Vernon Project, and filed a single NOI and PAD for its projects on October 31, 2012. The Commission's Scoping Document 1, issued on December 21, 2012, indicated its intent to prepare a single

with resource agencies, tribes, and other stakeholders to develop study plans and subsequently conduct studies that will serve to inform Commission staff's environmental analysis and, ultimately, the Commission's decision on whether and under what conditions to issue a license. The studies also provide information to resource agencies in considering terms and conditions for inclusion in any license.

Section 5.9(b) of the Commission's regulations requires that any study request from a stakeholder, including FERC and mandatory conditioning agencies, must address the following criteria ("Study Criteria"):

> (1) Describe the goals and objectives of each study proposal and the information to be obtained;
>
> (2) If applicable, explain the relevant resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied;
>
> (3) If the requester is not a resource agency, explain any relevant public interest considerations in regard to the proposed study;
>
> (4) Describe existing information concerning the subject of the study proposal, and the need for additional information;
>
> (5) Explain any nexus between project operations and effects (direct, indirect, and/or cumulative) on the resource to be studied, and how the study results would inform the development of license requirements;
>
> (6) Explain how any proposed study methodology (including any preferred data collection and analysis techniques, or objectively quantified information, and a schedule including appropriate field season(s) and the duration) is consistent with generally accepted practice in the scientific community or, as appropriate, considers relevant tribal values and knowledge; and
>
> (7) Describe considerations of level of effort and cost, as applicable, and why any proposed alternative studies would not be sufficient to meet the stated information needs. 18 C.F.R. § 5.9(b).

---

environmental impact statement for all five TransCanada and FirstLight projects located on the Connecticut River.

In Order No. 2002, the Final Rule promulgating these seven Study Criteria as Section 5.9(b) of the Commission's regulations, the Commission affirmed the following statement it had articulated in the Notice of Proposed Rulemaking regarding consideration of the Study Criteria:

> Our intention is that the criteria will be applied as a whole, so that *the mere fact that a study request can be related to an agency management goal will not ensure that the study is required to be conducted*. This necessarily implies that judgment calls will be made, and it is our intention that those calls be made in light of the principle that *the integrated licensing process should to the extent reasonably possible serve to establish an evidentiary record upon which the Commission and all agencies or tribes with mandatory conditioning can carry out their responsibilities*. We do not intend to second guess the appropriateness of agency or Tribal resource management goals, but must consider study requests based on those management goals in light of all applicable criteria, such as the "nexus" criteria, as well as the potential for conflict with important Commission policies, practices, or rules. Order No. 2002, at P 86 (citing NOPR, 102 FERC ¶ 61,185 (2003) (FERC Stats. & Regs. ¶ 32,568, at p. 34,705).

For studies proposed by the potential applicant in the Proposed Study Plan, the potential applicant must explain how each study satisfies the criteria enumerated in Section 5.11(d), which are substantially similar to the Study Criteria provided in Section 5.9(b), except that (2) and (3) from the Study Criteria above are replaced with a new (2) as follows: "Address any known resource management goals of the agencies or Indian tribes with jurisdiction over the resource to be studied." *See* 18 C.F.R. § 5.11(d).

The Commission has also prepared *A Guide to Understanding and Applying the Integrated Licensing Process Study Criteria*, dated March 2012, to help stakeholders craft study requests that clearly identify and explain the basis of their information needs and recommended study methods ("Guidance"). The Guidance expressly states that "[t]he requested study methodology must be generally accepted in the scientific community *for the purpose for which it*

would be used." Guidance at p. 6 (emphasis added). With respect to Study Criteria No. 7 (level of effort and cost), the Guidance states as follows:

> Where alternative methods of obtaining the data have been proposed, it is important that the study proponent explain why the proposed alternative study methods would not be adequate to meet the stated study objectives. Where such information is lacking, it is difficult for the applicant, Commission staff, and other stakeholders to compare the level of effort and cost with the type and quality of the information that would be obtained under the various proposed methodologies. *Id.*

The Guidance further answers the question "How does FERC assign value to *increments* of information when determining why costs are reasonable or unreasonable?" with the following answer:

> Section 5.9(b)(7) *requires* that study requests consider the level of effort and cost of the study being requested and *why an alternative (less costly) study would not be sufficient to meet the information needs*. A study would not be rejected based on cost alone; rather, the decision is based on whether the information is needed and whether that information can be gathered in a more cost-effective manner.
>
> The cost of the study should be in line with the potential level of effect. For example, we would not require a million dollar study to determine a precise answer to a minor potential impact. If the cost of the study appears to be out of line with the magnitude of the potential impact based on available information, the Commission may rely on existing information to assess the effects and may or may not require measures based on that information. Guidance at p. 14-15 (emphasis added).

Pursuant to Section 5.9, TransCanada received study requests for information to assess the Projects' effects from interested stakeholders, including, as relevant here, the U.S. Department of the Interior's Fish and Wildlife Service ("FWS"), the New Hampshire Fish and

Game Department ("NHFGD"), and the Vermont Agency for Natural Resources ("VANR"). The FWS requested 21 studies, four of which are relevant to this request for rehearing:[3]

(1) A study to determine the impact of Vernon Project operations on the downstream migration of juvenile American shad, which the FWS, under the header "Methodology Consistent with Accepted Practice," states would be best studied by a combination of approaches, including hydroacoustics,[4] radio telemetry, and balloon tags. The FWS recognized that "new, very small radio tags make assessment of juvenile shad passage now achievable." The FWS further states that additional hydroacoustic assessment immediately upstream and downstream of the Vernon Dam for one year would provide information on the timing of migration to and through the area. The FWS does not discuss the level of effort required for hydroacoustic studies for these two purposes, and it estimates that the cost would be $150,000 for radio tagging, balloon tagging, and the multiple hydroacoustic arrays required to assess migration to and through the area of the Vernon Project. FWS March 1, 2013 Study Request at p. 60-61;

(2) An American eel survey conducted through a combination of electroshocking and eel pots. The FWS estimated that the effort would be 30 days for the electrofishing survey. The FWS did not provide an estimated cost but instead offered that a similar study in another relicensing proceeding that would require two nights was estimated to cost $25,000. *Id.* at p. 69;

(3) An evaluation of the timing of downstream migratory movements of American eels on the mainstem Connecticut River preferably by active trapping methods. The

[3] VANR and NHFGD filed study requests for the juvenile American shad downstream migration study and the three eel studies that were *identical* to the FWS' study requests. *See* VANR March 1, 2013 Study Request and NHFGD March 1, 2013 Study Request.

[4] A brief description of hydroacoustic technology generally and the types of hydroacoustic technology are provided in Appendix A.

FWS recognizes that "these methods are technically challenging on larger mainstem rivers." The FWS states that "[p]assive monitoring of migrant eels using hydroacoustic methods offers an alternative to active trapping. However, this form of passive monitoring requires verification of potential acoustic targets." The FWS offers that "[t]wo potential locations offer opportunities to conduct simultaneous passive and active sampling: the Cabot Station (Turners Falls Project) canal/forebay and the Holyoke Dam forebay and canal louver/bypass system." Neither of these locations is near the Vernon Dam. The FWS estimates that the level of effort would be moderate and the cost is estimated to be $50,000 per year. *Id.* at p. 78-79; and

(4) A downstream American eel passage assessment at the Vernon, Bellows Falls, and Wilder Projects using radio telemetry because, as the FWS recognized, radio telemetry is "an accepted technology that has been used for a number of studies associated with hydropower projects." The FWS expects that the level of effort would be moderate to high, and the cost is estimated to be $175,000 per year. *Id.* at p. 84, 87.

Based on the received study requests and stakeholder comments on the PAD, on April 16, 2013, TransCanada filed its Proposed Study Plan pursuant to Section 5.11(a) of the Commission's regulations (18 C.F.R. § 5.11(a)). The Proposed Study Plan explained each proposed study in the context of the Study Criteria, and with respect to study requests, identified each received study request, the study plan responsive to the study request, and the rationale for why a particular study was not adopted. The Proposed Study Plan included 33 studies, including, as relevant to this rehearing, four studies that aligned with the FWS' information needs related to American eel and juvenile American shad:

- Study 11 – American Eel Survey;
- Study 19 – American Eel Downstream Passage Assessment;
- Study 20 – American Eel Downstream Migration Timing Assessment; and

- Study 22 – Downstream Migration of Juvenile American Shad.

With respect to these studies, the Proposed Study Plan provided preliminary cost estimates based on the scope of the study requests and the proposed studies. In general, TransCanada adopted the methodology proposed by the resource agencies. However, with respect to Study 22 (Downstream Migration of Juvenile Shad), TransCanada proposed to use radio telemetry and HI-Z Turb'N Tag®, a balloon tagging method (hereinafter referred to as "balloon tagging"), but did not propose to use passive hydroacoustics, as had been requested by FWS, VANR, and NHFGD in their identical study requests. The Proposed Study Plan explained that the use of hydroacoustics has limitations, which are known based on a previous study conducted in 2009 by Normandeau Associates Inc. ("Vernon 2009 Study").[5] The objective of the Vernon 2009 Study was to estimate the proportional route selection of emigrating juvenile American shad through Vernon Dam's ten turbine units, the fish pipe, and the fish tube through fixed-aspect hydroacoustics placed behind the trashracks. Sixteen transducers were installed by divers to sample each turbine unit, the fish pipe, and the fish tube. The results of the Vernon 2009 Study were disappointing because the study was not able to provide information on proportional route selection among generating units and passage routes as was intended.

On July 9, 2013, in response to comments on the Proposed Study Plan and study plan meetings, TransCanada filed with the Commission an updated Proposed Study Plan. Again, TransCanada had not proposed to use hydroacoustic technology for any study. On July 15, 2013, the FWS provided comments on 20 studies proposed in the updated Proposed Study Plan, including Study 11 (American Eel Survey); Study 19 (American Eel Downstream Passage Assessment); Study 20 (American Eel Downstream Migration Timing Assessment); and Study

[5] Normandeau 2010. Route Selection of Emigrating Juvenile American Shad at the Vernon Project, 2009. Prepared for TransCanada Hydro Northeast Inc., Concord, NH.

22 (Downstream Migration of Juvenile American Shad). With respect to Study 11, Study 19, and Study 20, the FWS provided comments that did not mention or request the use of hydroacoustic technology as a methodology for the studies. With respect to Study 22, the July 15, 2013 FWS letter stated equivocally that "relying *solely* on radio-tagged juveniles and [balloon tagged] juveniles . . . may or may not represent the natural timing, duration, and magnitude of wild fish outmigration(s) and the operational/environmental conditions that are occurring in those periods of natural movement." Therefore, the FWS recommended use of hydroacoustics in the Vernon Dam forebay "to *quantitatively* determine timing, duration, and magnitude of the juvenile outmigration, which would provide important context to the limited number and release timeframe of radio-tagged juvenile fish releases." FWS July 15, 2013 letter at p. 13 (emphasis added). This appears to reflect a shift in the FWS' request for use of hydroacoustic technology from a multi-array proposal to assess residency (migratory delay) to a one-array proposal to assess the timing, duration, and magnitude of the juvenile outmigration. The FWS did not explain the rationale behind this shift.

The FWS' July 15, 2013 letter then recounted a dialogue between a hydroacoustic vendor and FWS staff regarding the 2009 Normandeau study:

> The May 23, 2013 meeting stimulated significant discussion on the topic of hydroacoustic evaluations used at Vernon in an unsuccessful juvenile shad study in 2009. The [FWS'] Connecticut River Coordinator has contacted Hydroacoustic Technology Incorporated (HTI), the company that provided the equipment for that study, and corresponded with the Bruce Ransom, the HTI Program Manager who recalled working with TransCanada's consultant on that project. Mr. Ransom noted that the 2009 study was restricted to a set-up with transducers located only behind the trash racks (due to the objective of determining entrainment into the turbine units), and utilized wide beam transducers that resulted in significant backscatter (noise). He further noted that the transducers were mounted on fixed, non-adjustable mounts that did not allow for transducer adjustment to

> achieve a cleaner signal. Mr. Ransom's email response included the following statements: "there are better ways to instrument and hydroacoustically monitor shad…at Vernon Dam;" "One could resolve passing juvenile shad in-turbine with the transducer array deployed at Vernon in 2009, although only in certain bands;" "The Vernon 2009 results aren't indicative of hydroacoustic sampling capabilities at the site;" and "*With a sufficient deployment and testing period, proper transducer selection and placement, and probably incorporation of rotators to refine optimal aiming angle post deployment, we feel that one could do a good job of monitoring downstream shad entrainment from behind the trash racks at Vernon Dam…*" these statements indicate that despite the disappointing results of the 2009 study, *properly deployed hydroacoustic transducers would provide quality data to address the study objectives*. We note that as part of their relicensing studies, FirstLight is proposing installation of hydroacoustic equipment at Cabot Station and the canal Gatehouse at the Turners Falls Project and at the Northfield Mountain Pumped Storage intake to assess juvenile shad outmigration. The goals and objectives of those studies are the same as the goals and objectives of this study at Vernon. *Id.* at 13 (emphasis added).

The FWS' July 15, 2013 letter gave no consideration of the level of effort and cost of the hydroacoustic array advertised by the hydroacoustic vendor, nor did it discuss the potential difficulties in analyzing the data, even if the most comprehensive array were developed.

On August 14, 2013, TransCanada filed with the Commission its Revised Study Plan ("RSP"), pursuant to Section 5.13(a) of the Commission's regulations, which reflected comments received during the study plan meetings and discussions, and the formal comments filed by stakeholders with the Commission. The RSP again included 33 individual studies and data collection efforts, and the four studies relevant to American eel and juvenile American shad referenced in this rehearing request. The specific objectives and estimated cost of the four studies are summarized in the table below.

Study No.	Study Name	Species	Study Objective	Estimated Cost
11	Eel Survey	American Eel	• Characterize the distribution of American eel in the project	$115,000

Study No.	Study Name	Species	Study Objective	Estimated Cost
			impoundments, riverine sections and the project-influenced portions of tributaries upstream of Wilder, Bellows Falls and Vernon dams; and • Characterize the relative abundance of American eel in the project impoundments, riverine sections and the project-influenced portions of tributaries upstream of the dams.	
19	Eel Downstream Passage Assessment	American Eel	• Quantify the movement rates, timing and relative proportion of silver eels passing through various routes at the projects including the turbines, the Bellows Falls bypassed reach, downstream passage facilities and spillways; and • Assess instantaneous and latent mortality and injury of silver eels passed through each turbine type.	$400,000-$450,000
20	Eel Downstream Migration Timing Assessment	American Eel	• Assess the timing of American eels migrating from the Connecticut River to their spawning grounds.	$30,000
22	Downstream Migration of Juvenile Shad	Juvenile Shad	• Assess the effects of project operations on the timing, route selection, migration rates, and survival of juvenile shad migrating past the project; • Characterize the proportion of juvenile shad using all possible passage routes at Vernon over the period of downstream migration under normal operating conditions; and • Conduct controlled turbine passage survival tests for juvenile shad passed through one of the older Francis units and one of the new Kaplan units to estimate the relative survival specific to those unit types.	$360,000-$420,000

With respect to Study 22, TransCanada's RSP proposed to use a single-beam hydroacoustic transducer located at the fish bypass to assess the timing of the juvenile shad migration. TransCanada estimated that Study 22, with the addition of the single-beam hydroacoustic transducer, would cost between $360,000 and $420,000 for one year.

On August 29, 2013, the FWS provided comments on five studies proposed in the RSP, including Study 22 (Downstream Migration of Juvenile American Shad). Regarding TransCanada's proposal to use a single-beam hydroacoustic transducer at the fish pipe to monitor the timing of the migration of juvenile shad, the FWS stated as follows:

> The Service believes the way to gain the most comprehensive understanding of the juvenile shad outmigration and its relationship to project operations and environmental conditions is to have transducers at *all possible passage routes* (i.e., intake, fish bypasses, spillway gates). A single transducer near the fish pipe may provide sufficient insight into the timing, duration and relative abundance of the run, assuming that passage through the fish pipe is indicative of passage through other potential routes. However, a single transducer directed towards the fish pipe will not allow for an *assessment of delay at the project*. In order to determine if outmigrants are delaying in the forebay area, [TransCanada] needs to install an array of transducers sufficient to get full coverage on either side of the upstream end of the louver. As currently proposed, juvenile shad could enter the forebay area and be there for an unknown period of time before proceeding through the fish pipe (or other passage routes). The additional coverage in the upper forebay (or upstream of the forebay) is needed to assess rate of movement through the forebay area and relate this movement to project operations. FWS August 29, 2013 letter at p. 4 (emphasis added).

In response to TransCanada's RSP, no other agency filed comments discussing hydroacoustic technology.

On November 26, 2013, FERC conducted a technical meeting for stakeholders to identify resource studies that may be affected by the closure of Entergy Vermont Yankee's nuclear plant ("Vermont Yankee"). Vermont Yankee discharges a thermal plume into the

Connecticut River above Vernon Dam, and it is anticipated that the closure of Vermont Yankee on December 29, 2014, would eliminate this thermal plume, thereby affecting the baseline conditions upon which to analyze the Vernon Project's effects on resources, the study schedule, and the scope of proposed studies.

At the meeting, an agenda prepared by FERC staff was distributed.[6] This agenda included a list of 20 of TransCanada's proposed studies, which FERC staff had identified as potentially affected by the closure of Vermont Yankee. The agenda included one "new" study, the Vernon Hydroacoustic Study, which the agenda identified as recommended by FWS, NHFGD, and VANR, even though no entity had filed a study request for a Vernon Hydroacoustic Study. Notwithstanding, at the technical conference, FERC staff stated: "I inadvertently included [the Vernon Hydroacoustic Study] as a stand-along study request, but it was really a modification to other studies." November 26, 2013 Technical Meeting Transcript at p. 71.[7] FERC staff further stated with respect to the Vernon Hydroacoustic Study:

> And like I said yesterday, the last study here not being – *is a requested study that was not adopted*. *My mistake was the way I incorporated it here*. But it is an issue that is in dispute.
>
> I wanted to make sure we discussed these components that maybe influence – *this could almost be a stand-alone study*. We're discussing them equally as if they were proposed or not proposed. *Id.* at p. 76-77 (emphasis added).

To be clear, a Vernon Hydroacoustic Study was *never* requested as a separate study.

---

[6] The agenda for the November 26, 2013 technical meeting is provided in Appendix B. FERC staff emailed the agenda to stakeholders before the meeting and distributed the agenda at the meeting. The agenda is not docketed in FERC's eLibrary for any of the three Project proceedings.

[7] The transcript of the technical meeting regarding all three Projects is available in FERC's eLibrary only under Project No. 1892.

On December 31, 2013, TransCanada submitted revisions to the RSP based on discussions held at the November 26, 2013 technical meeting and on a December 18, 2013 conference call, and comments submitted in response to TransCanada's December 16, 2013, distribution via email of its proposed revisions. With respect to Studies 11, 19, 20, and 22, to ensure the baseline for evaluation of the Projects' effects reflect the actual baseline environmental conditions in the future, TransCanada and stakeholders agreed to delay initiation of all American eel and American shad studies until after the shutdown of Vermont Yankee.

On January 9, 2014, the FWS filed a brief letter with FERC to clarify the FWS' position with respect to the use of hydroacoustic technology as a method to evaluate the Vernon Project's potential impact on downstream juvenile shad migration. The FWS letter stated that it believes the use of a "comprehensive hydroacoustic array" is required to evaluate potential project operations and/or structural impacts to juvenile shad. The FWS indicated that its concerns are with respect to migration dynamics (*i.e.*, frequency, timing, and duration) that may be influenced by the Vernon Project. The FWS further stated that "hydroacoustics will be utilized to address the same objectives for potential juvenile shad impacts at both of FirstLight's projects . . . and [w]e believe it is important that similar approaches and techniques for American shad studies be used by [FirstLight and TransCanada] at their projects so that there can be consistent and comparative review. . . ."

As with its prior filings regarding use of hydroacoustics as a method to study juvenile shad, the FWS did not explain how a comprehensive hydroacoustics array as a methodology to study juvenile shad migration dynamics is consistent with generally accepted practice in the scientific community – as required by 18 C.F.R. § 5.9(b)(6) – except to repeat the sales pitch from the hydroacoustic vendor, Mr. Ransom, nor did FWS describe considerations of

level of effort and cost, or why any of TransCanada's proposed alternative studies would be insufficient to meet the FWS' information needs.

On January 10, 2014, TransCanada submitted a letter to FERC, in part, responding to the FWS' January 9, 2014 letter. TransCanada continued to contend that as proposed in its RSP, Study 22 will sufficiently meet the goals and objectives of the study. The January 10, 2014 letter also noted that the FWS had indicated differing objectives in Study 22 that a hydroacoustic array would help inform, and the wide range in costs associated with the FWS' loose terminology. For example, to conduct Study 22 with two hydroacoustic arrays – one above Vernon Dam and one below Vernon Dam – as requested in the FWS' March 1, 2013 study request, the total cost of Study 22 for one year would increase to between $1.6 and $1.7 million. TransCanada January 10, 2014 letter at p. 2. In contrast, the multiple-unit array of hydroacoustic transducers across all Vernon Dam passage routes (one array) was estimated to add an additional $530,000 to $600,000 to the existing cost of Study 22 for one year. *Id.* at p. 3.

On February 21, 2014, FERC issued the SPD for Aquatic Studies wherein it required a Vernon Hydroacoustic Study primarily associated with Study 22, but also as a component of Studies 11, 19, and 20. With respect to Study 11 (American Eel Survey), the Director required the installation of a hydroacoustic array at Vernon Dam in order to:

> provide data on the out-migrating population of adult American eel from above Vernon dam in an efficient and cost-effective manner because the study would be conducted at one key project location (Vernon dam) rather than the entire watershed upstream. Data provided by TransCanada's proposed study 18 – *American Eel Upstream Passage Assessment* along with data from study could be used to make some assumptions on the distribution and relative abundance of eels above each project. This information, when coupled with hydroacoustic data from Vernon dam, could be used to estimate the number of adult eel out-migrating past each project; thereby, supporting an analysis of the need for downstream fishways at each project (sections 5.9(b)(5), (6) and (7).

> For these reasons, we do not find it necessary to expand the geographic scope of study 11 – *American Eel Survey* to include tributaries to Connecticut River watershed or surveys for juvenile upstream migrating eels therein. SPD at B-16

With respect to Study 19 (American Eel Downstream Passage Assessment), the SPD adopted the study as proposed by TransCanada in its RSP, with the delay of the start of the study until after closure of the Vermont Yankee facility. Despite the fact that the Director does not discuss Study 19 in the SPD, the Director nonetheless effectively modified Study 19, without discussion or consideration of the Study Criteria, to require a comprehensive hydroacoustic array to gather information to be used to meet the objectives of Study 19.

With respect to Study 20 (American Eel Downstream Migration Timing Assessment), TransCanada proposed to conduct this study by reviewing available literature for the Connecticut River Basin and other rivers in the Northeast to characterize the general timing of the Connecticut River American eel downstream migration. NHFGS and VANR requested a field component to determine the migration timing of silver phase American eels. Specifically, NHFGD requested that fyke nets or other sampling methods be used at the mouth of upstream tributaries to obtain data. In response, the Director required TransCanada to develop and implement a comprehensive hydroacoustic study at Vernon Dam. The Director explained as follows:

> The resulting hydroacoustic data should be used to quantify and characterize the outmigration of silver phase American eels within the Connecticut River basin upstream of Vernon dam and would provide the information on the timing and magnitude of downstream American eel migration necessary to evaluate potential project effects on American eel and the need for protective license conditions (section 5.9(b)(5)) without the need for the requested and potentially costly fyke netting.
>
> Therefore, we recommend that the analysis of study 20 – *American Eel Downstream Migration Timing Assessment* incorporate the results of the Vernon Hydroacoustic Study. Because TransCanada

> proposes to utilize data from other on-going relicensing studies, it is unlikely this recommendation would result in any significant increase in cost to study 20 (section 5.9(b)(7)). SPD at B-27, B-28.

With respect to Study 22 (Downstream Migration of Juvenile American Shad), TransCanada's RSP proposed to include methods such as radio telemetry, balloon tags, and a single beam hydroacoustic transducer to monitor the downstream fish bypass at Vernon Dam, in response to agency requests. The Director did not substantively address Study 22 in the SPD, but instead requested a new Vernon Hydroacoustic Study. The Director characterized the stakeholders study requests as follows:

> Project operations and facilities may affect downstream migrating silver phase American eel and adult and juvenile American shad populations in the Connecticut River. These potential effects include entrainment and turbine mortality, migratory delay and route selection (section 5.9(b)(5)). SPD at B-28.

The Director stated that FWS, NHFGD, and VANR had filed the same study request to utilize hydroacoustic monitoring of the juvenile shad outmigration at the Vernon dam. The Director further stated that VANR also "notes" that the implementation of hydroacoustic monitoring could inform Study 11, and that VANR and NHFGD recommend a field component to support Study 20. SPD at B-27.

Thus, the Director ordered TransCanada to "develop a comprehensive hydroacoustic study for the Vernon Hydroelectric Project." The Director explained his reasoning as follows:

> TransCanada's proposed study 22 to monitor juvenile shad out-migration would provide nearly all the information FWS requested with one exception: the project's effect on downstream migratory delay. Because the source of radio-tagged shad is unknown and stresses associated with tagging, holding, and transport will occur, the radio-tagged shad may not be representative of their wild, untagged counterparts, and, therefore, may not be suitable to evaluate migratory delay as TransCanada asserts (section 5.9(b)(7)).

> Hydroacoustic data could also quantify and characterize the outmigration of silver phase American eels residing within the Connecticut River watershed upstream of the Vernon Project (sections 5.9(b)(6) and (7)). SPD at B-35.

In addition, because downstream migrations of adult American eels "are strongly influenced by environmental conditions which can vary significantly from year to year," SPD at B-35, the Director (citing section 5.9(b)(7)) ordered TransCanada to perform the Vernon Hydroacoustic Study for two years "to determine the timing, duration, and magnitude of the downstream migration of juvenile American shad and adult silver American eels at the Vernon Project." SPD at B-36.

The Director required TransCanada to file the Vernon Hydroacoustic Study with the Commission for approval when it files its initial study report in September 2014. The Director further required that the data generated from the Vernon Hydroacoustic Study be utilized in the analysis of Study 11, Study 19, Study 20, and Study 22. Finally, the Director stated the following with respect to the cost and level of effort required for the Vernon Hydroacoustic Study:

> Based on TransCanada's estimate, the development and implementation of this study would increase the cost of TransCanada's study plan by $530,000 to $600,000 but would provide significantly greater information on American eel population and their downstream migrations in the Connecticut River and on potential juvenile shad migration delays in the Vernon Project forebay (section 5.9(b)(7)). SPD at B-36.

DISCUSSION

Actions of the Commission must be supported by substantial evidence and must not be arbitrary or capricious. *See* § 313(b) of the Federal Power Act (16 U.S.C. § 825l(b)); *City of Centralia v. FERC*, 213 F.3d 742, 748 (D.C. Cir. 2000); *Bangor Hydro-Electric Co. v. FERC*, 78 F.3d 659, 663 (D.C. Cir. 1996). The Director's requirement in the SPD that TransCanada

develop and conduct the Vernon Hydroacoustic Study violated these requirements because it was arbitrary and capricious and not based on substantial evidence.

Specifically, the Director erred because:

- The use of hydroacoustic technology for the purpose of informing the objectives of Study 11 (American Eel Survey), Study 19 (American Eel Downstream Passage Assessment), Study 20 (American Eel Downstream Migration Timing Assessment), and Study 22 (Downstream Migration of Juvenile American Shad) is not generally-accepted in the scientific community;

- TransCanada's RSP proposed scientifically proven methodologies to study all objectives of Studies 11, 19, 20, and 22, and no stakeholder has demonstrated otherwise; and

- The estimated $8 million cost of the two-year Vernon Hydroacoustic Study (as described by the Director and the Director's uncritical reliance on the FWS' comments), as a single study would cost *more* than the current estimated cost of conducting *all* of the other 33 studies approved by the Director *combined*, which are estimated to cost approximately $6 million (an increase of more than 100 percent in the cost of studies).

TransCanada's proposed methodologies for conducting studies to gather information to determine the Projects' effects on juvenile American shad and American eel are based on proven scientific methods and would result in sufficient information at a reasonable cost to assess the Projects' effects on American eel and juvenile American shad in order for the mandatory conditioning agencies and FERC to craft appropriate license conditions. Therefore, the requirement to conduct a Vernon Hydroacoustic Study should be eliminated from the SPD.

I. The Director Erred in Requiring a Vernon Hydroacoustic Study

A. The Director Unilaterally Imposed a Compulsory Vernon Hydroacoustic Study Despite the Lack of Evidence in the Record that Any Stakeholder Requested a Stand-Alone Study or a Modification of the Four Studies Identified in the Vernon Hydroacoustic Study

There is no evidence in the record that *any* stakeholder requested a stand-alone Vernon Hydroacoustic Study. Notwithstanding, at the November 26, 2013 technical meeting conducted by FERC staff to identify *existing* resource studies presented in TransCanada's RSP

that may be affected by the closure of Vermont Yankee, FERC staff distributed an agenda that included for the first time a "*new* Vernon Hydroacoustic Study." In response to questions about this "new" study identified after TransCanada had submitted its RSP, FERC staff gave the following explanation:

> So the next item was kind of an error on my part in the study plan determination. It's the – We got requests for modification to TransCanada's studies to incorporate – to a number of TransCanada's movement studies to incorporate hydro-acoustics at Vernon. *I inadvertently included it as a stand-alone study request, but it was really a modification to other studies*. Transcript of November 26, 2013 Technical Meeting at p. 72.

At a minimum, based on this statement alone, the Director erred in requiring a stand-alone Vernon Hydroacoustic Study in the SPD.

The Director also erred in requiring the Vernon Hydroacoustic Study as a modification to the four other studies because, despite FERC staff's statement at the November 26, 2013 technical meeting that the presentation of a "new" study was in error, no stakeholder had submitted proposed modifications to TransCanada's Proposed Study Plan or Updated Proposed Study Plan with respect to hydroacoustics that addressed the Study Criteria, as required by Section 5.12 of the Commission's regulations. 18 C.F.R. § 5.12. In fact, as more particularly described with respect to each study below, only the FWS provided comments that even mentioned hydroacoustic technology, and these comments were provided only with respect to Study 22. Therefore, FERC staff had no basis for raising the issue of a "new" Vernon Hydroacoustic Study at this late stage of the study plan process. As described below, the Director also erred in modifying Study 22 to expand its existing hydroacoustic component.

Moreover, FERC staff did not present at the November 26, 2013 technical meeting nor in its SPD any discussion of the significant issues associated with a Vernon Hydroacoustic Study in the context of the Study Criteria, namely whether hydroacoustic

technology is the *only* available methodology to provide information for the development of license requirements; whether hydroacoustic technology is consistent with generally accepted practice in the scientific community for the purpose for which it would be used; and whether the exorbitant cost to conduct the Vernon Hydroacoustic Study is appropriate relative to the low value, incremental information to be gained. Therefore, the Vernon Hydroacoustic Study should be eliminated from the SPD.

B. The Director Grossly Misapplied TransCanada's Cost Estimates and Failed to Analyze the Incremental Value of the Low Quality Information Derived from Hydroacoustic Technology in Light of the Exorbitant Cost

In the SPD, the Director found that "the development and implementation of [the Vernon Hydroacoustic Study] would increase the cost of TransCanada's study plan by $530,000 to $600,000 but would provide *significantly greater information* on American eel population and their downstream migrations in the Connecticut River and on potential juvenile shad migration delays in the Vernon Project forebay." SPD at p. B-36. The Director is incorrect. The Director grossly underestimated the cost of such a study and grossly overestimated the value of the *incremental* information to be gained by the Vernon Hydroacoustic Study.

In the SPD, the Director incorrectly implies that a hydroacoustic array is a "one size fits all" tool that can be designed and installed once, and then used to collect data on various aspects of American eel and American shad behavior. On the contrary, the installation of a hydroacoustic array optimized to monitor juvenile shad in the Vernon forebay, as ordered by the Director, would not be useful for detecting eels during outmigration. Notwithstanding, in either case, the use of hydroacoustic technology for the purposes identified in the Director's Vernon Hydroacoustic Study would be very expensive.

Appendix C, attached hereto, provides three examples of hydroacoustic sampling plans to achieve the objectives of Studies 11, 19, 20, and 22, namely timing, duration,

magnitude, residency time, and route selection. Plan A in Appendix C is TransCanada's current proposal to use a single beam hydroacoustic transducer located at the fish pipe to assess the timing, duration, and relative magnitude of the juvenile shad migration. The *total* cost of Study 22, including radio tagging, balloon tagging, and the single beam hydroacoustic transducer, is estimated to be between $360,000 and $420,000. Plan B in Appendix C, which would only meet the objectives of Study 22 and would not target eels, is estimated to cost $2.93 million annually, or $5.86 million for two years. Plan C in Appendix C would assess the objectives of both the eel and juvenile shad studies and is estimated to cost $4.08 million annually or $8.16 million for two years.

In the SPD, the Director used estimated figures presented by TransCanada in its January 10, 2014 letter, wherein TransCanada estimated the cost of a *single* hydroacoustic array in the Vernon forebay for one year. The Director's use of these figures for the scope described in the Vernon Hydroacoustic Study for two years grossly misrepresented the costs of such a study, and was arbitrary and capricious. For this reason alone, the Director should eliminate the hydroacoustic study from the SPD.

The Director's further finding that use of hydroacoustic technology would provide "significantly greater information" on American eels and juvenile American shad is incorrect and unsubstantiated. In fact, the use of hydroacoustic technology for the purposes of assessing the objectives of Studies 11, 19, 20, and 22 is not a generally accepted practice in the scientific community. Hydroacoustic monitoring of outmigrating anguillid eels has not been well-documented (only two published studies exist on this topic), and there have been few applications of this technology. In fact, the Electric Power Research Institute ("EPRI") is *currently* soliciting proposals for a *pilot program and/or feasibility studies* to evaluate the

potential for using hydroacoustic arrays to monitor outmigrating silver American eels. This demonstrates the uncertainty of such a methodology in the scientific community. The Director should have considered the fact that hydroacoustic technology for monitoring eels is not a generally accepted practice within the scientific community. He failed to do so.

In addition, use of hydroacoustic technology to assess eel migration would be particularly ineffective at Vernon Dam because there are so few documented American eels in the Connecticut River watershed upstream of Vernon Dam. With these low numbers, it may be impossible to detect the eels, or the detections may be so few that the information will have little value. Except for a few eels detected in two small tributaries, there are *no* records of American eel since 1970 in the Connecticut River watershed between the West River (a tributary upstream of the Vernon Dam) and the Canadian Border. In addition, only 27 American eel were collected in the Vernon impoundment during a 21-year period from 1991 to 2011 as part of Vermont Yankee's annual monitoring. That same study collected only a single eel in the Vernon impoundment between 2000 and 2011.

Furthermore, the use of hydroacoustic technology to assess the residency time of juvenile American shad is not a generally-accepted practice in the scientific community. As explained below with respect to Study 22, residency is a behavioral characteristic exhibited by individual fish, which TransCanada will assess by radio tagging, a well-accepted practice in the scientific community for assessing residency.

The Director's assertion that a Vernon Hydroacoustic Study would result in "significantly greater information" with respect to American eel and juvenile American shad is incorrect, not supported by substantial evidence, and arbitrary and capricious. Moreover, there is no evidence in the record that the Vernon Hydroacoustic Study would provide incremental

information of reasonable quality. Given the exorbitant cost of the Vernon Hydroacoustic Study and the low-quality of any incremental information, the Director erred in requiring the Vernon Hydroacoustic Study. Therefore, it must be eliminated from the SPD.

C. The Director's Decision to Expand the Vernon Hydroacoustic Study to Two Years is Arbitrary and Capricious

The Director ordered that TransCanada conduct the Vernon Hydroacoustic Study for two years. The Director's *only* basis for this time period is a study that the Director cites for the proposition that "downstream migrations of adult American eel are strongly influenced by environmental conditions which can vary significantly from year to year." SPD at p. B-35. TransCanada agrees that the referenced study discusses environmental factors that may influence or trigger migration, primarily driven by precipitation. However, given the long residency times of eels prior to downstream migration (in some cases, decades), and the fact that not all silver eels may complete migration in a single year, it is unclear how a two-year study would more sufficiently address the magnitude of the outmigrating adult eel population than a one-year study. As previously noted, given the very small number of eels above Vernon Dam, the successful monitoring of such a small population would be difficult at best and perhaps impossible. Furthermore, the Director cited no basis for requiring a two-year Vernon Hydroacoustic Study for juvenile American shad.

The Director's imposition of a two-year study period for the Vernon Hydroacoustic Study is not based on substantial evidence in the record. Therefore, the Vernon Hydroacoustic Study must be eliminated from the SPD.

II. The Director Erred When He Modified Four Studies to Include the Vernon Hydroacoustic Study

A. Study 11 – American Eel Survey

The goal of Study 11 is to provide baseline data on the presence of American eel upstream of Vernon Dam in the project-affected areas of the Wilder, Bellows Falls, and Vernon Projects. The objectives of Study 11 are to characterize the *distribution* and *relative abundance* of American eel in the project impoundments, riverine sections, and the project-influenced portions of tributaries upstream of the Project dams. As proposed in the RSP, Study 11 would use electrofishing and eel traps and would include tributary sampling on a randomized subset of project-affected tributary reaches. TransCanada's preliminary estimate of the cost of this study, as proposed in the RSP, is $115,000.

In the SPD, the Director approved TransCanada's proposed Study 11 with modifications, one of which requires installation of a hydroacoustic array at Vernon Dam. Specifically, the Director concluded that installation of a hydroacoustic array *suggested by VANR* "would provide data on the out-migrating population of adult American eel from above Vernon dam in an efficient and cost-effective manner because the study would be conducted at one key project location (Vernon dam) rather than the entire watershed area upstream." SPD at B-16.

The requirement to install a hydroacoustic array to gather data for Study 11 is not based on substantial evidence in the record or a reasoned analysis of the Study Criteria and is therefore arbitrary and capricious.

As an initial matter, the Director mischaracterizes VANR's study request and comments on the updated Proposed Study Plan concerning hydroacoustics. VANR's study request stated that a combination of electroshocking and eel pots should be used to collect eels and determine catch rates. In its July 15, 2013 letter commenting on the updated Proposed Study

Plan, VANR's only objection to TransCanada's proposed Study 11 concerned the geographic extent of surveying upstream within the watershed, and VANR requested that the full Connecticut River watershed be surveyed. VANR even offered to collaborate with the licensee by using the electroshocking and eel pot methodologies, and offered that "if the licensee were to tag yellow eel and monitor within project-affected areas, [VANR] would be willing to take over and monitor and/or sample throughout tributaries or ponds." The July 15, 2013 letter concluded VANR's comments on Study 11 with the following statement: "Setting up Hydroacoustics array at Vernon would support this study, and *should be considered*." VANR July 15, 2013 letter at p. 12 (emphasis added). VANR did not include *any* discussion of the seven Study Criteria as they relate to use of hydroacoustics to gather information on the distribution and relative abundance of eels.

Because VANR's reference in the comment letter was only a suggestion to consider use of hydroacoustic technology, and was not a study request with discussion of the relevant Study Criteria (e.g., did not include discussions as to how this technology would support Study 11, the scientific validity of using hydroacoustic technology to achieve the objectives of Study 11, or the cost of a hydroacoustic array), TransCanada did not include a response to this request for consideration in its RSP. Likewise, VANR had not requested use of hydroacoustic technology in its March 1, 2013 study request. Notwithstanding, TransCanada did consider using hydroacoustic technology as part of Study 11 and ultimately rejected VANR's suggestion because of the high costs to install a hydroacoustic array relative to the low value of the data likely to be gathered on eels. The record includes no other discussion or mention of using a hydroacoustic array as a component of Study 11 by agencies or FERC.

The Director also erred when he concluded that a hydroacoustic array "would provide data on the out-migrating population of adult American eel from above Vernon dam," and that data from Study 18 and data from a hydroacoustic array under Study 11 "could be used to estimate the number of adult eel out-migrating past each project; thereby, supporting an analysis of the need for downstream fishways at each project." The purpose of Study 11 is to provide baseline data on the distribution and relative abundance of American eel; the purpose of Study 11 is not to evaluate migratory behavior. No agency, nor FERC before the issuance of the SPD, has suggested otherwise. In any event, given the small numbers of American eel in the basin above Vernon Dam, it is unlikely that many eels will be monitored during downstream migration and thus the study results from a hydroacoustic array would have little value.

TransCanada notes that the data gathered pursuant to several other studies will inform the objectives of Study 11 – information on the distribution and relative abundance of American eel. TransCanada agrees with the Director's statement that Study 18 (American Eel Upstream Passage Assessment) can be used in tandem with the data from Study 11 to make assumptions on the distribution and relative abundance of eels above each project. In addition, Study 10 (Fish Assemblage Study) likely will provide additional information on American eel distribution and abundance and Study 17 (Upstream Passage of Riverine Fish Species Assessment) may also identify upstream migrating immature eels that could inform Study 11.

With respect to the geographic scope of Study 11, TransCanada agrees with the Director's conclusion that a watershed-wide survey would be cost prohibitive, but disagrees with the Director's implication that a hydroacoustic array would therefore be cost effective. TransCanada did not include a watershed-wide eel survey component in Study 11 because the VANR study requests did not discuss how the results of such a study would inform potential

license requirements (Study Criteria No. 5) or the level of effort or cost of studying such a broad geographic scope (Study Criteria No. 7). A watershed-wide eel survey would be cost prohibitive, and the value of the study results would be low because the very low numbers of documented American eel in the upper basin suggest that very few eels will be available for monitoring at Vernon. Citing Study Criteria No. 7 (level of effort and cost), the Director concluded that limiting the geographic scope of Study 11 only to project-affected reaches of the Connecticut River would "misinform an analysis of potential project effects" because the population of eels affected by the Project "would likely be substantially underestimated." As described above in the general comments regarding eels, eel detection in the Vernon impoundment from 1991 to 2011 *was* extremely low. In addition, it is unclear how Study Criteria No. 7 (level of effort and cost), which was cited by the Director, is related to the Director's conclusion that TransCanada's proposed geographic scope of Study 11 would "misinform" an analysis of project effects by underestimating the population of American eels.

While TransCanada did not propose a watershed-wide geographic scope, Study 11 will include tributary sampling on a randomized subset of project-affected tributary reaches. Supplemental data for Study 11 will be provided on the number of immature eels migrating upstream from Vernon, as well as size class and distribution of American eel within the project-affected areas from Study 18, Study 10, and results from those studies will be incorporated into the Study 11 analysis.

Study 11, as proposed in the RSP, would survey the mainstem of the Connecticut River and selected tributaries by electrofishing and eel pot methods, would satisfy the agreed-upon objectives of the study (distribution and relative abundance of American eel), would provide information for agencies and FERC to develop license conditions, would use well-

proven methodologies accepted by the scientific community, and would constitute a feasible level of effort and reasonable cost. Including the entire Connecticut River watershed within the relevant geographic scope of Study 11 is not commensurate with the potential effects of the Projects on American eel.

B. Study 19 (American Eel Downstream Passage Assessment)

In the SPD, the Director approved TransCanada's RSP for Study 19 without modification or discussion. The goal of Study 19 is to assess whether project operations are adversely affecting American eel downstream migration timing and survival. The specific objectives of Study 19 are: (1) to quantify the movement rates, timing, and relative proportion of silver eels passing via various routes at the Projects including through the turbines, the Bellows Falls bypassed reach, downstream passage facilities, and spillways; and (2) to assess the instantaneous and latent mortality and injury of silver eels passed through each turbine type. Information regarding American silver eel downstream passage would be gathered by radio tagging and systematically monitoring fish movements and passage with the use of radio telemetry and balloon tags. Information regarding downstream passage survival would be gathered by using balloon tagging.

Notwithstanding the Director's approval of Study 19 without discussion, in requiring the new Vernon Hydroacoustic Study, the Director modified Study 19 to require that a comprehensive hydroacoustic array be utilized to "[p]rovide information on the timing, duration, magnitude, and passage route selection of downstream migrating American eels." SPD at B-36. The Director's decision was arbitrary and capricious and not based on substantial evidence in the record. No stakeholder in the entire prefiling process for this proceeding has requested the use of hydroacoustic technology as a methodology for Study 19. Therefore, the Director could not have relied on any evidence in the record to support such a modification of Study 19 to require use of

hydroacoustic technology to "provide information on the timing, duration, magnitude, and passage route selection of downstream migrating American eels."

The information identified by the Director to be gathered with a hydroacoustic array – timing, duration, magnitude, and passage route selection of downstream migrating American eels – is not consistent with the objectives of the "approved" study plan for Study 19, the goal of which is to assess the *timing* and *survival* of American eels during the downstream migration.

In modifying Study 19 to require a comprehensive hydroacoustic array, the Director also failed to consider any of the Study Criteria. The Director did not consider the objectives of Study 19 in determining whether hydroacoustic technology would be an appropriate methodology to gather data related to the timing and survival of American eels during the downstream migration. The Director also did not consider whether hydroacoustic technology is an appropriate methodology for assessing the timing and survival of American eel during the downstream migration. Finally, the Director did not consider the cost of a hydroacoustic array to "provide information on the timing, duration, magnitude, and passage route selection of downstream migrating American eels."

Because the Director erred when it required a comprehensive hydroacoustic array for the purposes of gathering information in Study 19, the Vernon Hydroacoustic Study should be eliminated from the SPD.

C. Study 20 (American Eel Downstream Migration Timing Assessment)

The goal of Study 20 is to assess the timing of American eels migrating from the Connecticut River to their spawning grounds. The specific objective of Study 20 is to characterize the general migratory timing and presence of silver phase American eels in the Connecticut River in the context of environmental factors such as air and water temperature,

turbidity, rainfall, river flow, lunar phase, and flow-related operations of hydroelectric projects on the mainstem of the Connecticut River. RSP at p. 199. In the RSP, TransCanada proposed to conduct a thorough review of currently available literature for the Connecticut River Basin and other rivers in the Northeast to characterize the general timing of the Connecticut River American eel downstream migration.

In the SPD, the Director approved TransCanada's proposed Study 20 with one modification: the Director required TransCanada to install "a comprehensive hydroacoustic system" at Vernon Dam, RSP at B-28, in order to "*quantify* and characterize the outmigration of silver phase American eels within the Connecticut River basin upstream of Vernon dam and . . . provide the information on the timing and magnitude of downstream American eel migration necessary to evaluate potential project effects on American eel . . . without the need for the requested and potentially costly fyke netting." SPD at B-27. The Director further surmises that "it is unlikely this recommendation would result in any significant increase in cost to study 20." SPD at B-28.

The Director's requirement to install a comprehensive hydroacoustic array is arbitrary and capricious and is not based substantial evidence in the record.

The original study requests from VANR and NHFGD, filed on March 1, 2013, recommended that both owners of the Connecticut River hydropower projects – TransCanada and FirstLight – conduct a study at either FirstLight's Turners Falls Project (at the Cabot Station) and/or at a downstream project owned by another licensee (City of Holyoke Gas & Electric Department, FERC Project No. 2004). VANR and NHFGD stated that the reason for conducting this study at both of these locations is because these locations have a canal and "offer opportunities to conduct simultaneous active and passive sampling." VANR and NHFGD

further stated that "[e]ach location possesses a route of downstream passage which conducts a significant portion of river flow . . . and each has a proximal bypass equipped with sampler so that fish can be concentrated/collected from the passage route."

In the Proposed Study Plan and RSP, TransCanada disagreed with the need to conduct a field component as part of Study 20 for four reasons: (1) none of TransCanada's Connecticut River Projects include a canal or other conveyance that would facilitate the monitoring requested for this study; (2) VANR and NHFGD requested the same study of FirstLight, which will gather information that can be used by all Connecticut River projects, and FirstLight has plans to conduct this field study at Cabot Station; (3) TransCanada's Study 20 purposefully proposed to conduct a literature review to supplement the field study to be conducted at FirstLight's project, which did not include a literature review component; and (4) until sufficient numbers of eels are documented within the TransCanada project-affected areas, a field component to this study is premature.

Neither VANR nor NHFGD filed comments in response to TransCanada's RSP related to this study or the use of hydroacoustic technology. Therefore, the Director erred in suggesting that a hydroacoustic component of this study was in dispute after TransCanada had submitted its RSP.

The Director erred in requiring a field component to Study 20 because there is no record evidence (in fact there is record evidence to the contrary) that this information must be gathered at Vernon Dam. Instead of reviewing the Study Criteria and considering TransCanada's comments that this very same information would be gathered as part of the FirstLight study at Cabot Station, the Director summarily concluded that "providing a field component to the study to sample outmigrating silver eels would provide empirical data for use

in TransCanada's proposed analysis in study 20." TransCanada agrees that empirical information is important, but a field component that satisfies the objectives of Study 20 at the Vernon Dam would be redundant, given the FirstLight study to be conducted at Cabot Station, and infeasible, given that there is no "proximal bypass equipped with sampler so that fish can be concentrated/collected from the passage route," as there is at Cabot Station. Even the FWS agrees that the "hydroacoustic data that FirstLight will collect . . . could provide valuable information regarding the timing of eel outmigration on the Connecticut River." FWS July 15, 2013 letter at p. 11. Accordingly, information will be collected on this topic at Cabot Station, and can be included in the TransCanada ILP record as a basis for the Commission and other agencies with mandatory conditioning responsibilities to carry out their responsibilities.

The Director's assertions that a hydroacoustic array at Vernon Dam for Study 20 would be "unlikely" to "result in any significant increase in cost to study 20," SPD at p. B-28, and could eliminate the need for "potentially costly fyke netting," SPD at p. B-27, is arbitrary and capricious and not supported by the record evidence. Neither VANR nor NHFGD included estimates of the cost of fyke netting in their study requests. Therefore, the Director had no basis to assume that fyke netting is costly, nor to imply that fyke netting is more costly than a hydroacoustic array. Furthermore, VANR only provided a cost estimate for conducting a limited hydroacoustic study as a field component of Study 20 at FirstLight's Cabot Station; a study which will be conducted by FirstLight. In the SPD, the Director included no cost information regarding the required hydroacoustic array in the vicinity of Vernon Dam for purposes of Study 20. Therefore, the Director had absolutely no basis on which to make these statements.

TransCanada estimates that the annual cost of a hydroacoustic study to characterize the migratory timing and presence of silver phase American eels in the Connecticut

River in relation to air and water temperature, turbidity, rainfall, river flow, lunar phase, and flow-related operations of the Projects would be $4.08 million (Appendix C at p. C-3, C-16). In contrast, TransCanada estimates that a properly designed fyke netting evaluation on a small subset of the tributaries of the Connecticut River would likely be two orders of magnitude less ($40,000) than the cost to install a comprehensive hydroacoustic array at Vernon.

D. Study 22 (Downstream Migration of Juvenile American Shad)

The goal of Study 22, as defined in the Revised Study Plan, approved by the Director in the SPD, is to assess whether Vernon Project operations affect the safe and timely passage of emigrating juvenile American shad. RSP at p. 219. The specific objectives of Study 22 are: (1) to assess the effects of project operations on the timing, route selection, migration rates, and survival of juvenile shad migrating past Vernon; (2) to characterize the proportion of juvenile shad using all possible passage routes at Vernon over the period of downstream migration under *normal operating conditions*; and (3) to conduct controlled turbine passage survival tests for juvenile shad passed through one of the older Francis units and one of the new Kaplan units to estimate the relative survival specific to those unit types. *Id.* In conjunction with a previous juvenile American shad turbine survival study, TransCanada expects that Study 22 would provide the information to evaluate migration timing and forebay residency of juvenile shad. *Id.*

In the RSP, TransCanada proposed to use several study methods to conduct Study 22, including radio telemetry, balloon tagging, and a single beam hydroacoustic transducer. TransCanada explained that due to the configuration and specifications of the Vernon Project and the potential limitations inherent in working with juvenile American shad, the prescribed combination of methods and monitoring tools would provide the necessary information for Study 22. RSP at p. 222. Radio telemetry would be used to provide information on the forebay

residency time of juvenile American shad and proportional passage route selection. Balloon tagging would be used to estimate the direct survival of fishes that pass through hydro turbines or spill structures. And, a single beam hydroacoustic transducer would be used to monitor in the forebay in the vicinity of the downstream fish pipe to provide additional *qualitative* information on the timing, duration, and relative abundance of the American shad downstream migration (*i.e.,* population information). This method can provide quantitative estimates of abundance of those fish detected within the acoustic beams, but cannot provide a quantitative estimate of absolute abundance or magnitude of the entire run. TransCanada's proposed combination of methods is the most reasonable given the unique configuration of the Vernon facilities, the objectives of Study 22, and the widely recognized limitations of working with juvenile shad.

The Director should eliminate the Vernon Hydroacoustic Study from the SPD because installing a comprehensive hydroacoustic array for the purposes identified in the SPD and the FWS comments is unreasonable given the exorbitant cost in light of the limited value of the incremental information to be gained, is not based on substantial evidence regarding costs, and is contrary to the Commission's Guidance. TransCanada's estimated cost for Study 22 prior to the Director's SPD was $360,000 to $420,000. In the SPD, the Director concludes that "[b]ased on TransCanada's estimate, the development and implementation of this study would increase the cost of TransCanada's study plan by $530,000 to $600,000 but would provide significantly greater information on . . . potential juvenile shad migration delays in the Vernon Project forebay." SPD at p. B-36. The Director grossly misapplied the cost figures presented by TransCanada.

Neither TransCanada nor any agency presented any estimated cost in the record for a study as expansive as the Director's Vernon Hydroacoustic Study. The Director used

estimated figures presented by TransCanada in its January 10, 2014 letter, wherein TransCanada estimated the cost of a *single* hydroacoustic *array* in the Vernon forebay, as proposed by the FWS in its January 9, 2014 letter. At a minimum, the "comprehensive hydroacoustic study" demanded by the Director would require *three* such arrays plus hydroacoustic transducers mounted on the dam at passage routes. The estimated cost for such a configuration is $2.93 million annually (Appendix C at p. C-3, C-13). Since the Director requires that the Vernon Hydroacoustic Study be performed for two years, the cost is estimated to be $5.86 million. This is approximately equal to the cost of *all* 33 studies proposed by TransCanada in its RSP *combined*. When considered in light of these costs, coupled with the fact that the information that may be gained from a Vernon Hydroacoustic Study has almost no incremental value beyond that which will be gathered through TransCanada's plans to assess juvenile shad migration through radio telemetry, balloon tagging, and a single beam hydroacoustic transducer, it is clear that the Vernon Hydroacoustic Study should be rejected.

Moreover, the Commission's own Guidance as to whether FERC would reject a study solely based on cost states that while a study will not be rejected on cost alone, the Commission's decision "is based on whether the information is needed and whether that information can be gathered in a cost-effective manner." The Commission's Guidance further states that "[i]f the cost of the study appears to be out of line with the magnitude of the potential impact based on available information, the Commission may rely on existing information to assess the effects." As described below, the information alleged to be "needed" from the Vernon Hydroacoustic Study has limited incremental value, and the cost of the study is far out of line with the magnitude of the potential incremental impact because TransCanada will be gathering

significant information though radio telemetry and balloon tagging. Therefore, the Director should eliminate the Vernon Hydroacoustic Study from the SPD.

In the SPD, the Director required TransCanada to develop a comprehensive hydroacoustic study based primarily on comments from the FWS.[8] The Director erred in relying on the FWS' unsubstantiated assertions regarding the acceptability of hydroacoustic technology in the scientific community for the purposes requested by the FWS, the incremental informational value of such a methodology, and the cost. Furthermore, the FWS requests and comments for comprehensive hydroacoustic monitoring systems have identified inconsistent goals for use of the technology and are inconsistent in the scope of the requested deployment of technology, without an attendant explanation of how the modified request or comment meets the Study Criteria.

In its March 1, 2013 study request for Study 22, the FWS stated that the impact to juvenile shad outmigrants would be best studied by a combination of approaches, including hydroacoustics, radio telemetry, and balloon tags (i.e., individual behavioral characteristics). The FWS further stated that an additional hydroacoustic assessment immediately upstream *and* downstream of the Vernon Dam would provide information on the timing of migration to and through the area (i.e., population characteristics). FWS estimated that Study 22 with all proposed methodologies – radio tagging, balloon tagging, and hydroacoustic technology – would cost $150,000. This is a gross underestimate of the estimated cost of such a study and reflects a lack of understanding of the sampling technology necessary to provide information to satisfy the

[8] FWS, VANR, and NHFGD initially submitted the same original study requests which generally requested the use of hydroacoustic technology to assess juvenile shad outmigration. In response to TransCanada's RSP, wherein it proposed to use a single-beam hydroacoustic transducer to assess the migration timing of the population of juvenile shad, neither VANR nor NHFGD filed any objections to the proposed study.

objectives of Study 22. In its Proposed Study Plan, TransCanada's Study 22 proposed to use radio telemetry and balloon tagging to assess individual shad behavioral characteristics such as residency, but did not propose any methodology to assess the population characteristics. In response, the FWS' July 15, 2013 letter expressed concern that "relying *solely* on radio-tagged juveniles and [balloon tagging] juveniles may or may not represent the natural timing, duration, and magnitude of wild fish outmigration." FWS July 15, 2013 letter at p. 13. The FWS "recommended the use of hydroacoustics in the Vernon Dam forebay to *quantitatively* determine timing, duration, and magnitude of the juvenile outmigration, which would provide important context to the limited number and release timeframe of radio-tagged juvenile fish releases." *Id.* The FWS did not mention downstream deployment of a hydroacoustic array or hydroacoustic technology to monitor and assess all potential passage routes such as spill gates.

In response, TransCanada proposed in its RSP to install a single beam hydroacoustic array at the fish bypass to assess population migration characteristics, such as the timing and duration of the migration. Hydroacoustic technology might provide some limited and *qualitative* information on forebay residency time, but such an array would not provide useful *quantitative* estimates of forebay residency time. As is the case at virtually all dams, juvenile shad at Vernon have been observed milling in the forebay. A hydroacoustic system would not facilitate an estimate of the number of fish passing Vernon because the bias of multiple records per fish could not be accounted for. Even if each route could be monitored at a point of commitment to passage (which may be infeasible at Vernon), the reliability of the estimate would be low due to temporal and spatial subsampling, bias due to debris and other species, and annual variability. Therefore, there would be little incremental value in any information gained from a hydroacoustic "array." In addition to failing to characterize accurately the value of

hydroacoustic technology to sample individual fish behavior, the FWS provided no additional cost information to support its expanded study request.

The FWS' July 15, 2013 letter also relied heavily on excerpts from emails from a hydroacoustic vendor, Mr. Ransom, to support its implied conclusion that a hydroacoustic array could produce data that would result in incremental additional information to meet the objectives of Study 22. Referring to the Vernon Dam 2009 study, the objective of which was to estimate the proportional route selection of emigrating juvenile American shad through Vernon Dam's ten turbine units, the fish pipe, and the west fish tube via fixed aspect hydroacoustics, the FWS offered the following excerpts from Mr. Ransom's email to justify the use of hydroacoustic technology to assess individual fish behavior:

> 'The Vernon 2009 results aren't indicative of hydroacoustic sampling capabilities at the site;' and 'With a sufficient deployment and testing period, proper transducer selection and placement, and probably incorporation of rotators to refine optimal aiming angle post deployment, we feel that one could do a good job of monitoring downstream shad entrainment from behind the trash racks at Vernon Dam…' *These statements indicate that despite the disappointing results of the 2009 study, properly deployed hydroacoustic transducers would provide quality data to address the study objectives*. FWS July 15, 2013 letter at p. 13 (emphasis added).

These statements are not reliable for purposes of establishing that a comprehensive hydroacoustic array for assessing the residency of juvenile shad in Vernon forebay is generally accepted within the scientific community (Study Criteria No. 6). First, the Vernon 2009 study had *disappointing* results, largely because of the difficulty of installing a suitable hydroacoustic array. TransCanada agrees that the Vernon 2009 study could be improved upon, but the cost to produce high value, incremental data for purposes of Study 22 is exorbitant and not justifiable based on the Commission's Study Criteria. Moreover, Mr. Ransom (and the FWS) mischaracterize the objective of the Vernon 2009 Study as measuring entrainment of

individual juvenile shad, when, in fact, the purpose of the study was to estimate the proportional route selection exhibited by the population. The FWS made no attempt to address the level of effort and cost of installing the array advertised by Mr. Ransom. In the entire record, these statements from Mr. Ransom are the FWS' *only* evidence supporting the FWS' incorrect conclusion that hydroacoustic technology is generally accepted within the scientific community for the purposes of assessing individual juvenile shad behavior. In any event, Mr. Ransom's statements are out of context, not specific to the objectives of Study 22, and unsubstantiated. Therefore, the Director erred in relying on them, and the Vernon Hydroacoustic Study must be eliminated from the SPD.

The FWS also notes in the July 15, 2013 letter that FirstLight is proposing to install hydroacoustic equipment at Cabot Station to assess juvenile shad outmigration, and summarily concludes that the "goals and objectives of those studies are the same as the goals and objectives of this study at Vernon." This is incorrect, and the Director cannot reasonably rely on such assertions as a basis for requiring TransCanada to install a comprehensive hydroacoustic array. In suggesting a link between the FirstLight and TransCanada studies with respect to juvenile shad, the FWS ignored the significant differences in the physical configuration of the projects. FirstLight intends to install hydroacoustic technology in a canal at the Cabot Station. This likely would involve a simple configuration that allows the hydroacoustic transducers to monitor fish passing through the canal. In contrast, the FWS requested that TransCanada install comprehensive hydroacoustic arrays upstream and downstream of the Vernon Dam and with full coverage of the Vernon forebay. Therefore, the Director erred in relying on the FWS' implication that because a hydroacoustic array at Cabot Station is relatively simple, the same can be said for Vernon.

Notwithstanding, TransCanada proposed to install a single-beam hydroacoustic transducer at the fish pipe for the purpose of monitoring the timing, duration, and relative abundance of the juvenile shad run (*i.e.*, population information). The FWS filed responsive comments on August 29, 2013, which stated as follows:

> a single transducer directed towards the fish pipe will not allow for an assessment of *delay* at the project. In order to determine if outmigrants are delaying in the forebay, [TransCanada] needs to install an array of transducers sufficient to get full coverage on either side of the upstream end of the louver. As currently proposed, juvenile shad could enter the forebay area and be there for an unknown period of time before proceeding through the fish pipe (or other passage routes). The additional coverage in the upper forebay (or upstream of the forebay) is needed to assess rate of movement through the forebay and relate this movement to project operations. FWS August 29, 2013 letter at p. 4 (emphasis added).

There are a number of problems with the FWS' characterization of the purpose of the study. Specifically, the FWS continues to request use of hydroacoustic technology to assess residency, an individual fish characteristic, when TransCanada is collecting this information through radio-tagged individuals. Radio tagging is the *best* methodology for assessing residency in the forebay, and neither the FWS nor any other stakeholder has introduced a shred of evidence to the contrary. Hydroacoustic technology is not appropriate as a sampling methodology to gather information on individual fish because there is no way to track individuals; hydroacoustic technology is only appropriate to monitor populations and TransCanada will be monitoring the juvenile shad population characteristics with its single-beam hydroacoustic transducer. Moreover, in order to assess "rate of movement through the forebay" (also known as "residency") with hydroacoustic technology, a second upstream array would be necessary, for a total of three arrays. Despite effectively expanding its study request, the FWS provided no

additional cost information and no explanation as to why this new requested information is necessary. The Director in the SPD failed to recognize or address this matter.

Based on the repeated unsubstantiated assertions of the FWS with respect to the use of hydroacoustic technology to assess individual shad behavior such as residency, the Director requires TransCanada to conduct a Vernon Hydroacoustic Study for the sole reason that it believes Study 22 would not provide information on the Project's effects on downstream migratory delay. On this point, the Director states the following:

> TransCanada's proposed study 22 to monitor juvenile shad out-migration would provide nearly all the information FWS requested with *one exception*: the project's effect on downstream migratory delay. Because the source of the radio-tagged shad is unknown and stresses associated with tagging, holding, and transport will occur, the radio-tagged shad may not be representative of their wild, untagged counterparts, and, therefore, may not be suitable to evaluate migratory delay as TransCanada asserts. SPD at B-35.

The Director's finding that radio tagging *may* not be suitable to evaluate juvenile shad residency (migratory delay) is arbitrary and capricious, not supported by substantial evidence, and patently untrue. Nowhere in the record does the FWS or any other agency challenge the validity of radio tagging to assess residency (migratory delay). Assuming that juvenile shad of sufficient size to tag are available, a telemetry-based evaluation is the *best* way to characterize forebay residency time (and proportional passage route selection). In order to facilitate this, the FWS is hoping to raise juvenile shad longer than 110 millimeters in length in a hatchery so the juvenile shad are of a sufficient size to accommodate a radio tag in order to assess residency time. TransCanada has conducted passage delay assessments utilizing radio telemetry at Vernon Dam for more than 20 years. In response to this point the Director merely quipped "that TransCanada did not indicate for which species these assessments were conducted – Atlantic salmon or American shad or other." SPD at p. B-35.

Residency information and route selection is specific to each individual fish, and therefore can only be deduced by methods that track an individual, such as radio tagging. Hydroacoustic technology cannot discern between individuals and therefore conclusions cannot be made about individual behavior. A single-beam hydroacoustic transducer is sufficient to assess the timing of the migration of juvenile shad, which is accomplished by measuring the movement of schools of shad (population) through Vernon Dam. For the Director to require a hydroacoustic array to gather the *same* information that will otherwise be gathered on individual shad through radio tagging is contrary to the Commission's own guidance, which explains that the decision whether to reject a study based on cost alone "is based on whether the information is needed and whether that information can be gathered in a more cost-effective manner." In this case, population information on the timing of juvenile shad migration will be provided by the single-beam hydroacoustic transducer, and information on individual fish behavior regarding residency and route selection will be provided by the radio tagging. The use of radio telemetry is the *best* way to evaluate individual behavior, assess route selection relative to operations and flow, estimate residency time and congregation areas, and many other aspects of fish behavior, and is well documented in the published literature. Neither FERC nor any agency has explained (although FERC and the FWS have made unsubstantiated assertions) why TransCanada's significantly less costly study would not be sufficient to meet the information needs of FERC and the agencies.

The Director also errs in his finding that "[b]ecause the source of the radio-tagged shad is unknown and stresses associated with tagging, holding, and transport will occur, the radio-tagged shad *may* not be suitable to evaluate migratory delay." SPD at p. B-36. As with the last point, neither FERC nor any agency has provided any evidence to substantiate this assertion.

First, the "source" of the juvenile shad to be tagged is *known*: they are expected to be grown in a hatchery by the FWS. Second, the notion that wild fish are more representative than tagged fish and that hydroacoustic technology is a better tool to assess wild fish ignores the fact that hydroacoustic technology *cannot* identify individuals, and therefore there is no way to assess the residency of an individual in the Vernon forebay with hydroacoustic technology whether that individual is wild or tagged (except that radio telemetry provides information on the behavior of the tagged fish). Finally, TransCanada does not agree with the Director's characterization of potential behavioral differences between tagged shad and wild shad. In practice, the tagged shad and the wild shad will move in the same schools of fish and therefore exhibit the behavior of the population. To conduct Study 22, TransCanada intends to collect hundreds of wild shad in back water areas upstream of Vernon Dam and release ten groups of ten radio tagged juvenile shad together with the wild fish in order to have a large enough group of fish (including the radio tagged subset) migrating in their natural schooling behavior. Radio telemetry will provide specific information on the behavior of individual shad and the school of shad as a whole, particularly where multiple signals emanate from similar locations. The single beam hydroacoustic transducer will provide information on the timing and duration of the wild juvenile shad population.

In the FWS' August 29, 2013 letter, cited by the Director in his SPD, the FWS states that the single-beam hydroacoustic transducer at the downstream fish pipe would not allow for an assessment of delays to downstream migration at the Project. The FWS further requests the installation of a hydroacoustic array at "all possible passage routes" (*e.g.*, turbine intakes, fish pipe, fish tube, spillway gates) through Vernon Dam, without any discussion of the cost of such a

proposal (which is a significant expansion from the original study request), whether alternative methods suffice, or whether such a method is generally accepted in the scientific community.

As previously discussed, TransCanada's single beam hydroacoustic transducer is intended to assess the timing, duration, and relative abundance of juvenile shad, not residency (migratory delay). The information from the radio tagged fish will be used to assess residency and route selection. A hydroacoustic array "across all possible passage routes" to assess residency is inappropriate, infeasible, and unnecessary to meet the overall goal and objectives of Study 22. The Vernon Project is complex and includes eleven surface and eight submerged spillway gates, ten turbine generators, a trash sluice gate, and two downstream fish bypasses. Collectively, these structures are more than 950 feet long and constitute the dam/powerhouse structure. Given TransCanada's protocol for inflow that exceeds station capacity, in which various spill gates are opened methodically based on the amount of inflow and to maintain specified reservoir elevations under different inflow levels, it would be rare to operate most of the spill gates. Therefore, it is unreasonable to propose installation of hydroacoustic technology at many of the spill gates because they would not be used for passage.

None of the agencies, including FERC in the SPD, explained why TransCanada's proposed hydroacoustic transducer located at the downstream fish pipe would be insufficient to provide the information needed to meet the study objectives. The fish pipe, along with a louver array and supplemental downstream fish tube, are designed to direct downstream migrating fish into those passage routes. Thus, the fish pipe is the most appropriate location to qualitatively monitor for passage timing, duration, and for an index of magnitude.

CONCLUSION

The Director's determination that TransCanada must perform the Vernon Hydroacoustic Study should be eliminated from the SPD. The determination was in error,

arbitrary and capricious, and unsupported by substantial evidence. Specifically, the Director erred because: (i) the use of hydroacoustic technology for the purpose of informing Studies 11, 19, 20, and 22 is not generally accepted in the scientific community; (ii) TransCanada's RSP proposed scientifically proven methodologies to study all objectives of Studies 11, 19, 20, and 22, and no stakeholder has demonstrated otherwise; and (iii) the estimated $8 million cost of a Vernon Hydroacoustic Study, which alone would cost more than the total cost of the other 33 TransCanada studies *combined*, is out of line with the low value, incremental information that may be gained from such a study.

Accordingly, TransCanada respectfully requests that the Commission grant rehearing of the Director's SPD, and eliminate the requirement to develop and conduct a Vernon Hydroacoustic Study, as requested herein.

Respectfully submitted,

/s/ Kimberly Ognisty

Erin A. O'Dea
Legal Counsel
TransCanada Hydro Northeast Inc.
110 Turnpike Road, Suite 300
Westborough, MA 01581
Tel: (508) 599-1434
Email: erin_odea@transcanada.com

John A. Whittaker, IV
Kimberly Ognisty
Winston & Strawn LLP
1700 K Street N.W.
Washington, D.C. 20006
Tel: (202) 282-5766
Tel: (202) 282-5217
Email: jwhittaker@winston.com
Email: kognisty@winston.com

ATTORNEYS FOR TRANSCANADA HYDRO NORTHEAST INC.

Dated: March 24, 2014

APPENDIX A

What is Hydroacoustic Technology?

Hydroacoustics is a general term for the study and application of sound in water. Hydroacoustic sensing involves passive acoustics - listening for sounds, or active acoustics - making a sound and listening for the echo. The primary tool in fisheries acoustics is an echo sounder (active acoustics). This instrument operates on the same principles as a recreational or commercial fishfinder, but is engineered for greater accuracy and precision. An acoustic echo sounder transmits a pulse of acoustic energy into the water. The pulse of energy travels through the water at a speed of approximately 1,500 m/sec. When the acoustic pulse encounters an object, such as a fish or the bottom of the riverbed, some of the energy (i.e., an echo) is reflected back to the transducer. The echo sounder amplifies the received signal and then sends it to an output device and digital echo processor.

Target strength is a critical factor in fisheries acoustics because it provides a link between acoustic backscatter and animal biomass. Target strength is a measurement of how well a fish or other target scatters sound back towards the transducer. In general, larger animals have larger target strengths, though other factors, such as the presence or absence of a gas-filled swim bladder in fishes, may have a much larger effect. Target strength is usually measured empirically by comparing field samples against acoustic signals, or calculated with numerical models.

A basic hydroacoustic system includes a high frequency echo sounder, one or more transducers with cables, a chart recorder, an oscilloscope, and a computer-based echo processing system. If more than one transducer is used, a multiplexer is also required.

A variety of echo sounders are available:

- Single-beam is the earliest version; a target is detected in the beam but its specific location within the beam is unknown.
- Split-beam uses a single beam but divides the transducer face into four quadrants, allowing the location of the target to be triangulated to a specific location (in three dimensions) within the beam. The split beam calculates target strength which allows for the target to be located and tracked within the beam. Distinct characteristics, such as size or swim pattern can be used to differentiate target species from other species or backscatter. However, species with similar characteristics, or species with echos resembling backscatter, may not be distinguishable from one another. In Appendix C we have proposed using this type of echo sounder.
- Multi-beam uses multiple overlapping single beams. Typically these units track a target from one beam to another but not within each beam. It isn't possible to separate target species from other species with this system because it cannot measure direct target strength. This system is also considerably more expensive than split-beam echo sounders.
- Imaging sonar or duel frequency identification sonar (e.g., DIDSON or Aris) is a relatively new tool. It is a high frequency multi-beam sonar that uses an acoustic lens system to focus the sonic beam while providing video-like images of the monitored

area. The high-resolution images can provide information on the targets physical size, shape and orientation as well as location and movement. Equipment costs are significantly higher than echo sounder systems. In Appendix C we have proposed using this in limited areas.

Most echo sounders emit just one frequency, which can be customized. Low frequencies are less susceptible to background noise and therefore provide a cleaner "view" of the target and have been applied in limited studies to monitor eel. Shad, however, avoid low frequencies so higher frequencies are used in non-confined areas. Low frequencies are sometimes used to monitor shad after they have passed trash bars or intake screens where they are unable to swim away from the sound. Multi-frequency units are on the market, but are extremely expensive (~ million dollar range) and found on NOAA ships.

For the study designs included in Appendix C, a testing period, which could be significant depending on complexity of the hydroacoustic array, is necessary to determine optimal system configuration before the final array is installed and wired. Divers would install transducers and run cables, and adjust transducers as necessary through the monitoring period. An instrumentation shed would store the electronics and computers and would include a moderate sized propane tank to fuel a power generator for 2-3 days before re-fueling is required. Periodic sampling is done to confirm species and size composition of acoustically detected fish.

Hydroacoustics offers a tool to fisheries science but it is not a panacea. Concerns inherent to hydroacoustics include:

- Hydroacoustics cannot reliably identify species directly. It can estimate fish size, and this information coupled with multi-frequency and distributional information (e.g., depth or diel distributions) or behavioral data (e.g., swimming path, velocity) frequently aids partitioning of fish abundance estimates by species.
- The collection of large quantities of data, so much data that it can be challenge to store and analyze.
- Difficulty monitoring fish very close to boundaries, such as near the very bottom or the surface.
- Scientific hydroacoustic equipment capable of reliable quantification of fisheries parameters requires a significant investment. Expenses incurred at the front end include leasing and purchasing equipment, designing and testing an optimal site specific and study specific array configuration, and installation of the equipment. Back end expenses include processing and analyzing the copious data collect.

APPENDIX B

Vermont Yankee Technical Meeting
Wilder, Bellows Falls, and Vernon Hydroelectric Projects

Meeting Agenda

Tuesday, November 26, 2013, at 9:00 AM
Marlboro College Graduate School, Glass Room
28 Vernon Street
Brattleboro, VT 05301
(802) 258-9200

9:00 – 9:20 Overview
- Introduction of Participants
- Meeting Objectives
- Ground Rules

9:20 – 10:00 Entergy
- Presentation on Vermont Yankee Closure
- Clarification Questions / Answers

10:00 – 10:30 Stakeholder Caucus

10:30 – 12:00 Study Discussion*

12:00 – 1:00 Lunch

1:00 – 2:45 Study Discussion*

2:45 – 3:00 Break

3:00 – 3:45 Study Discussion*

3:45 Meeting Summary
Licensing Process Schedule and Concerns
Next Steps

* Discussed in the order listed in the attachment

LIST OF PROPOSED AND REQUESTED STUDIES THAT WE HAVE IDENTIFIED AS POTENTIALLY AFFECTED BY THE DECOMMISSIONING OF VERMONT YANKEE

Study	Recommending Entities
6 -- Water Quality Monitoring and Continuous Temperature Monitoring	TransCanada
7 -- Aquatic Habitat Mapping	TransCanada
8 -- Channel Morphology and Benthic Habitat Study	TransCanada
9 -- Instream Flow Study	TransCanada
10 -- Fish Assemblage Study	TransCanada
11 -- American Eel Survey	TransCanada
12 -- Tessellated Darter Survey	TransCanada
13 -- Tributary and Backwater Area Fish Access and Habitats Study	TransCanada
14 -- Resident Fish Spawning in Impoundments Study	TransCanada
15 -- Resident Fish Spawning in Riverine Sections Study	TransCanada
16 -- Sea Lamprey Spawning Assessment	TransCanada
17 -- Upstream Passage of Riverine Fish Species Assessment	TransCanada
18 -- American Eel Upstream Passage Assessment	TransCanada
19 -- American Eel Downstream Passage Assessment	TransCanada
20 -- American Eel Downstream Migration Timing Assessment	TransCanada
21 -- American Shad Telemetry Study – Vernon	TransCanada
22 -- Downstream Migration of Juvenile American Shad - Vernon	TransCanada
23 -- Fish Impingement, Entrainment, and Survival Study	TransCanada
24 - Dwarf Wedgemussel (Alasmidonta heterodon) and Co-Occurring Mussel Study	TransCanada
25 -- Dragonfly and Damselfly Inventory and Assessment	TransCanada
New -- Vernon Hydroacoustic Study	FWS, NHFGD, VANR

APPENDIX C

Appendix C - Alternatives/Options

This appendix outlines three hydroacoustic sampling options (Plans A through C) depending on the objectives, cost-benefit considerations, and justification of scope. Table C-1 provides an overview of each Plan's intended objective, relative data quality, and additional cost over that estimated for Study 22 – *Downstream Migration of Juvenile American Shad*. The narrative and diagrams that follow Table C-1 for each plan detail the hydroacoustic equipment required, the configuration of transducers and/or arrays needed, an estimated annual cost for each plan (+/- 10%) that would be in addition to the Study 22 (or other studies) costs, verification, analysis and results expected from the hydroacoustic plan, as well as important assumptions and considerations.

Definitions of the terminology for the parameters of interest, as stated by resource agency requests and the Director in his SPD, and referenced in Plans A-C below:

- "**Timing**" is the time of arrival and departure of migratory fish (shad or eels) in the forebay, and not the timing of passage of the project through turbines, gates, or fishpipe.
- "**Duration**" of the migration is undefined in the study requests, but is defined herein to mean the duration of the period when outmigrating shad or silver eels are present within the forebay, and not the overall duration from spawning site to sea.
- "**Magnitude**" of the migration run of shad or silver eels is an undefined term in the study requests, and an ambiguous term in fisheries science, but is interpreted herein to be relative (*e.g.*, CPUE, decibels, low-medium-high), which can be used as a relative index of abundance if standard methods are consistently used. However, magnitude in the context of migration runs would be synonymous with absolute abundance or counts (*i.e.*, population size). Plans B and C attempt to estimate absolute abundance, but there is an element of imprecision inherent in such an estimate due to sampling error, sampling biases, and extrapolation of data to account for locations and periods of time in which monitoring was ineffective or absent.
- "**Delay**" is a term that implies knowledge of an ambient ("natural) or defined threshold in residence time in a particular river reach. If the Vernon forebay residence time is statistically longer than the residency time would be if a particular river reach was not impounded, then "delay" could be determined. Since the natural residency time is unknown, we assume "delay" to mean the quantitative estimate of time an individual spends in the forebay.

State of the Science

Hydroacoustic sampling methods have become an accepted technique for estimating fish abundance in coastal and ocean waters as well as to monitor fish passage in riverine waters (Simmonds and MacLennan 2005). Its use to estimate fish passage originated with the focus on migrating salmonids at hydropower facilities (Thorne and Johnson 1993; Kubecka and Wittingerova 1998; Enzenhofer and Cronkite 2000; Krumme and Saint-Paul 2003). Fixed-location hydroacoustics have since been adopted to measure other species such as clupeids such as American shad (Guillard et al 1998; Pedersen and Trevorrow 1999; Dunning and Gurshin 2012). However, hydroacoustic monitoring of outmigrating anguillid eels has not been well

documented with the exception of a couple of published studies (McCarthy et al. 2008; Mueller et al. 2008).

Table C-1. **Summary of example hydroacoustic sampling plans that achieve the objectives identified in Studies 11, 19, 20, and 22.** The objectives include timing and duration, magnitude, residency time, and route selection. "High Data Value" means reliable data that satisfies the study goals and objectives. "Low Data Value" refers to data that is imprecise or adds little additional information to study goals and objectives. Cost information is ±10% and represented as *additional* costs to study plans as proposed.

	Plan A	**Plan B**	**Plan C**
Additional Annual Cost	**$0** (Included in Study 22 in RSP)	**$2.93 Million**	**$4.08 Million**
Total 2-year Study Cost		**$5.86 Million**	**$8.16 Million**
Location of hydroacoustic equipment	Single transducer at Fish Pipe.	3 river arrays plus transducers behind trash racks and across expected bypasses.	3 bi-level river arrays plus transducers behind trash racks and across expected bypasses.
Juvenile Shad			
Timing and Duration	**HIGH Data Value** based upon monitoring at Fish Pipe.[a]	**HIGH Data Value** based upon monitoring forebay and passage routes.[a]	**HIGH Data Value** based upon monitoring forebay and passage routes.[a]
Magnitude	**HIGH Data Value** of relative index of abundance of entire run, based upon monitoring at Fish Pipe.[a]	**HIGH Data Value** but low incremental value of relative index of abundance within entire run, based upon monitoring forebay and passage routes.[a] **LOW Data Value** of absolute abundance or population size, based upon sampling error, biases, and the extent of extrapolation for areas not effectively monitored.	**HIGH Data Value** of relative index of abundance within entire run, based upon monitoring forebay and passage routes.[a] **LOW Data Value** of absolute abundance or population size because of sampling error, biases, and the extent of extrapolation for areas not effectively monitored.
Residency Time	**Determined in Study 22** - not by hydroacoustic transducer at Fish Pipe.[b]	**LOW Data Value** as it requires positive identification schools as they pass multiple sequential arrays and transducers or are repeatedly identified by a single array or transducers. Not possible to determine individual fish behavior or residency time.	**LOW Data Value** as it requires positive identification schools as they pass multiple sequential arrays and transducers or are repeatedly identified by a single array or transducers. Not possible to determine individual fish behavior or residency time.
Route Selection	**Determined in Study 22** - not by hydroacoustic transducer at Fish Pipe.[b]	**HIGH Data Value** but low incremental value of estimation of proportional selection based upon comparison of relative number of targets detected by monitoring forebay and passage routes.[b] **LOW Data Value** in terms of definitive population numbers utilizing passage route options. Not possible to determine individual fish behavior or residency time.	**HIGH Data Value** but low incremental value of estimation of proportional selection based upon comparison of relative number of targets detected by monitoring forebay and passage routes.[b] **LOW Data Value** in terms of definitive population numbers utilizing passage route options. Not possible to determine individual fish behavior or residency time.

	Plan A	Plan B	Plan C
American Eel	Does not target eels.[c]	Does not target eels.[c]	
Timing and Duration			**LOW Data Value** because (1) unproven technology for monitoring eels; (2) unknown (predictably low) population of eels outmigrating leading to lower probability of detection; and (3)Non-schooling behavior leading to lower probability of detection.
Magnitude			Similar to Shad above
Residency Time			Similar to Shad above
Route Selection			Similar to Shad above

[a] Coupled with data from downstream monitoring from FirstLight studies at Turners Falls or Holyoke Dams.
[b] Study 22 will provide information on residency time and route selection of sampled shad via radio tagging and release with wild shad population.
[c] Study 19 will also provide information on residency time and route selection of sampled eels via radio tagging.

Plan A: Single Split-Beam Transducer to Monitor Juvenile Shad Near Fish Pipe

This design is included in TransCanada's Study Plan 22 – Downstream Migration of Juvenile Shad at Vernon.

Location—Figure A-1 shows the location of the transducer in the forebay.

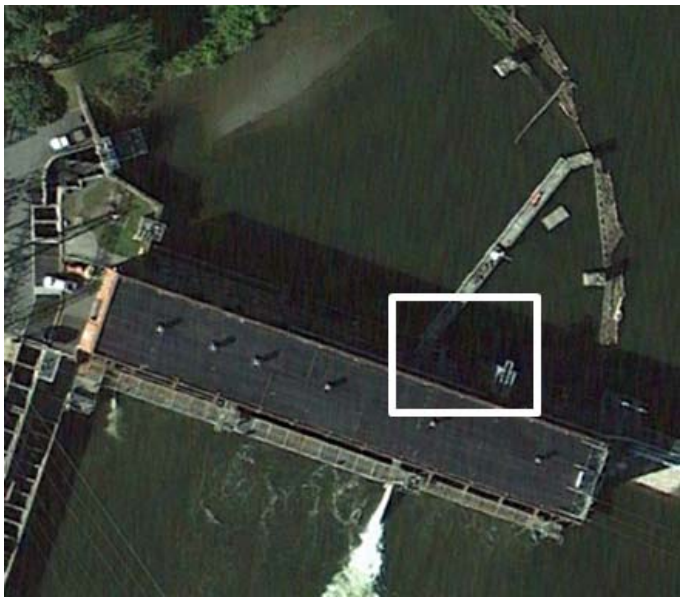

Figure A-1. Conceptual diagram of the location of a single split-beam transducer (in white square) mounted to sample about 100% of the fish pipe entrance for monitoring the temporal pattern in relative abundance of out-migrating juvenile American shad at Vernon dam.

Equipment Description— This plan is based on using a single HTI split-beam echosounder. The acoustic frequency of 420 kHz would be selected because shad may detect (Mann et al. 1997) and avoid the ultrasound at commonly used fishery echosounder frequencies (38-200 kHz; Dunning et al. 1992; Ploskey et al. 1995; Ross et al. 1993, 1996), and the higher frequency and resolution is suitable for detecting small fish. The transducer cable would be secured to the dam infrastructure and lead to an indoor facility where echosounder electronics and computers could be operated.

Sampling Coverage—The opening at the entrance of the fish pipe is 7.6 ft x 4.0 ft. Following a site visit, the transducer beam width and deployment configuration will be determined. A horizontally aimed transducer could be mounted to the face of the dam. A transducer could also be mounted to the river bed or to the dam structure and aimed vertically to the surface where the juvenile shad are expected to congregate and pass through the fish pipe opening. Either configuration could sample near 100% of the depth layer and width of the fish pipe immediately upstream of the opening (Figure A-2).

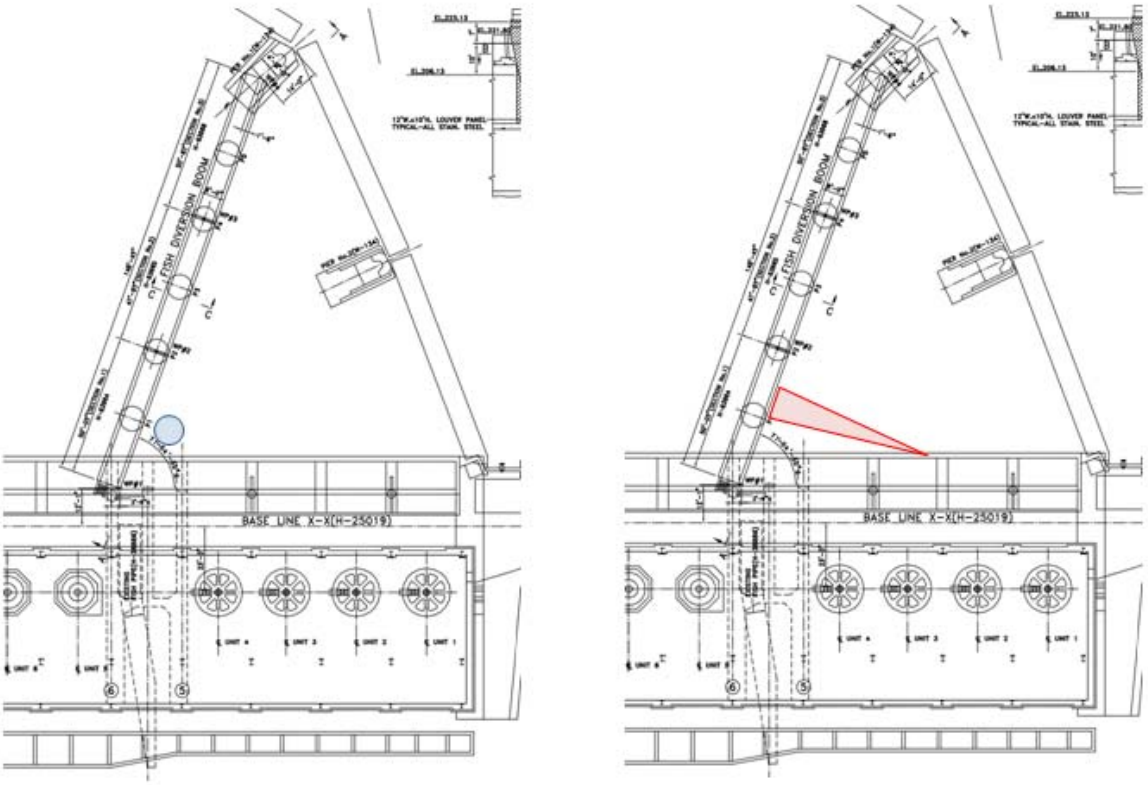

Figure A-2. Beam geometry of two Plan A configuration options dependent on an evaluation of site conditions. Left: blue circle showing an approximately 10-ft wide beam footprint from a 15° split-beam transducer mounted near the bottom and aimed toward the surface. Right: red triangle represents the ideal beam cone shape from a 15° split-beam transducer mounted to the dam face and aimed horizontally near the fish pipe entrance.

Sampling Schedule—The system would be installed and adjusted in late July for continuous monitoring from August through November, which will capture the entire period outmigrating juvenile shad are known to move downstream. The temporal sampling by the transducers would be continuous (24/7) and would be sampled in manageable echogram sizes of 1- to 5-minute durations.

Expected Results—Both the relative index of volume backscattering strength and acoustic estimate of passage can provide sufficient temporal resolution for estimating the timing, duration, and relative magnitude of juveniles in the vicinity of the upstream fish pipe opening. However, it provides no direct measure of absolute or relative abundance of the whole-river outmigration, exit route selection or the residency time of individuals within the forebay.

Cost—The estimated one-year cost of this option is approximately $135,000 ±10% and is included in the total Study 22 cost where this option was proposed (Revised Study Plan, August 14, 2013). The cost is based on a 2-month monitoring period (Sep – Oct), consistent with the rest of the Study 22 schedule, and assumes no schedule delays and no equipment replacement due to weather or other acts beyond TransCanada's control.

Analysis and Metrics—The split-beam transducer will collect information necessary for determining relative fish size, position within the beam, direction and rate of movement through the beam, and volume backscattering strength proportional to fish density (Foote 1983; Simmonds and MacLennan 2005). Echo integration, echo counting or both would be considered for deriving fish density depending on their observed distributions. Like other clupeids (Dunning and Gurshin 2012; Gurshin et al. *in review*), juvenile shad may form dense schools during the day that make echo counting difficult, but scatter as individuals during the night. The fish flux (number per unit area [vertical plane] and time) would be determined by the acoustic fish density estimate, and the rate of movement downstream and proportion that move toward the fish pipe opening as estimated by split-beam tracking of individuals of juvenile shad size and/or from radio telemetry results that are also part of Study 22. The fish flux then can be used to extrapolate to daily passage through the fish pipe.

Verification—Weekly cast netting effort is also included in Study 22 and would provide biological samples to confirm species and size composition of acoustically detected fish.

Assumptions and Considerations — Several assumptions and considerations are important in this approach and its results:

- Background noise and acoustic scattering contributions by other targets (e.g., macroinvertebrates, entrained surface bubbles, sediment gas bubbles, other small fish) are assumed to be either negligible, or can either be quantified, or can be removed from analysis.
- The continuity of the study and the completeness of results may be compromised by natural acts beyond control (e.g., hurricanes, floods) or by vandalism.
- The acoustic estimate of fish density attributable to juvenile American shad during outmigration can be separated from the natural variability. This could be problematic if abundance is low and the relative contribution of false detection and false classification is high. During the most recent three years that data are available, the annual (July-November) catch of juvenile American shad in the Vernon impoundment based on about 240 beach seine hauls/year was only 1,313 in 2012, 82 in 2011, and 195 in 2010 (Normandeau 2013). The standing crop index for juvenile American shad in the lower Vernon impoundment during 2000-2012 ranged from 723 to 31,491 (Normandeau 2013). During the same period, the number of adult shad passing upstream at Vernon dam ranged from 65 in 2007 to 10,715 in 2012 and the number trucked from the Holyoke Lift and stocked in the Vernon impoundment ranged from 71 in 2001 to 2,128 in 2009 (Normandeau 2013).
- For estimating timing and duration of the outmigration, migration must start and end during the study period. Early and late migration is subject to more environmental variability.
- Absolute or relative abundance of the outmigration run for the whole river, residency time of individuals, and route selection cannot be determined by this sampling configuration. Theoretically, if sufficient fine-scale radio telemetry results from Study 22 provide an estimate of the proportion of all juvenile shad that exit through the fish pipe, then acoustically derived fish passage estimates at the fish pipe could be scaled to the whole river. However, this depends on being able to differentiate between fish

swimming toward the opening, those being entrained, and those milling about in front of the opening.

- The trends in relative abundance of juvenile shad observed at the fish pipe are assumed to be representative of juveniles arriving to the other locations (forebay, turbine units, and spillways).

Plan B: Hydroacoustic Arrays at 3 RIVER Sites AND AT DAM to Monitor Juvenile Shad Migration & Transit Times

This plan includes three river hydroacoustic arrays upstream, in the forebay and downstream of the dam plus additional transducers located at expected passage routes (primary spill gates, fish bypasses and at the 10 turbine intakes). This plan targets juvenile shad only, not American eel.

Location—Figure B-1 shows the approximate locations of the three river transducer arrays. Three arrays are needed in order to estimate run timing, duration and magnitude through the project. The upstream array should be located downstream of significant shad spawning areas (to be determined by Study 21 – American Shad Telemetry Study). One potential spawning area may exist in the east side backwater area shown in Figure B1 between the upstream and forebay arrays. If it is a spawning area, this could confound results by introducing juvenile shad not monitored at the far upstream array, but the overall effect is expected to be small. Proper site river morphology for optimal technology performance is also a factor in locating the upstream and downstream arrays.

Figure B-2 shows the approximate locations of transducers at the dam at Units 1-10, the two fish pipes, the trash sluice and two most eastern tainter gates (Nos. 1 and 2) because typical flow conditions would not require operation of other possible exit routes under most circumstances.

Figure B-1. Conceptual diagram of locations for the three river arrays for Plan B. Red lines mark the upstream, forebay and downstream transducer arrays. Exact locations may change following site evaluations.

Figure B-2. Conceptual diagram of the dam sampling configuration for Plan B. Cyan dots represent the upward-looking split-beam transducers; Red triangle represent the conical beams of four horizontally aimed transducers pointing across the opening to the two tainter gates; and blue bar representing the bank of 10 upward-looking elliptical split-beam transducers mounted behind the trash racks.

Equipment Description—For each river array, this design includes two leased HTI split-beam echosounder systems equipped to multiplex up to 12 transducers per echosounder (total of 24 transducers). Transducers would be mounted to 6-ft long pipe X-shaped stands and secured to the riverbed. Twenty 15° transducers would be aimed vertically to the surface and four 6° transducers would be aimed horizontally (a few degrees from horizontal) to cover the upper water column in the shallow water along the slopes of the shore.

The acoustic frequency of 420 kHz would be selected because shad may detect (Mann et al. 1997) and avoid the ultrasound at commonly used fishery echosounder frequencies (38-200 kHz; Dunning et al. 1992; Ploskey et al. 1995; Ross et al. 1993, 1996), and the higher frequency and resolution is suitable for detecting small fish. Figure B-3 shows a conceptual illustration of the forebay river array beam geometry.

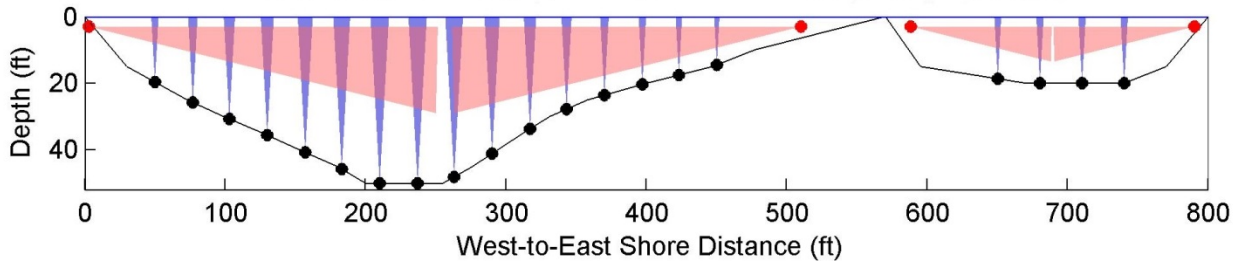

Figure B-3. Conceptual diagram of beam geometry of the forebay river array, pending site evaluation. Beams are mapped to scale but axis units are not to 1:1 scale to improve visualization. Blue cones represent upward-looking 15° split beam transducers and red cones represent side-looking 6° split beam transducers to target shad only.

For the dam-based transducers this design includes two leased 200-kHz HTI split-beam echosounder systems set to multiplex up to a total of 20 transducers to be installed, one set behind each of the trash racks. Upward and downward looking beams provide better coverage of the intakes and make no assumptions of where the fish will actually go, and would improve the design and results from the 2009 study (Normandeau, 2010). Each 6°x12° elliptical split-beam transducer at the intakes would mounted on a pan-tilt rotator to the inside face of each intake trash rack, aimed upward to effectively sample the upper water column inside the intake to target shad (Figure B-4).

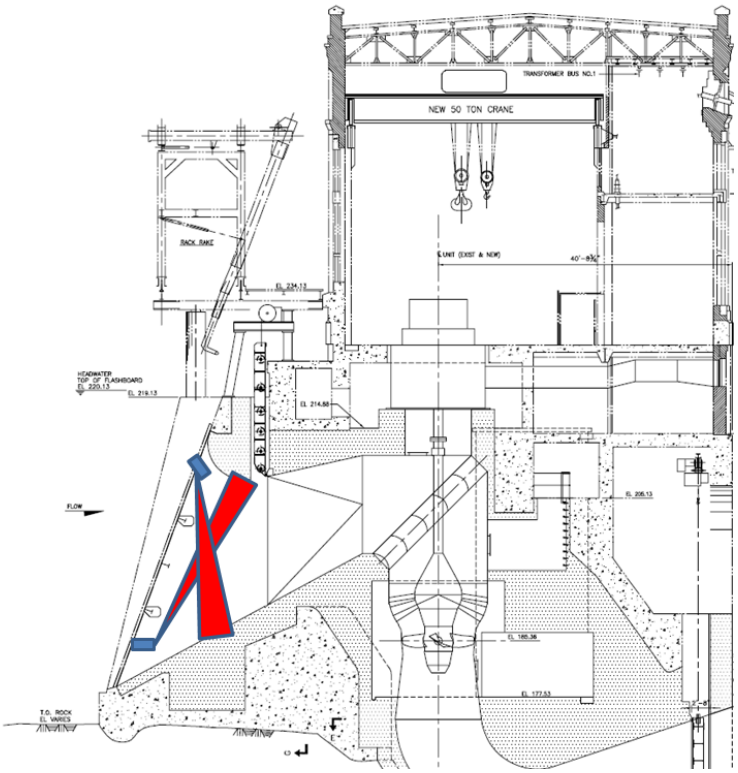

Figure B-4. Example of each turbine generating unit's intake with an upward-looking and downward-looking transducer (200 kHz split-beam) mounted on pan-tilt rotators for adjusting to optimal sampling behind the trash racks.

In addition, a 420-kHz split-beam echosounder system would be used to sample in front of the openings to the west fish bypass, the fish pipe and trash sluice, and at the most eastern two tainter gates Nos. 1 and 2 (see Figure B-2). Transducers would be mounted to the dam structure. The fish pipe, fish tube, and trash sluice openings would likely be sampled by upward-looking 15° split-beam transducers while the opening to the tainter gates may be sampled by a horizontally aimed transducer. Actual system design would depend upon site evaluation. The acoustic frequency of 420 kHz would be selected for beams sampling in the forebay because shad may detect (Mann et al. 1997) and avoid the ultrasound at commonly used fishery echosounder frequencies (38-200 kHz; Dunning et al. 1992; Ploskey et al. 1995; Ross et al. 1993, 1996), and the higher frequency and resolution is suitable for detecting small fish. However, 200 kHz would be used inside the trash racks to reduce scattering from bubble and flow-induced reverberation that would be higher at 420 kHz. The avoidance effect would be considered negligible based on the pointing direction and the location behind the trash racks where fish are committed to entrainment.

Transducer cables would be weighted down with sandbags secured by divers and would run to the east (NH) shore. An instrumentation shed would store the electronics and computers. The system would include a moderate sized propane tank to fuel a power generator for 2-3 days before re-fueling is required.

Sampling Coverage—The three river arrays would be located upstream and downstream of the dam. The effective sampling coverage may vary depending on exact locations and bathymetry at the selected sites. The forebay array would sample approximately 18% of the river's total cross-section (see Figure B3). Due to beam spreading, the wide 15° upward-looking transducers would effectively sample the upper water column where juvenile shad are expected to be predominantly distributed. The degree of coverage of the 20 upward-looking transducers over the ~500-ft channel segment would provide approximately 10-20% sampling error (coefficient of variation of 0.1-0.2). It is expected that the upstream and downstream arrays would have similar sampling coverage. The dam-based transducers would sample all possible passage routes that would be available to downstream migrating juvenile shad approximately 95% of the time during the migration season.

Sampling Schedule—The system would be installed and adjusted in late August for continuous monitoring from September through October because previous studies in the Connecticut River (O'Leary and Kynard 1983) and in the lower Vernon impoundment (Normandeau 2013) have shown the peak migration of out-migrating juvenile American shad occurs within this period. Alternatively, and at higher cost, the system could be installed in late July for continuous monitoring from August through November to better ensure that very early and/or late migrations are captured.

The temporal sampling by the transducers would likely follow a stratified systematic or random sampling scheme suitable for estimating a patchily distributed species, and provide an unbiased mean and variance estimate (Skalski et al. 1993, 1996). For example, at the start of each 2-hour block, one transducer would be randomly selected to start the sequence of each transducer transmitting at a high ping rate for one minute that would produce a total of 5 replicates per block for each transducer.

Expected Results—Both the relative index of volume backscattering strength and acoustic estimates of absolute abundance can describe the natural variability before and after out-

migration. However, the signature of the outmigration could be episodic and detected at the array as transient peaks in the acoustic index. If fish are low in abundance, gradually come down the river, or if milling creates a dampening effect, there could be a long moderate elevation in the acoustic index or a long semi-continuous damped signal in the time series corresponding to active outmigration.

The temporal pattern described can infer the timing and duration of the outmigration upstream of the project. The magnitude in the abundance index can be used as a relative measure for comparing multiple years using the same gear and sampling design, or as an estimate of absolute abundance if the uncertainty can be quantified and error within an accepted value. The lag time between pulses (peaks) can provide inference on transit time or residency time at the population level with two river segments (a far upstream segment and segment containing the forebay, dam, and tailrace). In addition, acoustic estimates of entrainment and passage would provide temporal and spatial patterns for quantifying the timing, duration, abundance and route selection over the range of typical flow conditions that include operation of the sampled passage routes (turbines, fish bypasses, trash sluice and tainter gates No. 1 and 2).

Acoustic estimates of entrainment and passage would provide temporal and spatial patterns for quantifying the timing, duration, abundance and route selection over typical flow conditions that operate the sampled passage routes.

Cost— Total estimated annual cost for a study using this hydroacoustic sampling plan would be approximately $2.93 million for a 4-month sampling period (Aug–Nov) and assumes no schedule delays and no equipment replacement due to weather or other acts beyond TransCanada's control. This cost includes study plan development, mobilization, monitoring, demobilization, analysis, and reporting. It doesn't include additional costs for modifications that may result from the study plan approval process. This cost does not include any costs associated with other sampling methods proposed in the revised study plans, and would replace Plan A proposed in Study 22. Costs associated with dive operations, safety and operational review, and direct mount materials are also not included.

Analysis and Metrics—The split-beam transducers would collect information necessary for determining relative fish size, position within the beam, direction and rate of movement through the beam, and volume backscattering strength proportional to fish density (Foote 1983; Simmonds and MacLennan 2005). Echo integration, echo counting or both would be considered for deriving fish density depending on their observed distributions. Like other clupeids (Dunning and Gurshin 2012; Gurshin et al. *in review*), juvenile shad may form dense schools during the day that make echo counting difficult, but then scatter as individuals during the night. The fish flux (number per unit area [vertical plane] and time) would be determined by the acoustic fish density estimate, and the rate of movement downstream and proportion that move downstream as estimated by split-beam tracking of individuals of juvenile shad size and/or from radio telemetry results. The fish flux then could be used to extrapolate to daily passage for the whole river cross-section. Depth layers could be weighted accordingly to the observed vertical distribution of juvenile shad. For transducers behind the trash racks, entrainment can be assumed to be 100%.

Verification—A weekly pelagic trawl and cast netting effort upstream of each of the three river arrays would provide biological samples to confirm species and size composition of acoustically detected fish.

Assumptions and Considerations—Several assumptions and considerations are important in evaluating this approach and its results:

- Background noise and acoustic scattering contributions by other targets (e.g., macroinvertebrates, entrained surface bubbles, sediment gas bubbles, other small fish) are assumed to be either negligible or can either be quantified or can be removed from analysis.
- The continuity of the study and the completeness of results may be compromised by natural acts beyond control (e.g., hurricanes, floods) or by vandalism.
- The fish density metrics derived from sampled portions will be representative of the unsampled portions, and can be scaled to stratified or whole-river estimates.
- The selected river array locations will be far enough upstream to minimize effects of milling behavior and far enough downstream to include counts of juveniles from all spawning grounds upstream of Vernon dam.
- The acoustic estimate of fish density attributable to juvenile American shad during out-migration can be separated from the natural variability which could be problematic if abundance is low and the relative contribution of false detection and classification is high. During the most recent three years that data are available, the annual (July-November) catch of juvenile American shad in the Vernon impoundment based on about 240 beach seine hauls/year was only 1,313 in 2012, 82 in 2011, and 195 in 2010 (Normandeau 2013). The standing crop index for juvenile American shad in the lower Vernon impoundment during 2000-2012 ranged from 723 to 31,491 (Normandeau 2013). During the same period, the number of adult shad passing upstream at Vernon dam ranged from 65 in 2007 to 10,715 in 2012 and the number trucked from Holyoke Lift and stocked in Vernon Pool ranges from 71 in 2001 to 2,128 in 2009 (Normandeau 2013).
- For estimating timing and duration of the outmigration, migration must start and end during the study period. Early and late migration is subject to more environmental variability.
- The peaks in magnitude (relative or absolute) that correspond to episodes of outmigration can be detected above the natural variability at the three sites and can be tracked (correlated) between the sites to determine the statistically significant lag times.
- Outmigration of juveniles from spawning or nursery habitat between sites does not confound the results (i.e., fish detected at sites downstream that didn't pass at the upstream sites).
- If outmigration occurs gradually, especially if abundance is low, then the peaks in the three time series may be difficult to track and determine transit times.
- Ideally, the pre-migration and post-migration levels should be observed at all sites so tracking of all pulses or peaks in the time series brackets the outmigration. As a result, this may require monitoring for longer than the cost-estimated 4-month duration to ensure that early or late migrants are detected at the first and last sites.
- Absolute abundance is subject to uncertainty of multiple parameters.

- Modifications to the 2009 Vernon Study (Normandeau 2010) would improve acoustic data quality include elliptical instead of circular beams, exclusive split-beam transducers for locating and TS estimates instead of single beam transducers, use of pan-tilt rotators to adjust the deployment for reducing interference, the use of 200 kHz instead of 420 kHz would reduce effects from bubbles, and raw data collection would allow for optimizing threshold and analysis settings.

Plan C: Hydroacoustic Arrays at 3 RIVER Sites AND AT DAM to Monitor Juvenile Shad AND ADULT EEL Migration & Transit Times

This plan is similar to Plan B and designed to target both juvenile shad and adult American eels.

Location—Same as Plan B (see Figures B-1 and B-2).

Equipment Description—Similar to Plan B for the river arrays but replaces two of the upward-looking split-beam transducers with two additional horizontally aimed transducers to sample near the bottom of the center of the channel where adult eels are likely to prefer (Figure C-1). Two horizontally-aimed imaging sonars at each river array also would be added to classify adult eels. The dam-based design is similar to Plan B with the addition of an imaging sonar (ARIS) suitable for classifying eel echo traces that would be deployed on a pole or rail system that could be used to move between turbine units (Mueller et al. 2008). It could also be mounted on a pan and tilt rotator to optimize sampling coverage in front of turbine intakes.

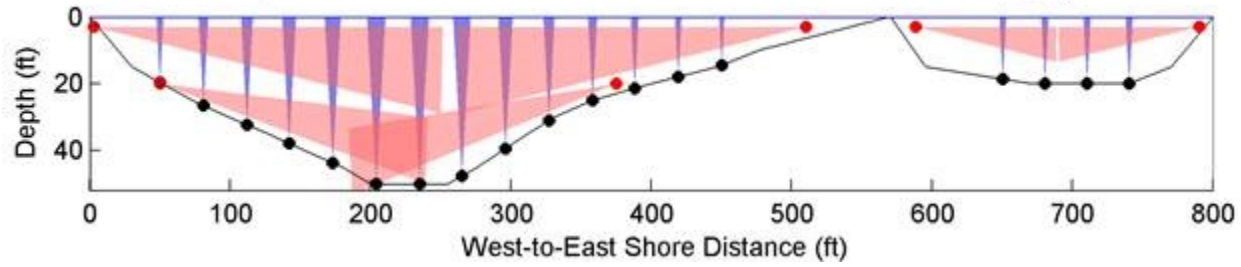

Figure C-1. Conceptual diagram of beam geometry of the forebay river array, pending site evaluation. Beams are mapped to scale but axis units are not to 1:1 scale to improve visualization. Blue cones represent upward-looking 15° split beam transducers and red cones represent side-looking 6° split beam transducers. Note: Imaging sonars would be aimed horizontally (2 additional red cones) and co-located with the bottom centered horizontal transducers to target adult eels.

Sampling Coverage—Same as Plan B and with the addition of imaging sonars and transducers aimed horizontally at river arrays to target adult eels, and the downward-looking beams at the turbine intakes in Plan B would also target where eels may prefer to pass (Brown et al. 2009).

Sampling Schedule—The system would be installed and adjusted in late July for continuous monitoring from 1 August through 30 November when out-migrating juvenile American shad and out-migrating silver-phase American eels are known to occur. Temporal sampling by the transducers would likely follow a stratified systematic or random sampling scheme suitable for estimating a patchily distributed species and provide an unbiased mean and variance estimate (Skalski et al. 1993, 1996). For example, at the start of each 2-hour block, one transducer would be randomly selected to start the sequence of each transducer transmitting at a high ping rate for one minute that would produce a total of 5 replicates per block for each transducer.

Expected Results—Same as Plan B, and targeting both juvenile shad and adult eels.

Cost—Total estimated annual cost for a study using this hydroacoustic sampling plan would be approximately $4.08 million for a 4-month monitoring period (Aug – Nov) and assumes no schedule delays and no equipment replacement due to weather or other acts beyond control. This cost includes study plan development, mobilization, monitoring, demobilization, analysis, and reporting. It doesn't include additional costs for modifications that may result from study plan

approval process. This cost doesn't include any costs associated with other sampling methods proposed in the revised study plans, and would replace Plan A proposed in Study 22. Costs associated with dive operations, safety and operational review, and direct mount materials are not included.

Analysis and Metrics — Same as Plan B with the addition of analysis for, and classification of adult American eels.

Verification—Weekly cast netting effort would provide biological samples to confirm species and size composition of acoustically detected fish. In addition, the imaging sonars would provide density information and target classification for eels to corroborate and complement the split-beam transducer results.

Assumptions and Considerations—Same as Plan B with the addition of:

- The distribution and abundance of eels will be suitable for acoustic detection.

Appendix C References

Brown, L., A. Haro, and T. Castro-Santos. 2009. Three-dimensional movement of silver-phase American eel in the forebay of a small hydroelectric facility. American Fisheries Society Symposium 58: 277-291

Dunning, D. J., and C. W. D. Gurshin. 2012. Downriver passage of juvenile blueback herring near an ultrasonic field in the Mohawk River. North American Journal of Fisheries Management 32:365-380.

Dunning, D. J., Q. E. Ross, P. Geoghegan, J. J. Reichle, J. K. Menezes, and J. K. Watson. 1992. Alewives avoid high-frequency sound. North American Journal of Fisheries Management 12:407-416.

Enzenhofer, H. J., and G. Cronkite. 2000. Fixed location hydroacoustic estimation of fish migration in the riverine environment: an operational manual. Canadian Technical Report of Fisheries and Aquatic Sciences 2312:46.

Foote, K. G. 1983. Linearity of fisheries acoustics, with addition theorems. Journal of the Acoustical Society of America 73(6):1932-1940.

Guillard, J. 1998. Daily migration cycles of fish populations in a tropical estuary (Sine-Salloum, Senegal) using a horizontal-directed split-beam transducer and multibeam sonar. Fisheries Research 35:23-31.

Gurshin, C.W.D., B.E. Lenz, M.P. Balge, and M.M. Taylor. In review. Importance of Ultrasonic Field Direction for Guiding Juvenile Blueback Herring Past Hydroelectric Turbines. North American Journal of Fisheries Management.

Krumme, U., and U. Saint-Paul. 2003. Observations of fish migration in a macrotidal mangrove channel in Northern Brazil using a 200-kHz spli-beam sonar. Aquatic Living Resources 16:175-184.

Kubecka, J., and M. Wittingerova. 1998. Horizontal beaming as a crucial component of acoustic fish stock assessment in freshwater reservoirs. Fisheries Research 35:99-106.

Mann, D. A., Z. Lu, and A. N. Popper. 1997. A clupeid fish can detect ultrasound. Nature 389:341.

McCarthy, T.K. P. Frankiewicz, P. Cullen, M. Blaszkowski, W. O'Connor, and D. Doherty. 2008. Long-term effects of hydropower installations and associated river regulation on River Shannon eel populations: mitigation and management. Hydrobiologia 609: 109-124.

Mueller, A.M., T. Mulligan, and P.K. Withler. 2008. Classifying sonar images: can a computer-driven process identify eels? North American Journal of Fisheries Management 28: 1876-1886.

Normandeau (Normandeau Associates, Inc.). 2010. Route Selection of Emigrating Juvenile American Shad at the Vernon Project, 2009. Prepared for TransCanada Hydro Northeast Inc. Concord, NH.

Normandeau (Normandeau Associates, Inc.). 2013. Vermont Yankee/Connecticut River System Analytical Bulletin 93: Abundance of Juvenile American Shad in Lower Vernon Pool During 2012. Prepared for Entergy Nuclear Vermont Yankee, LLC.

O'Leary, J. A., and B. Kynard. 1986. Behavior, length, and sex ratio of seaward-migrating juvenile American shad and blueback herring in the Connecticut River. Transactions of the American Fisheries Society 115:529-536.

Pedersen, B., and M. V. Trevorrow. 1999. Continuous monitoring of fish in a shallow channel using a fixed horizontal sonar. Journal of the Acoustical Society of America 105:3126-3135.

Ploskey, G., J. Nestler, G. Weeks, and C. Schilt. 1995. Evaluation of an integrated fish-protection system. Waterpower 1:162-171.

Ross, Q. E., D. J. Dunning, J. K. Menezes, M. J. Kenna, Jr., and G. Tiller. 1996. Reducing impingement of alewives with high-frequency sound at a power plant intake on Lake Ontario. North American Journal of Fisheries Management 16:548-559.

Simmonds, J., and D. MacLennan. 2005. Fisheries Acoustics: Theory and Practice, Second edition. Blackwell Science, Oxford, UK.

Skalski, J. R., A. Hoffman, B. H. Ransom, and T. W. Steig. 1993. Fixed-location hydroacoustic monitoring designs for estimating fish passage using stratified random and systematic sampling. Canadian Journal of Fisheries and Aquatic Sciences 50:1208-1221.

Skalski, J. R., G. E. Johnson, C. M. Sullivan, E. Kudera, and M. W. Erho. 1996. Statistical evaluation of turbine bypass efficiency at Wells Dam on the Columbia River, Washington. Canadian Journal of Fisheries and Aquatic Sciences 53:2188-2198.

Thorne, R.E., and Johnson, G.E. 1993. A review of hydroacoustic studies for estimation of salmonid downriver migration past hydroelectric facilities on the Columbia and Snake rivers in the 1980s. Rev. Fish. Sci. 1: 27.56.

CERTIFICATE OF SERVICE

I hereby certify that I have this day served the foregoing document upon each person designated on the official service list compiled by the Secretary in the proceedings for Project Nos. 1892, 1855, and 1904 via electronic mail or first-class mail.

Dated at Washington, D.C., this 24th day of March, 2014.

/s/ *Kimberly Ognisty*

Kimberly Ognisty