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AR-1231

Response to Comments from Public Service Company of New Hampshire

on

EPA's Revised Draft National Pollutant Discharge Elimination System

Permit No. NH 0001465

for

Merrimack Station

Public Service of New Hampshire

A Northeast Utilities Company

Submitted to the U.S. Environmental Protection Agency

October 22, 2014

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on

EPA's Revised Draft National Pollutant Discharge Elimination System Permit

No. NH 0001465 for Merrimack Station

I. INTRODUCTION

Public Service Company of New Hampshire ("PSNH") submits the following response to the public comments received on or before August 18, 2014, pertaining to the United States Environmental Protection Agency-Region 1's ("EPA") April 18, 2014 revised draft National Pollutant Discharge Elimination System ("NPDES") permit for PSNH's Merrimack Station, Permit No. NH 0001465 ("draft permit"). The majority of comments submitted to the draft permit mirror and support comments PSNH made in its initial comments and therefore do not require any response. Specifically, the Utility Water Act Group ("UWAG"), Southern Company, and the Electric Power Research Institute ("EPRI") each submitted comments that agree with the following key points set out in PSNH's initial comments:

- EPA's determination that the softening, evaporation, and crystallization technology (*i.e.*, PSNH's secondary waste water treatment system ("SWWTS")), and corresponding zero liquid discharge limits, for the treatment of flue gas desulfurization ("FGD") waste water is "best available technology" ("BAT") is wrong;

- The SWWTS does not meet the legal definition of BAT, which means the SWWTS does not satisfy a finite set of well-established factors with precise definitions;

- EPA's associated zero liquid discharge effluent limit is not achievable at Merrimack Station and its inclusion in the draft permit is unfounded, arbitrary, and capricious;

- EPA rushed to judgment in issuing this latest draft permit based on incomplete and unreliable information. The agency's supposed "site-specific, case-by-case determination based on the facts at Merrimack Station," ignores the actual, undisputed facts concerning Merrimack Station;

- The draft permit relies on secondary sources, cursory research, and superficial interviews of the few companies in the world utilizing this cutting-edge technology whose plants and systems differ greatly from Merrimack Station and its FGD waste water treatment system;

- The SWWTS, which PSNH was forced to install at Merrimack Station when EPA refused to identify an appropriate waste water treatment technology outside the multi-year renewal process of PSNH's NPDES permit, has consistently served its intended purpose as a volume reduction system that generates a manageable volume of effluent that can be transported to a facility with an NPDES discharge permit;

- The SWWTS does not and cannot eliminate all FGD waste waters and must have a purge stream in order to maintain stable treatment system operations;

- EPA's three proposed "compliance scenarios" do not save the agency's erroneous BAT determination. Operation as a "true ZLD system" is not possible at this time. Fly ash conditioning is also not a viable option because Merrimack Station does not generate enough ash to condition the volume of FGD waste water generated by the SWWTS. And, the only currently viable option—continued shipments to publicly owned treatment works ("POTWs")—cannot serve as the foundation of a legally permissible "best professional judgment" ("BPJ") BAT determination, provides nominal environmental benefit, and improperly subjects PSNH to the actions and/or discretions of third parties that could eliminate this compliance option at some point in the future.

- The physical/chemical treatment system with additional Enhanced Mercury and Arsenic Removal System (*i.e.*, the "PWWTS") at Merrimack Station is BAT. This treatment system removes approximately 90 percent of all toxic weighted pound equivalents ("TWPE") from FGD waste waters and satisfies water quality standards established by the New Hampshire Department of Environmental Services;

- Alternatively, EPA's decision to utilize its BPJ authority is unlawful and/or an abuse of discretion because national effluent guidelines already exist for FGD waste waters or will be promulgated within the year.

UWAG, Southern Company, and EPRI offered unique perspective and comments to the draft permit that critique EPA's determinations, as well. PSNH specifically addresses these comments in this submission.

Several environmental organizations (Earthjustice, Environmental Integrity Project, Sierra Club, and the Conservation Law Foundation) (collectively, the "Environmental Special Interest Groups" or "ESIGs"), submitted one set of comments that are contrary to those made by

PSNH and the other above-referenced entities.[1] Yet, the ESIGs' comments provide no value in this permit renewal proceeding. The ESIGs lack the necessary understanding of the operations and capabilities of evaporative technologies for the treatment of FGD waste waters. With no factual foundation, the comments lack legitimacy and are at best aspirational.

PSNH has responded to the isolated comments made by the ESIGs that are factually incorrect and/or based on false premises. However, the majority of the ESIGs' comments are so lacking in specifics or relevance it is difficult to formulate a meaningful response to them. PSNH believes the ESIGs' comments are adequately addressed and refuted already by PSNH's August 18, 2014 comments to the draft permit. In these comments, PSNH and its consultants also respond to each of the topical assertions set out in the ESIGs' comments.

II. PSNH'S RESPONSE TO COMMENTS ON EPA'S LATEST DRAFT PERMIT

A. PSNH Agrees with the Comments of Southern Company and UWAG Addressing EPA's Attempted Burden Shifting

In its Fact Sheet for the draft permit, EPA creates a "rebuttable presumption" that Merrimack Station's VCE and crystallizer system is "available . . . (*i.e.*, it is technologically and economically achievable for the Facility)" because PSNH has installed and operated its unique SWWTS for more than two years. *See* EPA Fact Sheet ("Fact Sheet") at 18-19. EPA provides that "[t]his presumption might possibly be overcome" by a showing that operational costs and/or technological issues may inhibit the long-term viability of this technological treatment option. *Id.* at 19. PSNH addressed this attempted burden-shifting in its August 18, 2014 comments and likewise agrees with Southern Company and UWAG's comments addressing this unlawful rebuttable presumption. *See* PSNH Comments on EPA's Revised Draft NPDES Permit No. NH 0001465 for Merrimack Station at 6-7 (Aug. 18, 2014) ("PSNH 2014 Comments"); Southern

[1] The Upper Merrimack River Local Advisory Committee also submitted a letter, but that letter specifically offered "no comment on th[e] revised draft NPDES permit" and therefore requires no response from PSNH.

Company Comments on EPA Region 1's Revised Draft NPDES Permit No. NH0001465 for Merrimack Station at 11-12 (Aug. 18, 2014) ("Southern Company 2014 Comments"); UWAG Comments on Revised NPDES Permit for the Merrimack Station at 21-22 (Aug. 18, 2014) ("UWAG 2014 Comments").

1. Southern Company's objection to EPA's rebuttable presumption

Southern Company, like PSNH, challenged EPA's ability to shift its statutorily-mandated burden to consider all required BAT factors before deciding what technological option constitutes BAT. *See* Southern Company 2014 Comments at 11. EPA is required to consider each BAT factor before making this determination and cannot side-step its regulatory requirements and simply presume the SWWTS is BAT. *See* 40 C.F.R. § 125.3(c) & (d). EPA's attempt to do so in this renewal proceeding is unlawful and "contravene[s] a long and continuous line of cases invalidating such presumptions. *See*, *e.g.*, *Dir., Office of Workers' Comp. Programs v. Greenwich Collieries*, 512 U.S. 267, 281 (1994); *Chemical Mfrs. Ass'n v. DOT*, 105 F.3d 702, 705 (D.C. Cir. 1997)." Southern Company 2014 Comments at 11-12.

Furthermore, simply because PSNH installed the SWWTS at Merrimack Station does not support an inference that the SWWTS is technologically and economically "available" and/or viable under the CWA's BAT factors. Southern Company correctly recognized that "an agency may only establish a presumption if there is a sound and rational connection between the proved and inferred facts." *Id.* at 12. "[T]he fact that [PSNH's SWWTS] is installed proves nothing about whether all of the other required BAT factors support its selection as 'technologically and economically achievable' under the particular test that Congress laid out in the Clean Water Act." *Id.*

Determinations as to each BAT factor are required before establishing any treatment technology as BAT. EPA failed to complete this fundamental analysis. And, even if EPA's burden-shift was legal, which it is not, PSNH has rebutted the presumption in its comments to the draft permit. *See, e.g.*, PSNH 2014 Comments at 9-30 (explaining in detail the reasons and purpose behind PSNH's installation of the SWWTS); PSNH Comments on EPA's Draft NPDES Permit No. NH 0001465 for Merrimack Station at 153-54 (Feb. 28, 2012) ("PSNH 2012 Comments") (same). It was EPA's refusal to work with NHDES and PSNH to identify the appropriate waste water treatment technology through any means other than the multi-year renewal process of the NPDES permit that left PSNH no choice but to minimize its FGD waste water so that it could meet the state statutory deadline to commence operation of the scrubber and continue operating Merrimack Station.[2] PSNH agrees with Southern Company that EPA's attempt to shift its burden and presume without proper analysis that the SWWTS at Merrimack Station is BAT is unlawful, arbitrary, and capricious. *See* Southern Company 2014 Comments at 12.

2. EPA also improperly relied on incomplete information about other facilities

Relying solely on EPA's unsupported statements in the Fact Sheet, the ESIGs argue that the VCE and crystallizer "is BAT for Merrimack Station" in part because they claim such systems are in use at other facilities abroad. *See* ESIGs' Comments on Revised NPDES Permit for the Merrimack Station, NPDES Permit No. NH0001465 at 5 (Aug. 18, 2014) ("ESIGs 2014 Comments"). Here, too, EPA seeks to shift its burden of persuasion to PSNH merely by mentioning that six other facilities in the world operate some form of this treatment technology. *See* Fact Sheet at 16-19. EPA provides no specifics about the water chemistry or operational details of any of these six facilities and does not attempt to compare them to the unique, complex, and evolving chemistry and SWWTS at Merrimack Station. EPA simply lists whether

[2] For this reason, UWAG's *fait accompli* comparison is an apt one. *See* UWAG 2014 Comments at 21.

or not these facilities utilize a VCE system, brine concentrator, and/or crystallizer. *See id.* Basing a BAT determination on such a cursory and incomplete examination, and effectively placing the burden on the permit holder to prove otherwise, is improper, bad science, and bad law.

EPA is tasked with thoroughly evaluating and understanding the details of waste water treatment technologies before making a BAT determination. It did not fulfill its obligations in this proceeding and has impermissibly attempted to shift its burden to PSNH. Despite the illegality of EPA's approach, PSNH provided extensive comments distinguishing the operations at Merrimack Station from those at the Iatan, Mayo, and the Italian facilities. PSNH also discussed in detail each of the facilities that abandoned the use of evaporative technologies due to operational and technical problems. *See generally* PSNH 2014 Comments at 96-119. PSNH's comments are uncontroverted.

PSNH has demonstrated that EPA failed to meet its statutory burden of rigorously evaluating whether the VCE/crystallizer technology and corresponding "no discharge" limit are legally "available" for the treatment of FGD waste waters. Further, PSNH has shown that EPA's reliance on other facilities to support the determination that the VCE/crystallizer technology and "no discharge" limit are legally "available" at Merrimack Station is improper, arbitrary, and capricious. The waste water chemistry generated, and the treatment technologies utilized, at the other facilities identified by EPA are unlike those at PSNH's Merrimack Station and a comparison of these facilities is therefore irrational.

While PSNH's August 18, 2014 comments address the Iatan, Mayo, and Italian facilities, very little information is known regarding the Chinese and Danish facilities mentioned in comments submitted by PSNH and UWAG. *See* PSNH 2014 Comments at 99; UWAG 2014

Comments at 24 (referencing the Chinese facility). With regard to the Chinese facility, there is no information in the record to which EPA can reasonably refer to support its assertion that the treatment system is capable of reliably and consistently eliminating all FGD waste waters or make a rational comparison of this facility to the SWWTS at Merrimack Station. In fact, what little, unverified information is included about the Chinese facility in EPA's fact sheet—*i.e.*, a treatment system supposedly has operated since 2009 without a brine concentrator and with a four-stage crystallizer—describes a technology and treatment process that is wholly distinct from that employed at PSNH's Merrimack Station. EPA's attempt to reference this Chinese facility in support of its BAT determination for Merrimack Station based on its incomplete and unsupported claims is therefore improper, arbitrary, and capricious.

On the other hand, more information has been obtained concerning the Vattenfall Nordjyllandsvaerket power station in Denmark. This information undercuts EPA's claims because the Denmark facility—like Merrimack Station—has been unable to eliminate its FGD purge stream. Instead, it is selling the "concentrated calcium chloride solution" or "brine" generated by normal FGD operations and the facility's evaporative treatment technology as a liquid de-icer that "will cover the market . . . within a distance of 25-50 km from" the plant.[3] Prior to discovering this beneficial reuse, the FGD purge had been "discharged in solution to a local water treatment plant."[4] Although identified as brine or as "calcium chloride liquor,"[5] the generated FGD purge contains the following constituents:

[3] N.O. Knudsen, *Production of a Liquid De-Icer by Evaporation of FGD Waste Water at Nordjyllandsvaerket, Unit 3*, VGB PowerTech J. 5/2006, at 1, 6 ("De-icer Paper").

[4] International Energy Agency, *Fossil Fuel-Fired Power Generation: Case Studies of Recently Constructed Coal- and Gas-Fired Power Plants*, at 48 (2007).

[5] *Id.* at 12, 46, 48.

Density	1,250 kg/m^3
Dry matter	25%
Freezing point	< 20 °C
Chloride	15 – 16%
Calcium	2 – 8%
Sodium, magnesium, potassium	<7%
Total nitrogen	<0.25%
Heavy metals: Cd, Hg, Cu, Ni, Zn, Cr, Pb	< 5 mg/liter

Table 4: Specification of the liquid de-icer [6]

There is no indication in literature reviewed that the Vattenfall facility has ever been able to eliminate all waste waters generated by its FGD system. Therefore, like the other facilities mentioned in EPA's Fact Sheet and heralded by the ESIGs, consideration of such facilities employing evaporative technologies as "zero discharge" facilities comes with the caveat that purges of waste water are required to keep the systems in balance and to avoid recurring maintenance, repair, and other operational issues. Merrimack Station is no different, and EPA's contrary conclusions are erroneous.

3. UWAG's related *fait accompli* comparison

PSNH agrees with UWAG's comment that EPA has circumvented its statutorily-required BAT analysis by assuming incorrectly that PSNH's SWWTS, as it currently exists, is capable of achieving zero liquid discharge. *See* UWAG 2014 Comments at 21. Specifically, EPA's only defense for its determination that PSNH's SWWTS is BAT for Merrimack Station, and the agency's corresponding "zero discharge" limit, would be that the agency believes it is requiring only that which already has been installed. *Id.* According to UWAG, then (and only then) could EPA's BAT determination potentially pass muster because "the decision causes no harm . . .

[6] De-icer Paper at 6.

because the money has been spent and the incremental cost of the requirement should be close to zero." *Id.*

But as UWAG points out:

> [T]he facts are different. The proposed permit does not accept the already-installed system as it is but demands that it be "zero discharge" without a purge stream. The permit ¶ 4 (p. 6) says simply that "the permittee is *not* authorized to discharge treated effluent from the Flue Gas Desulfurization System Waste Treatment Plant." But the assumption that the existing system is "zero discharge" is contrary to fact . . . . As a result, the zero discharge requirement imposes costs the Region has not even begun to consider. Those costs include ongoing expensive operations and maintenance costs and the continued cost of offsite disposal of the purge water.

Id. at 22. In its comments to the latest draft permit, PSNH explained why the SWWTS at Merrimack Station cannot achieve a zero discharge, must continue to generate a purge stream that has to be discharged, and requires flexibility due to periodic operational and maintenance issues. EPA failed to consider the unknown costs of modifying the existing SWWTS to attempt to achieve the draft permit's unattainable "no discharge" limit, and likewise ignored the perpetual costs associated with the aforementioned operation and maintenance occurrences. EPA simply presumes no additional costs exist. This determination is short-sighted and erroneous.

In sum, EPA cannot base its BAT determination on a presumption that the SWWTS can achieve zero discharge when, in fact, it cannot. EPA's attempt to reduce its statutorily-required BAT review to a presumption that BAT already exists is arbitrary and capricious. PSNH supports UWAG's comments concerning this gaping hole in EPA's BAT determination.

B. EPA Failed to Address a Mandatory BAT Factor

Southern Company correctly comments that EPA altogether failed to address one of the factors it is required to consider in establishing BPJ-based BAT effluent limits—namely, analysis of the available control technologies for FGD waste streams within the electric power generation industry, followed by a review of treatment technologies at PSNH's Merrimack Station in particular. *See* Southern Company 2014 Comments at 12-16.

In developing BPJ-based BAT effluent limits, EPA is required to consider not just the factors in 40 C.F.R. § 125.3(d), but also the factors in § 125.3(c)(2), including "the appropriate technology for the category or class of point sources of which the applicant is a member, based upon all available information." *See* 40 CFR § 125.3(c)(2) and § 125.3(d); *see also* NPDES Permit Writers' Manual, EPA-833-k-10-001 (Sept. 2010), Chapter 5, Section 5.2.3.3 (confirming that case-by-case determinations must include a consideration of all of the factors in both § 125.3(c)(2) and § 125.3(d)). This factor mandates that EPA conduct a reasoned analysis of available control technologies for FGD waste streams within the electric power generation industry, followed by a review of treatment technologies at PSNH's Merrimack Station in particular. *See* Southern Company 2014 Comments at 15 (citing *See U.S. Steel Corp. v. Train*, 556 F.2d 822, 844 (7th Cir. 1977); *Alabama v. EPA*, 557 F.2d 1101, 1110 (5th Cir. 1977); *NRDC v. EPA*, 863 F.2d 863 F.2d 1420 (9th Cir. 1988)). EPA failed to consider this BAT factor or document its consideration of each BAT factor in the draft permit Fact Sheet. *See* NPDES Permit Writers' Manual at Section 5.2.3.6 ("Permit writers will need to document the development of case-by-case limitations in the NPDES permit fact sheet. . . . The information in the fact sheet should provide the NPDES permit applicant and the public a transparent, reproducible, and defensible description of how the BPJ limitations comply with the CWA and EPA regulations."). This failure renders EPA's BAT determination inadequate for PSNH's Merrimack Station.

Proper consideration of this BAT factor may have impacted EPA's analysis in this permit renewal proceeding because much of the analysis already was completed by EPA Headquarters in its Proposed Effluent Guidelines for the Steam Electric Power Generating Category. *See* 78 Fed. Reg. 34,432 (June 7, 2013) (hereinafter "NELGs"). In its rulemaking, EPA evaluated VCE/ZLD[7] technology and, following its analysis, did not select the treatment technology as one of its four preferred options for the treatment of FGD waste waters. This determination strongly suggests EPA will not mandate VCE/ZLD for the treatment of FGD waste streams in its final NELGs. EPA Region 1 failed to explain or document the basis for its departure from EPA Headquarters' determination that VCE/ZLD technologies are not a preferred treatment option for the treatment of FGD waste waters. EPA Region 1 must explain the basis for its divergence from EPA Headquarters' thorough analysis of this technological treatment option. Its failure to do so is arbitrary and capricious and warrants additional consideration—including public comment—prior to any final permit issuance for Merrimack Station.

C. PSNH Agrees that the Costs Associated with the Installation, Operation, and Maintenance of PSNH's SWWTS Exceed EPA's Established Cost-Benefit Threshold

PSNH, UWAG, EPRI, and Southern Company are the only entities that offered comments analyzing the cost and relative benefits associated with the operation of the SWWTS at Merrimack Station. Indeed, EPA did not even do so. In the respective comments of PSNH, UWAG, EPRI, and Southern Company, each determined the SWWTS at PSNH's Merrimack Station does not satisfy EPA's established $404/TWPE (1981 $) cost-effectiveness threshold, *even if one hypothetically were to assume PSNH could, within its current operational*

[7] PSNH explained in its original comments to the latest draft permit that the term "ZLD" is an improper one because "zero liquid discharge" is a discharge limitation and is not a technological treatment option for FGD waste waters. *See, e.g.*, PSNH 2014 Comments at 30-31. PSNH utilizes the "ZLD" term here only because that is how EPA referred to the evaporative technological option evaluated in the draft NELGs.

circumstances, comply with the "no discharge" effluent limit in EPA's draft permit and eliminate the remaining TWPE from the PWWTS effluent (which, for the reasons explained extensively in PSNH's original comments to this latest draft permit, it cannot). PSNH supports the comments and calculations included in EPRI's and UWAG's respective comments on the cost-effectiveness issue. *See* PSNH 2014 Comments at 135-38; UWAG 2014 Comments at 12-21, Attachment 1; EPRI Comments on the Revised Draft Determination of Technology-based Effluent Limits for the Flue Gas Desulfurization Wastewater at Merrimack Station in Bow, New Hampshire at 1-2, Appendix A (Aug. 18, 2014). PSNH likewise supports the comments and calculations included in Southern Company's comments to the draft permit. *See* Southern Company 2014 Comments at 17-19, Attachment 1.

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In both these and its original comments to the draft permit, PSNH has provided ample facts and analyses to inform EPA that the SWWTS at Merrimack Station: (1) is a volume reduction system installed at the facility to enable PSNH to handle manageable quantities of treated FGD effluent; (2) has consistently satisfied PSNH's volume reduction needs; and (3) was not designed or installed at Merrimack Station to function as a pollutant reduction system. EPA's consideration of the SWWTS as a pollutant reduction system is a false premise. And, its establishment of a zero discharge limit based on this false premise is improper.

Therefore, even if the SWWTS currently was capable of achieving the no discharge limit in the draft permit (and it is not), the costs and corresponding benefits under the above-described scenarios do not satisfy any cost-benefit test or threshold consistently used by EPA in the past for determining BAT. In reality, no existing FGD treatment technology could satisfy EPA's standards because the simple fact is that very few constituents remain in Merrimack Station's FGD waste water following treatment by the PWWTS, the principal pollutant reduction system at Merrimack Station. For these reasons, EPA's designation of the SWWTS at Merrimack Station as BAT and as "ZLD," coupled with the agency's "no discharge" limit, are erroneous, arbitrary, and capricious.

D. The Environmental Special Interest Groups' Comments to the Draft Permit and to the NELGs are Superficial, Not Credible, and Reveal the Organizations' Unwavering Objective to Eliminate Coal-Fired Electric Generation

The ESIGs submitted comments supporting EPA's BAT determination and its zero-discharge limit for FGD waste water at Merrimack Station, while seeking to prohibit discharges of treated waste water to POTWs or the discharge of leachate containing waste water-conditioned fly ash. In other words, the ESIGs support the draft permit's zero limit and at the same time seek to eliminate the "compliance scenarios" the draft permit relies upon for achieving the zero limit.[10] The ESIGs' comments are superficial, unreliable, and demonstrate why an NPDES permit limit should not be made dependent on compliance scenarios already challenged by environmental groups.

1. The ESIGs Ignore the Operational Constraints of the SWWTS

The ESIGs dedicate about one page of their comments to asserting that PSNH's SWWTS at Merrimack Station and EPA's proposed "no discharge" limitation are technologically achievable. *See* ESIGs 2014 Comments at 4-5. Their trifling remarks offer no value to EPA in making its permitting determinations and, correspondingly, merit little response from PSNH.

[10] This is not surprising, considering Conservation Law Foundation's mission is "to shut down" coal-fired power plants "such as Merrimack Station in Bow." *See* www.clf.org. Similarly, Sierra Club's objective is to shut down all coal-fired electric generating facilities in America, regardless of the impact on or cost to the public. http://content.sierraclub.org/coal/.

Specifically, the ESIGs do not attempt to address the actual operations of the SWWTS at Merrimack Station and/or why they believe the treatment system can achieve the “no discharge” limit proposed in the draft permit. Conversely, PSNH offered detailed comments about the SWWTS operations, the purpose for which it was installed at Merrimack Station, and why the treatment system cannot currently achieve a “no discharge” limit. *See, e.g.*, PSNH 2014 Comments at 79-96; 119-33. PSNH’s August 18, 2014 comments explain why EPA’s BAT determination, and corresponding “no discharge” limitation, are arbitrary, capricious, and unachievable for PSNH’s Merrimack Station.

The ESIGs’ comments regarding technological availability hinge on two basic propositions: (1) PSNH has installed and operated its SWWTS at Merrimack Station; and (2) other VCE and crystallizer systems are in use at other plants in the world. *See* ESIGs’ 2014 Comments at 4-5. The ESIGs’ restatement of the incomplete information in EPA’s Fact Sheet does not support the draft permit’s requirement that PSNH eliminate all FGD waste water discharges from Merrimack Station.

As to the first proposition, while it is true that the SWWTS is installed and operates successfully at Merrimack Station, it is not currently able to achieve a “no discharge” limitation. Because the ESIGs offer no support, evidence, or justification for their belief that PSNH’s SWWTS can achieve this flawed permit condition, the ESIGs’ comments do nothing to rebut the fact the SWWTS must generate a purge stream and requires certain operational flexibilities. *See, e.g.*, PSNH’s 2014 Comments at 79-96; 119-33. Of course, the ESIGs seek to eliminate any operational flexibility in their comments. The ESIGs’ unsubstantiated hyperbole is contradicted by PSNH’s first-hand experience explained in its comments.

The ESIGs' second proposition also is devoid of any meaningful comparison of the few VCE and crystallizer technologies utilized in other parts of the world to the SWWTS at Merrimack Station.[11] The ESIGs do not address any site-specific factors or whether any such facility is consistently achieving a "no discharge" limit. They do not address whether these other facilities experience periodic technical and operational issues and/or need to generate and dispose of a discharge stream akin to the purge stream generated by the SWWTS at Merrimack Station. In its own comments, PSNH comprehensively reviewed these other facilities that employ some form of evaporative technology and explained that they, too, do not eliminate all FGD waste waters through their respective treatment processes. Further, many continue to experience episodic technical and operational issues that cause periodic disruptions in plant operations. *See* PSNH 2014 Comments at 96-119. The ESIGs' cursory comments on this topic must therefore be disregarded by EPA.

The relevant portions of the ESIGs' comments to EPA's NELGs are immaterial to this permit renewal proceeding. The ESIGs' NELG comments discuss waste streams and/or technological options (*e.g.*, cooling tower blowdown and cold crystallization) inapplicable to PSNH and its SWWTS, and suffer from the same deficiencies addressed above by PSNH. *See* ESIGs' Comments to NELGs at 19-21. These comments lack any substance.

The ESIGs' NELGs comments addressing the "process changes" BAT factor as it relates to mechanical evaporation technology are fatally flawed as well and signify an overall fundamental misunderstanding about the operational realities of this treatment technology. Those comments provide:

[11] The ESIGs claim that Duke Energy's Roxboro Station is in the process of installing a VCE system. *See* ESIGs 2014 Comments at 5. This is not true. There is no full or partial VCE installation planned or underway for FGD waste water treatment at Roxboro Station.

> The type of coal burned in a generating unit affects the concentrations of chlorides, dissolved solids, and metals in the FGD blowdown. However, the pre-treatment steps that EPA has evaluated as part of the mechanical evaporation technology option are designed to bring each of these components into the range suitable for the brine concentration system. Therefore, <u>no upstream process changes are required for proper operation of the mechanical evaporation system</u>.

Id. at 26 (emphasis added). The first sentence is correct inasmuch as it acknowledges that the type of coal utilized at a facility impacts the makeup and chemistry of the FGD waste water. The remainder is entirely wrong.

PSNH has made myriad operational changes to its PWWTS and other "upstream" processes in order to stabilize and optimize operation of its SWWTS at Merrimack Station. Changes of this kind likely have been required at all other facilities utilizing some form of evaporative technology, as well. PSNH's engineer, Mr. Richard R. Roy, has implemented so many changes in fact that he, along with Ms. Patricia Scroggin with Burns & McDonnell, drafted a paper summarizing the key process changes made at Merrimack Station in order to effectively operate the SWWTS. *See* R. Roy & P. Scroggin, "The Thermal Experience for FGD Wastewater at PSNH's Merrimack Station," IWC Paper 13-47 (2013) (referencing pH changes, softening steps, settling techniques, water balance impacts, etc. as process changes employed at Merrimack Station due to operation of the SWWTS). These ongoing process changes were described in great detail in PSNH's original comments to the latest draft permit, as well, and directly refute the ESIGs' contradictory claim. *See, e.g.,* PSNH 2014 Comments at 31-61.

The ESIGs' hollow assertion that "no upstream process changes are required for proper operation of the mechanical evaporation system" illustrates a fundamental lack of understanding of power plants, the operational sensitivities of evaporative treatment systems, and the manner in which this treatment technology is utilized at electric generating facilities. The ESIGs' cursory and self-serving comments—both in this permit renewal proceeding and in the NELGs rulemaking—therefore offer no value and should be disregarded by EPA as it makes its final BAT determinations for Merrimack Station.

2. The ESIGs' Statement that PSNH's SWWTS and "No Discharge" Limitation are Economically Achievable is Self-Serving and Perfunctory

The ESIGs' assertion that PSNH's SWWTS, coupled with EPA's proposed "no discharge" limit, are economically achievable is unsupported and baseless. Like EPA, the ESIGs misunderstand the operational capacity of this treatment system technology and what it can reasonably and consistently achieve.

PSNH explained in its original comments that the SWWTS at Merrimack Station was not designed or installed to function as a pollutant reduction system and cannot achieve the impossible "no discharge" limit included in EPA's draft permit. *See, e.g.,* PSNH 2014 Comments at 17-20. The SWWTS was designed and installed at Merrimack Station as a volume reduction system and continues to serve this purpose for PSNH. *See id.* Any assertion or belief that the SWWTS has completely "eliminate[ed] the discharge of FGD wastewater at the Merrimack Station" is false, yet, it is the linchpin to the ESIGs' analysis in their comments. *See* ESIGs 2014 Comments at 6. Because the SWWTS cannot achieve the "no discharge" limit included in EPA's draft permit, it is not technologically achievable and, therefore, cannot be economically achievable at this time. The mere fact of installation of the SWWTS in 2012 does not make a zero discharge limit technologically or economically achievable. PSNH's thorough explanations about the capabilities, limitations, and purpose of the SWWTS, based on first-hand experience, render the ESIGs' conclusory comments unsupported and meaningless.[12]

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[12] Aside from being factually flawed, the ESIGs' comments regarding economic achievability are misleading because they mischaracterize the appropriate legal standard for analyzing costs to establish BAT

3. The ESIGs' Comments and Justifications Seeking to Compel EPA to Prohibit Continued Shipments of FGD Waste Water to POTWs as a Compliance Option for Merrimack Station are Wrong

The ESIGs lack a basic understanding of POTW operations and the NPDES permits these facilities possess. The entirety of the ESIGs' comments suggest actions that either already have been undertaken by the various POTWs accepting waste water from PSNH or are outside the scope of EPA's regulatory authority. PSNH's consultant, GZA GeoEnvironmental, Inc. ("GZA"), addressed and responded to each of the ESIGs' POTW comments.[13] GZA's comments, along with the October 20, 2014 comments Lowell Regional Wastewater Utility ("LRWWU") filed with EPA, invalidate each of the ESIGs' comments on this topic and prove that the ESIGs' comments should be disregarded by EPA in this permit renewal proceeding.

4. The Drinking Water Concerns Raised by the ESIGs are Nonexistent

The ESIGs' generic discussion of trihalomethane ("THM") formation within drinking water systems due to the presence of bromide in source waters is irrelevant to the permit renewal process for Merrimack Station. *See* ESIGs 2014 Comments at 11-12. PSNH does not add any bromine- or bromide-containing materials in its plant operations and/or treatment processes and does not intend to do so within the foreseeable future to comply with EPA's new Mercury Air Toxics Standards ("MATS") or otherwise. Moreover, there are currently no water quality limits

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standards. The ESIGs contend that the CWA forbids EPA from using a cost-benefit analysis for a BAT determination. *See* ESIGs 2014 Comments at 11. This is neither accurate nor supported by the cases they cite. In fact, courts have concluded the opposite, finding "the agency *must* consider the benefits derived . . . *in relation to* the associated costs in order to determine whether, in fact, the resulting progress [from a limitation established under CWA § 301(b)(2)(A)] is 'economically achievable,' and whether the progress is 'reasonable.'" *Appalachian Power Co. v. Train*, 545 F.2d 1351, 1361 (4th Cir. 1975) (emphasis added); *see also BP Exploration & Oil v. US EPA*, 66 F.3d 784, 796 (6th Cir. 1995) (providing that it "is wrong to contend that EPA is not permitted to balance factors such as cost against effluent reduction benefits"); *Weyerhaeuser Co. v. Costle*, 590 F.2d 1011, 1045 (D.C. Cir. 1978) (noting that "[a]ll factors, including costs and benefits, are consideration factors" when making a BAT determination).

[13] GZA's comments, entitled "Response Comments to August 14, 2014 Letter from Conservation Law Foundation/Earthjustice/Environmental Integrity Project/Sierra Club to USEPA Region 1" (October 2014), are attached hereto as Exhibit 2.

for bromide because the constituent, in and of itself, does not constitute an environmental or health hazard.[14] Regardless, to the best of PSNH's knowledge, there is no evidence drinking water facilities located downstream of Merrimack Station have experienced excessive disinfection by-product ("DBP") formation issues. The ESIGs' interjection of this red herring in an attempt to support the "no discharge" limitation in the draft permit is therefore improper and must be disregarded by EPA.

Even if this were a material issue for Merrimack Station and the Merrimack River, which it is not, the comments offered by the ESIGs and in Dr. Jeanne VanBriesen's ("VanBriesen") report entitled "Potential Drinking Water Effects of Bromide Discharges from Coal-Fired Electric Power Plants" are incorrect and/or oversimplified. For instance, VanBriesen's report insinuates a direct, causal relationship with elevated bromide concentration and THM development, resulting in the adverse impact of treatment processes at drinking water treatment plants. This purportedly straightforward relationship between bromide and THM development is flawed. PSNH's consultant, Mr. William Kennedy ("Kennedy"), addresses VanBriesen's report and explains the host of factors that impact THM formation.[15] PSNH supports the comments offered by Kennedy.

In the end, and as explained above, the imposition of a technological treatment system at Merrimack Station due to this potential THM development issue is unjustified because no such THM formation issues currently exist. And, even if such issues were to arise in the future, there

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[14] *See* World Health Organization, *Bromide in drinking-water" Background document for development of WHO Guidelines for Drinking-water Quality*, WHO/HSE/WSH/09.01/6, at 1 (2009) (identifying bromide as non-toxic to humans and further stating that because the "[b]romide ion has a low degree of toxicity . . . bromide is not of toxicological concern in nutrition" and may even be "nutritionally beneficial" on some level); EPA, *Environmental Assessment for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, EPA-821-R-13-003, at 3-10 (April 2013) (providing that "bromide is not of toxicological concern to humans").

[15] Kennedy's comments, entitled "Review of Comments to the Proposed NPDES Permit for Public Service of New Hampshire's Merrimack Station" (October 2014), are attached hereto as Exhibit 3.

is nothing to suggest that Merrimack Station's current operations impact this wholly distinct drinking water treatment issue.

5. The ESIGs' Comments on Leachate Discharges Associated with Mixing FGD Waste Water with Fly Ash are Factually Flawed

Further compounding their misunderstanding of how VCE/crystallizer technologies function (and, more importantly, how PSNH's SWWTS operates at Merrimack Station), the ESIGs direct EPA to eliminate any purported circumvention of the erroneous "no discharge" limit the agency has set out in the draft permit by: (1) expressly prohibiting the application of brine concentrate to fly ash destined for a landfill; and (2) setting effluent limits for landfill leachate based on the characteristics of that leachate when the fly ash is not conditioned with brine concentrate. *See* ESIGs 2014 Comments at 10. As justification for this requested action, the ESIGs provide that allowing PSNH to mix brine concentrate from the "first phase" of its SWWTS does not force the company to operate the "second phase" of the SWWTS, which is the crystallizer that, according to the ESIGs, eliminates the brine concentrate and produces only a salt cake and distillate that can be reused in the FGD system. *Id.* The comments and demands of the ESIGs are erroneous for the reasons that follow.[16]

[16] The ESIGs' comments about ash conditioning also are inconsistent with those made by the organizations in response to EPA's draft NELGs, which also were submitted to EPA Region 1 in response to the Merrimack Station draft permit despite having little to no relevance in this permit renewal process. As background, EPA "reject[ed]" mechanical evaporation (i.e. VCE/crystallizer) technologies as BAT for the treatment of FGD waste waters in the draft NELGs "because the total industry cost . . . [was] too high." ESIGs' Comments to NELGs at 24. The ESIGs disagreed with EPA's affordability determination and argued that EPA's industry cost estimates were too high. In doing so, the ESIGs specifically referenced ash conditioning with brine concentrate as a viable alternative to operating the more costly forced-circulation crystallizers for the elimination of brine concentrate. *Id.* at 23.

Ash conditioning is either an acceptable treatment option for FGD waste waters or it is not. The ESIGs cannot argue that ash conditioning is a viable treatment/disposal option in an attempt to lower cost estimates associated with operating the technology and yet, on the other hand, argue that EPA should expressly prohibit the ash conditioning process because it purportedly allows regulated entities to circumvent a "no discharge" limit for FGD waste waters. The ESIGs cannot have it both ways, and their inconsistent positions discredit their overall arguments regarding this treatment technology.

As a threshold matter, PSNH thoroughly explained in its original comments to the latest draft permit that EPA's proposed compliance "scenario" of using "treated FGD waste water for ash conditioning prior to landfilling" is not, in and of itself, a viable compliance option for the elimination of all FGD waste waters due to insufficient quantities of fly-ash at Merrimack Station.[17] *See* PSNH 2014 Comments at 88-90. This fact alone renders the ESIGs' comments and suggested actions regarding fly ash conditioning superfluous and unnecessary.

The ESIGs' comments also depend on facts that are untrue. First, the ESIGs are incorrect that operation of "both phases" of the SWWTS at Merrimack Station results in only a salt cake and a distillate that can be reused in the FGD system. PSNH's SWWTS must also generate a purge stream for reasons the company explained in detail in its original comments to the latest draft permit. *See, e.g.*, PSNH 2014 Comments at 80-88. Running the "second phase" of the SWWTS therefore does not eliminate all FGD waste water, as the ESIGs assert in their comments. The unavoidable purge stream must be disposed of in some manner regardless of the components of the SWWTS utilized at Merrimack Station.

Second, contrary to the ESIGs' belief, PSNH does not mix any waste water that is directly from the brine concentrator with fly ash generated at Merrimack Station. The ESIGs' requested prohibition on the application of waste water from the brine concentrator to fly ash destined for a landfill is therefore irrelevant.

Lastly, the ESIGs erroneously assume that a landfill exists at Merrimack Station within which PSNH disposes of FGD purge-conditioned fly ash. This is not the case. Any discussion of, or request for, regulation of landfill leachate due to ash conditioning in any final renewal permit for Merrimack Station is therefore misplaced.

[17] UWAG submitted similar comments on the viability of this ash conditioning compliance scenario, which PSNH concurs with and supports. *See* UWAG 2014 Comments at 10-11.

The underlying factual errors in the ESIGs' comments on ash conditioning, coupled with PSNH's declaration that fly-ash conditioning is not a viable compliance option due to insufficient quantities of fly-ash at Merrimack Station, necessitate that EPA disregard the ESIGs' comments on this regulatory compliance option.

6. The ESIGs' Attack on EPA's Compliance Scenarios Demonstrates the Necessity of a Permit to Discharge Waste Water to the Merrimack River Following Treatment with the PWWTS

Parts II and III to the ESIGs' comments challenge two of the draft permit's "compliance scenarios"—discharging treated waste water to POTWs (Part II) and mixing treated FGD waste water with fly ash (Part III). Notwithstanding the lack of merit to their comments, the ESIGs' comments demonstrate another reason why EPA's "no discharge" limit BAT determination is unlawful. Permit compliance cannot be made dependent on the actions and permits of third-parties, as illustrated by the ESIGs' attacks on the various "compliance scenarios." *See* PSNH 2014 Comments at 88-96. In effect, the ESIGs seek a zero limit and no means for PSNH to comply with it. This is absurd and demonstrates why PSNH should be allowed to discharge FGD effluent treated by the PWWTS directly to the Merrimack River.

7. The Report of John H. Koon submitted with Conservation Law Foundation's 2012 Comments to EPA's Draft Permit for Merrimack Station is Superficial and of No Value or Relevance

EPA has requested comments on its determination that the evaporative technology implemented at PSNH's Merrimack Station is BAT. EPA has moved beyond water quality standards and discharge loadings to request a discussion on BAT for the treatment of FGD waste waters. Dr. John H. Koon's ("Koon") February 24, 2012 report offers nothing of relevance to that discussion. There is no technology discussion in his report. He has no experience with physical-chemical treatment, biological treatment, brine concentrators, crystallizers, or salt presses, much less any of these individual components utilized in series as a combined system that he has articulated in his report. His report provides no input into the technological discussion of these or alternate technologies competing to best treat PSNH's FGD wastewater. Instead, Koon's report recites publicly available information with no technology-specific analysis. While it relates waste water treatment capital expenditures to project capital expenditures or plant worth, there is no comparison to other technologies as would be expected to determine the best technology. While he has related parasitic load for the wastewater treatment system to the overall station service or nation-wide electrical load, there is no comparison of parasitic load with other technologies as would be expected to determine the best technology. The words "brine concentrator" and "crystallizer" only appear as a quote from a document prepared for PSNH. There are no meaningful comments to his report as it provides no relevant information to comment upon.

Kennedy, PSNH's consultant, responds to and critiques Koon's cursory report.[18] PSNH supports the comments offered by Kennedy.

III. PSNH AGREES WITH UWAG'S COMMENT THAT EPA MUST REVISIT ITS CWA SECTION 316(b) DETERMINATIONS IN LIGHT OF THE NEW FINAL RULE AND REFRAIN FROM ANY BPJ-BASED BTA DETERMINATION DUE TO THE FINAL RULEMAKING

On May 19, 2014, EPA released its final rule on cooling water intake structures ("CWISs") for existing power plants, pursuant to Section 316(b) of the CWA (hereinafter the "316(b) Rule"). The rule was published in the Federal Register on August 15, 2014, and became effective on October 14, 2014. *See* 79 Fed. Reg. 48,300 (Aug. 15, 2014). The issuance of this rule eliminates EPA's ability to issue a final NPDES permit regulating the CWIS at Merrimack Station utilizing the agency's outmoded BPJ regulatory authority. UWAG correctly noted this fact in its August 18, 2014 comments to EPA's latest draft permit. *See* UWAG 2014 Comments

[18] *See* Exhibit 3, at 5-8.

at 33. ("The Merrimack Station draft permit must now be revised to comply with the [316(b) Rule], and the revisions should be made available for comment."). PSNH agrees with UWAG's comments and has retained consultants to evaluate how the requirements of the new rule apply to Merrimack Station and its CWISs, as well as how best to tailor and/or improve upon analytical evaluations the company previously submitted to EPA to conform with the scientific studies required by the 316(b) Rule. EPA is legally obligated to revisit its 316(b) determination in the draft permit for Merrimack Station and must allow the public to review and comment on the revisions to the draft permit mandated by the final 316(b) Rule.

A. Any Attempt by EPA to Finalize a BPJ-Based BTA Determination is Unlawful, Arbitrary, and Capricious in Light of EPA's 316(b) Rule

BPJ-based case-by-case Section 316(b) best technology available ("BTA") determinations are only proper when national regulations have not been set. Because EPA has finalized a national rulemaking, EPA's authority to issue a case-by-case determination for the CWISs at Merrimack Station ceases to exist. *See* 40 C.F.R. § 125.3(c)(2) (providing that the imposition of case-by-case technology-based treatment requirements in NPDES permits is acceptable only if EPA-promulgated effluent limitations developed under section 304 of the CWA are inapplicable). Any attempt by EPA to issue a final permit at this time using its BPJ therefore would be unlawful and would amount to an attempt to impose limits on Merrimack Station that simply will not be required at other facilities in the industry.

The Ninth Circuit has recognized the absurdity of proceeding with establishing BPJ case-specific effluent limits when NELGs are almost complete, much less when final NELGs have been issued. *See Nat. Res. Defense Council, Inc. v. EPA*, 863 F.2d 1420 (9th Cir. 1988) ("*NRDC*"). It was EPA that defended its refusal to utilize its BPJ authority to set effluent limits because national standards for the offshore oil industry would soon be promulgated to set a nationwide, uniform requirement on this issue and EPA did not want to conflict with the forthcoming national effluent limits. *Id.* at 1427. The court agreed with EPA's decision and provided the following apt statement:

> The recent "anti-backsliding" amendment to the Act is designed to prevent "backsliding" from limitations in BPJ permits to less stringent limitations which may be established under the forthcoming national effluent limitation guidelines. . . . If the EPA were to require as BAT the retrofitting of all drilling sources for reinjection of produced water in the Gulf of Mexico, and, the *eventual* national standards were less stringent in any respect, there would be an <u>inconsistency between BAT for Gulf drilling and BAT for the rest of the nation's off-shore drilling. This inconsistency would lack any apparent scientific or equitable basis.</u> If, on the other hand, the eventual national standards embody more stringent standards that this permit requires, this permit can be reopened and its standards made more stringent. Given the large commitment of resources that would be necessary to begin retrofitting, <u>the values of certainty and uniformity inherent in the congressional scheme [of the CWA] take on added significance. There is a justification for some delay in this situation in order to ensure that the produced water limitation in the Gulf conforms with the national standard.</u>

Id. (emphasis added) (internal citation and quotation marks omitted); *see also Delaware Riverkeeper Network v. Delaware*, No. N13M-10-009 DCS, at 6, 9-10 (Del. Sup. Ct. Jan. 2, 2014) (holding that a permit writer was justified in delaying the issuance of a renewed NPDES permit for 11 years due to, *inter alia*, EPA's repeatedly advising that the final 316(b) Rule was forthcoming); 49 Fed. Reg. 37,998, 38,020 (Sept. 26, 1984) (in addressing concerns about EPA's proposed anti-backsliding standard and the expectation that more permits issued based on a permit writer's BPJ would be challenged as a result, EPA provided its policy would be that "if promulgation of a [national effluent limitation] guideline is expected, [it] will generally defer permit issuance rather than issue a BPJ permit").[19]

Guidelines and/or technology standards should be applied equally to all permittees and not penalize or create a competitive disadvantage for regulated entities subjected to case-by-case permit determinations—especially when those case-by-case determinations are unlawfully rendered after a national rule has been promulgated. *See NRDC v. Costle*, 568 F.2d 1369, 1378 (D.C. Cir. 1977) ("the primary purpose of the effluent limitations and guidelines was to provide uniformity" and minimize pressure to "compete for industry and developments"). Requiring installation of closed-cycle cooling technologies at Merrimack Station will forever deprive PSNH the opportunity to pursue the more reasonable compliance options afforded by the new national regulations due to anti-backsliding rules that prevent EPA from changing, renewing, or reissuing an NPDES permit with technology limits that are less strict than the limits in the previous permit. *See* 33 U.S.C. § 1342(o). It is therefore not only proper, rather mandatory, for EPA to abandon its BPJ-based BTA determinations and apply the national standards included in the final 316(b) Rule to the CWISs at Merrimack Station. Otherwise, the BPJ-based permit could lead to the absurd result of forcing PSNH to go through timely, costly, and unnecessary efforts to comply with the case-specific BTA limits that will never be applied to any other source. For these reasons, the determination also deprives PSNH equal protection under the law.

Ultimately, any attempt to issue a final permit for Merrimack Station including BPJ-based BTA requirements would be patently unreasonable and unlawful due to the issuance of the final 316(b) Rule. The CWA obligates EPA to abandon its case-specific BTA determinations for

[19] Notably, this argument applies to FGD waste water effluent guidelines, as well. EPA has issued proposed NELGs for the steam electric power generating category and is obligated to finalize the regulatory rulemaking in or before September 2015.

Merrimack Station's CWISs and formulate new permit conditions in accordance with the final 316(b) Rule.

B. PSNH Must Revise its Scientific Studies to Conform with the Requirements of the Final 316(b) Rule

The new 316(b) Rule offers a number of compliance options and, with limited exceptions, requires a regulated entity to conduct and submit myriad scientific studies to their respective permit writer in order to evaluate permissible impingement and entrainment compliance scenarios. PSNH has submitted numerous 316(b)-related studies to EPA over the years. However, none of its scientific studies include the precise comprehensive analyses now required by the 316(b) Rule. EPA must allow PSNH an opportunity to complete the mandatory studies and compliance evaluations enumerated in the 316(b) Rule before the agency makes a final decision regarding the regulation of CWISs at Merrimack Station. The compliance options and studies required by the 316(b) Rule are described in detail below.

A general overview of the 316(b) Rule is obligatory in order to properly put into context the scope and purpose of the mandatory scientific studies. As background, Section 316(b) of the CWA requires the location, design, construction, and capacity of CWISs to reflect BTA for minimizing adverse environmental impacts, primarily by reducing the amount of fish and shellfish that are impinged or entrained at a CWIS. Because the 316(b) Rule impacts 544 power plants within the United States, including PSNH's Merrimack Station, EPA determined it best to "ensure flexibility" for compliance with the final rule. The agency therefore specifically stopped short of requiring closed-cycle cooling to be implemented nationwide at all existing facilities, citing several reasons including reliability of energy delivery and prohibitive costs for some facilities. Instead, the agency offered regulated entities the following seven options for meeting the BTA requirements for reducing impingement:

- Operate a closed-cycle recirculating system (i.e. cooling tower);
- Operate a CWIS that has a maximum through-screen design intake velocity of 0.5 foot per second (fps);
- Operate a CWIS that has a maximum through-screen intake velocity of 0.5 fps;
- Operate an offshore velocity cap, an open intake designed to change the direction of water withdrawal from vertical to horizontal and located a minimum of 800 feet from the shoreline;
- Operate a modified traveling screen that the EPA determines meets the 316(b) Rule standard and is the BTA for impingement reduction;
- Implement another combination of technologies, management practices and operational measures that the EPA determines is BTA for impingement reduction; or
- Achieve a 12-month impingement mortality performance of 24 percent mortality or less, including latent mortality (18 to 96 hours), for all nonfragile species.

See 40 C.F.R. § 125.94(c). Few, if any, power plants in the United States are expected to elect to operate a closed-cycle recirculating system (Option 1) or adhere to the 12-month impingement mortality performance of 24 percent mortality or less (Option 7) to comply with the impingement mortality requirements of the 316(b) Rule. Options 1, 2 and 4 are preapproved technologies requiring little or no demonstration of flow reduction. Options 3, 5 and 6 require additional information to be submitted to the permitting agency, including an impingement technology performance optimization study that includes two years of at least monthly impingement mortality monitoring, before the technology may be accepted as BTA to control impingement mortality. For compliance alternatives 5 and 6, this additional information includes site-specific impingement studies supported by two years of biological sampling data.

In addition to the seven impingement compliance options, the 316(b) Rule offers a *de minimis* rate of impingement option where facilities can assert that rates of impingement are so low that additional impingement controls are not justified. *See* 40 C.F.R. § 125.94(c)(11). The standard is not precisely defined. Instead, permitting authorities, based on a review of site-specific data provided by the facility, could conclude that the documented rate of impingement at the cooling water intake is so low that no additional controls are warranted. *Id.* Separately, the 316(b) Rule authorizes a facility with a low average annual capacity utilization factor (less than 8 percent averaged over a 24-month period) to obtain less stringent requirements for impingement mortality for its intake structure. *See* 40 C.F.R. § 125.94(c)(12).

Regardless of the chosen compliance option, each regulated facility must complete a battery of analyses as part of the impingement mortality assessment, including the following:

- Source Waterbody Physical Data: Requires a description and scaled drawings showing the physical configuration of the water body, including areal dimensions, depths, and temperature ranges, identification and characterization of the source waterbody's hydrological and geomorphological features, estimates of the intake's area of influence within the waterbody, and locational maps;

- CWIS Data: Requires information on the design of the intake structure and its location in the water column, including design intake flows, daily hours of operation, number of days of the year in operation and seasonal changes, if applicable, a flow distribution and water balance diagram that includes all sources of water to the facility, recirculating flows, and discharges, and engineering drawings of the cooling water intake structure;

- Source Waterbody Baseline Biological Characterization Data: Characterization of the biological community in the vicinity of the CWIS;

- Cooling Water System Data: Information on the operation of the cooling water system, including descriptions of reductions in water withdrawals, recycled water, and proportion of the source waterbody withdrawn;

- Impingement Compliance Method Plan: A description of the chosen compliance method for impingement mortality, including any requests for BTA determinations under the alternative standards for *de minimis* rates of impingement or low capacity utilization power generation units;

- Performance Data: Summary of biological survival studies conducted at the facility and a summary of any conclusions or results, including site-specific studies addressing technology efficacy, entrainment survival, and other impingement and entrainment mortality studies; and

- Operational Status Information: Descriptions of each unit's operating status, including the age of the unit, capacity utilization for the previous five years, and any major upgrades completed within the last 15 years.

See 40 C.F.R. § 122.21(r)(ii)(1)-(8).

The 316(b) Rule does not establish a national BTA entrainment standard. Instead, the permitting agency will determine BTA entrainment requirements for a facility on a case-by-case basis utilizing the following mandatory factors: the numbers and types of organisms entrained, including threatened and endangered species; the impact of changes in particulate emissions or other pollutants; land availability relating to the feasibility of entrainment technology; remaining useful plant life; the quantified and qualitative social benefits and costs of available technologies; entrainment impacts on the source waterbody; and impacts on the reliability of energy delivery within the immediate area. *See* 40 C.F.R. § 125.94(d).

Existing facilities with an actual intake flow ("AIF") of more than 125 million gallons per day ("MGD") of cooling water are required to conduct comprehensive peer-reviewed studies to help determine whether and what site-specific controls, if any, are required to reduce entrainment mortality caused by the operation of CWISs. *See* 40 C.F.R. § 122.21(r)(ii)(9)-(13) The required entrainment studies include the following:

- Entrainment Characterization Study: Requires the regulated entity to develop and submit an entrainment mortality data collection plan; requires that the entrainment mortality data collection plan be peer-reviewed within 1 year; and requires the entrainment mortality data collection plan to be implemented within 6 months after submission of the entrainment mortality data collection plan to the permitting authority;

- Comprehensive Technical Feasibility and Cost Evaluation Study: Requires a description of all technologies and operational measures considered, including documentation of factors that make a technology impractical for further evaluation. The cost evaluation is based on least-cost approaches to implementing each technology while meeting all regulatory and operational requirements of the facility. The study must be peer-reviewed;

- Benefits Valuation Study: Requires a detailed discussion of the magnitude of water quality benefits, both monetized and non-monetized, of the entrainment mortality reduction technologies evaluated in the Comprehensive Technical Feasibility and Cost Study, including incremental changes in the impingement mortality and entrainment mortality of fish and shellfish; and monetization of these changes to the extent appropriate and feasible using the best available scientific, engineering, and economic information. Benefits that cannot be monetized will be quantified where feasible and discussed qualitatively. The study would also include discussion of recent mitigation efforts already completed and how these have affected fish abundance and ecosystem viability in the intake structure's area of influence. Finally, the report would identify other benefits to the environment and the community; and

- Non-water Quality and Other Environmental Impacts Study: Requires a detailed discussion of the changes in non-water quality factors attributed to technologies and/or operational measures considered. These changes could include increases or decreases in the following, as examples, energy consumption, thermal discharges including an estimate of increased facility capacity, operations, and reliability due to relaxed permitting constraints related to thermal discharges; air pollutant emissions and their health and environmental impacts, noise, safety such as the potential for plumes, icing, and availability of emergency cooling water, grid reliability including an estimate of changes to facility capacity, operations, and reliability due to cooling water availability, consumptive water use, and facility reliability. This assessment also must be peer-reviewed.

See id. Facilities with per day AIF of 125 MGD or less are not required to submit any of the aforementioned studies.

As stated above, PSNH has over the years submitted to EPA scientific information, evaluations, and studies pertaining to its CWISs that are of some relevance to the new 316(b) Rule and the evaluations necessary under this regulatory regime. This documentation needs to be updated and adjusted to better address the requirements of the new final rule. PSNH's consultants, Enercon Services, Inc. ("Enercon") and Normandeau Associates, Inc. ("Normandeau"), prepared reports outlining PSNH's potential compliance options under the new rule, along with what information, evaluations, and/or studies PSNH would need to compile or complete and submit to EPA in the foreseeable future to assess potential technological compliance options at Merrimack Station.[20] PSNH supports the reports provided by Enercon and Normandeau.

[20] Normandeau's report is "Attachment 1" to Enercon's report, which is entitled "Assessment of 2007 Response to United States Environmental Protection Agency CWA § 308 Letter, PSNH Merrimack Station Units 1

In their respective reports, Enercon and Normandeau both evaluate existing impingement data for Merrimack Station and conclude that the facility should qualify for the *de minimis* exception due to the documented low rate of impingement, especially compared to the rates of impingement at other existing facilities in the country. As for entrainment, Enercon notes that flow data from 2011 through 2013 demonstrate that current AIF for Merrimack Station is approximately 113.8 MGD, which falls below the 125 MGD threshold triggering the need to carry out peer-reviewed scientific studies, according to the 316(b) Rule. Because flow rates will likely increase in the future at Merrimack Station, however, Enercon preemptively includes in its report an assessment of what information, evaluations, and/or scientific studies, as well as what potential technologies, need to be further evaluated to determine the most effective technological option for reducing entrainment abundance. PSNH intends to submit to EPA the information, evaluations, and/or scientific studies outlined in the Enercon and Normandeau reports as soon as reasonably possible. EPA is legally obligated to consider this documentation to make a BTA determination for the CWISs at Merrimack Station, in accordance with the requirements of the 316(b) Rule. In sum, EPA cannot legally impose requirements on PSNH that equate to in excess of $100 million in costs to implement technologies that are unnecessary and not required of any other source in the country.

IV. EPA SHOULD ALLOW SUPPLEMENTAL COMMENTS ON ITS CWA 316(a) AND 316(b) DETERMINATIONS DUE TO THE PASSAGE OF TIME, NEW EVIDENCE, AND THE AGENCY'S INABILITY TO TIMELY RESPOND TO INFORMATION REQUESTS CRITICAL TO THIS NPDES PERMIT PROCEEDING

Given the length of time that has passed since 2011, PSNH requests the opportunity to submit new information concerning the CWA Section 316(a) and (b) determinations contained in

& 2, Bow, New Hampshire" (October 2014) (contains Confidential Business Information pursuant to 40 C.F.R Part 2). Both reports are attached hereto as Exhibit 4.

the September 30, 2011 permit. PSNH's comments on the 2011 draft permit were the last substantive submission PSNH provided to the agency addressing these issues. Within the past three years, EPA has not requested or accepted any such information from PSNH. The agency also has not communicated with PSNH regarding the status of its 316(a) or (b) determinations in light of comments submitted by interested stakeholders, including PSNH. Given the import and potential substantial consequences of EPA's 316(a) and (b) permit determinations, it is critical that PSNH be allowed to update this information before EPA issues a final permit. Additionally, because any alteration to existing cooling water processes or infrastructure has the potential to affect FGD operations and, correspondingly, the reliability and efficiency of the FGD waste water treatment systems at Merrimack Station, EPA should allow submission of updated comments generally addressing 316(a) and (b) issues. All plant processes are interconnected, as explained in PSNH's August 18, 2014 comments. EPA cannot evaluate technological treatment options for one waste stream in isolation. For all of these reasons, PSNH requests that the comment period be reopened with respect to EPA's 316(a) and (b) determinations, and otherwise reserves the right to submit any new information PSNH has developed since 2011 concerning the determinations in the September 30, 2011 draft permit.

Further, EPA should reopen the administrative record for this permit renewal proceeding with respect to both 316(a) and (b) to the extent EPA intends to rely on any new information to support its September 30, 2011, permit determinations. Since 2011, PSNH has issued Freedom of Information Act ("FOIA") requests to EPA seeking its documentation and support for the standards and limitations in the draft permit issued in 2011 and the revised draft permit. PSNH first issued a FOIA request on October 12, 2011, to which EPA failed to adequately respond. *See* PSNH 2012 Comments at 199-201. More recently, on March 24, 2014, PSNH issued a

FOIA request[21] seeking documents from the prior two years concerning the draft permit and communications and work papers of EPA officials involved in this proceeding. EPA advised in July 2014 that it was unable to complete its response to this latest FOIA request until October 17, 2014, only a week before completion of this comment period. Last week, EPA delayed its deadline again to October 22nd, and produced an additional 626 records on October 17th. PSNH has not had an adequate opportunity to consider this information. Moreover, some of the information produced in response to PSNH's March 24, 2014, FOIA request to date appears to be related to 316(a) and (b) issues, although it is impossible to know for sure whether it has any relevance to this permit proceeding. EPA must allow PSNH and the public an opportunity to comment on EPA's prior 316(a) and 316(b) permit determinations to the extent EPA intends to base them on any new information developed since 2011.

V. CONCLUSION

The current draft permit is unrealistic and unachievable. EPA must reconsider its determination in the revised draft permit that the SWWTS at Merrimack Station is BAT and its erroneous conclusion that this SWWTS can achieve a ZLD limit. It is not based on sound science, ignores technological realities and limitations, and lacks a defensible cost analysis. No comments from other stakeholders alter this conclusion originally set out in PSNH's August 14, 2014 comments to the draft permit.

EPA must also reassess its preliminary Section 316 determinations due to changed circumstances and new scientific information. Since 2011, PSNH has collected new information pertaining to the balanced indigenous population within the Hooksett Pool that EPA has a duty to consider prior to issuing any final 316(a) thermal discharge determination for Merrimack Station.

[21] See PSNH's March 24, 2014 FOIA request, available at https://foiaonline.regulations.gov/foia/action/public/view/request?objectId=090004d2802099d5.

Distinctly, the new 316(b) Rule significantly impacts EPA's ability to render a BPJ-based BTA determination for Merrimack Station's CWISs and requires the agency to modify its technological conclusions to conform to the tenets of the final rulemaking. PSNH intends to submit information, evaluations, and scientific studies to EPA as soon as possible to inform the agency's Section 316 technological decision-making. PSNH respectfully requests that EPA delay issuing any final permit for Merrimack Station until the agency evaluates this new information.

Exhibit 1

Redacted

CONFIDENTIAL BUSINESS INFORMATION

Exhibit 2

RESPONSE COMMENTS TO

August 18, 2014 Letter from
Conservation Law Foundation / Earthjustice / Environmental Integrity Project /
Sierra Club to USEPA Region 1

Re: Revised Draft Permit for Merrimack Station
NPDES Permit No. NH0001465

Ronald A. Breton, P.E.

October 2014

GZA GeoEnvironmental, Inc.
5 Commerce Park North, Suite 201
Bedford, New Hampshire 03110-6984

RESPONSE COMMENTS TO
August 18, 2014 Letter from
Conservation Law Foundation/Earthjustice/Environmental Integrity Project/Sierra Club
to USEPA Region 1
Re: Revised Draft Permit for Merrimack Station, NPDES Permit No. NH0001465

RESPONSES PERTAIN TO YELLOW HIGHLIGHTED TEXT

Page 7, First Paragraph

II. **EPA SHOULD USE ITS AUTHORITY TO PREVENT NEGATIVE WATER QUALITY IMPACTS FROM MERRIMACK DISCHARGING ITS FGD WASTEWATER TO POTWS THAT ARE NOT EQUIPPED TO HANDLE SUCH WASTEWATER.**

> EPA's fact sheet states that PSNH could circumvent a zero-liquid discharge standard for its FGD wastewater by not operating the VCE and crystallizer system but instead sending the FGD wastewater to a local publicly owned treatment works. Fact Sheet at 49. PSNH itself acknowledges that POTWs are not designed to remove the toxic pollutants present in FGD wastewater from Merrimack, such as mercury and selenium. 2011 Draft Permit, Attachment E at 14. Moreover, EPA notes that a number of toxic pollutants, including persistent, bioaccumulative toxins, are present in FGD wastewater and will not be treated effectively in a POTW. Fact Sheet at 49 ("It is unclear whether these pollutants receive any treatment at the POTWs. These constituents are generally expected to pass through a typical municipal sewage treatment plant."). EPA has proposed to address this regulatory gap in the proposed ELG rule, but in the meantime there are currently no pretreatment standards for many of the pollutants present in the FGD wastewater from Merrimack. *See* 78 Fed. Reg. at 34,477 (noting that "all of the pollutants proposed for regulation under BAT/NSPS pass through," including arsenic, mercury, and selenium).

Merrimack Station's treated FGD wastewater contains concentrations of certain pollutants of concern (POCs) (e.g., arsenic, mercury, and selenium) at levels in the parts per billion and parts per trillion range. These levels are one and two orders of magnitude less than typical concentrations of pollutants common to treated wastewater from significant industrials users (SIUs), such as metal finishers, medical laboratories, hospitals, textiles, electronics, industrial launderers, etc. POTWs have the ability to remove a variety of pollutants including non-conservative (e.g., BOD, TSS, oil & grease) and conservative (e.g., metals) pollutants. Common biological and physical processes employed by POTWs have the ability to remove most pollutants, in particular arsenic, mercury, and selenium. Based on published removal rates (EPA Guidance for Local Limits Development Document – July 2004), removal rates for these three metals typically range from 45% to 60% in POTWs. Biological treatment processes tend to assimilate metals in the biomass and/or convert dissolved metals to insoluble chemical forms that are subsequently removed through physical gravity settling processes inherent to all municipal treatment facilities.

These removal capabilities represent one critical input in a POTW's approach to determining the Maximum Allowable Headworks Loading (MAHL) for its particular treatment process. It is a fundamentally and universally accepted fact that all POTWs remove a significant percentage of pollutants contributed by non-domestic sources. In particular, all toxic metals of concern are removed generally in a range of 30% to 70% at POTWs.

In October 2010, PSNH provided comments to EPA setting out a BAT analysis for the treatment of FGD wastewaters at Merrimack Station. A comment suggesting that publicly owned treatment works (POTWs) are not designed to remove toxic pollutants present in FGD wastewater from Merrimack Station was included in the record. This assertion was included to highlight the fact that the primary wastewater treatment system designed specifically for the treatment of FGD wastewaters would achieve better pollutant removals than POTWs. POTWs do provide incremental removal of already very low levels of metals. Merrimack Station's primary treatment system provides a higher removal rate of pollutants, but PSNH acknowledges that additional treatment is provided through the POTW treatment process despite the fact that the effluent from the primary wastewater treatment system already complies with water quality standards in the Merrimack River at Merrimack Station.

<u>Page 8, First Paragraph</u>

> To prevent Merrimack Station from sending FGD wastewater to POTWs that cannot treat the toxic pollutants in the FGD wastewater, EPA should take actions regarding both Merrimack Station's NPDES permit and the POTWs' NPDES permits. EPA should include a clause in the final Merrimack Station NPDES permit providing that EPA will reopen the permit to include the new pretreatment standards for FGD wastewater established by the forthcoming ELG rule. EPA should then reopen and revise Merrimack Station's NPDES permit as soon as the new pretreatment standards for FGD wastewater are finalized. In addition, EPA should require PSNH to submit to EPA Region 1 a report at the end of each month providing detailed information on any FGD wastewater sent to a POTW for treatment, including the name and location of the receiving POTW, the amount and pollutant characteristics of the wastewater, and such other information as is necessary.

Action on the part of EPA, such as amending the NPDES permits of Merrimack Station and/or the various POTWs, to prevent treated FGD wastewater from being managed at local POTWs is unwarranted and would lead to further incongruent standards for the steam electric generating industry compared to other industrial dischargers. The concentrations and mass of POCs in Merrimack Station's treated FGD wastewater are extremely miniscule and insignificant. A comparison of wastewaters received from other typical, non-domestic and domestic sources further illustrates this fact. For example, the average concentration of common metals in domestic septage is similar or greater than treated FGD wastewater generated at Merrimack Station. The average concentration of arsenic is typically in the range of 0.17 mg/l in septage[1] compared to values typically below 0.03 mg/l in treated FGD wastewater. Considering the removal efficiencies typically achieved at POTWs, the resulting mass of pollutants in the POTW's effluent attributable to Merrimack Station's treated discharge is insignificant.

[1] Septage data from Allenstown NH POTW (9/24/13) provided by NHDES

The following sections address and disprove the purported "actions" the Environmental Organizations assert EPA should carry out to further regulate PSNH's FGD waste stream.

Page 8, Second Paragraph

> In addition, EPA should also take actions relating to the POTWs' NPDES permits to address this problem. First, EPA should determine whether the POTWs receiving FGD wastewater from the Merrimack Station are violating their NPDES permits by doing so (and should immediately inform the POTW operators of its intent to undertake this determination). Between 2012 and 2014, Merrimack Station sent FGD wastewater to 5 POTWs: S. Portland, Attleboro, Lowell, Hooksett, and Franklin. Fact Sheet at 24-25. As the table below indicates, it is our understanding that EPA Region 1 is the permitting authority for all of these facilities except the S. Portland POTW.[7]
>
> **Table 1. POTWs that Receive FGD Wastewater from Merrimack Station and Have NPDES Permits Issued by EPA Region 1**

POTW	NPDES Permit Date	Permit Number	Expired?
Attleboro	6/9/2008	MA0100595	Yes
Franklin	6/19/2009	NH0100960	Yes
Hooksett	8/5/2013	NH0100129	No
Lowell	9/1/2005	MA0100633	Yes

> As the agency that issued the NPDES permits for these facilities, EPA should determine whether receiving Merrimack Station's FGD wastewater results in a violation of any permit terms, such as terms prohibiting the pass through of pollutants[8] and/or prohibitions on the discharge of toxic amounts of pollutants or toxic components that will result in demonstrable harm to aquatic life.[9] EPA should also investigate whether the POTWs are complying with any reporting requirements that may be triggered by the receipt of FGD wastewater from Merrimack Station, such as requirements to inform EPA Region 1 when new pollutants are introduced from an indirect discharger or when there is a substantial change in the pollutants introduced to the POTW.[10]

Contrary to the tone of, and requests for action within, the Environmental Organizations' comments, PSNH did not carelessly decide to transport FGD wastewater to POTWs, nor did the POTWs unsystematically accept the wastewater from Merrimack Station. Instead, PSNH and the various POTWs accepting FGD wastewater from Merrimack Station collaborated extensively to determine the best and most reasonable concept of transporting and managing treated FGD wastewater to ensure that no environmental criteria was being or would be exceeded. This analysis specifically included evaluations to verify that pass-through, inhibition, and/or interference violations would not likely occur. There is no legitimate challenge that can be advanced with respect to this issue.

It is not customary, nor is it necessary, for EPA to determine whether POTWs receiving treated FGD wastewater are violating their permits. NPDES permits issued by POTWs include a general condition that requires POTWs to determine what types and quantities of pollutants they can accept without causing environmental impact (i.e., pass-through, inhibition, and interference). POTWs with SIUs are required to develop scientifically-derived and legally-defensive local limits using EPA-approved protocols (i.e., modeling pollutant impacts to a variety of performance, sludge management, and pass-through criteria). The fundamental principle associated with this approach dictates that the local limits derived from this process ensure that the POTW's discharge has no significant impact on the environment. The process for establishing local limits is described with greater specificity in the next section.

Page 9, First Paragraph

Second, if EPA concludes that the current NPDES permits for these POTWs do not include terms that adequately address the receipt and discharge of FGD wastewater, then EPA Region 1 should modify the permits for these 4 POTWs and include new permit conditions to prohibit or adequately treat FGD wastewater from Merrimack Station. 40 C.F.R. § 122.63(a)(2) authorizes EPA to modify a NPDES permit under the following circumstances:

No such action on the part of EPA is necessary. All NPDES permits (individual and general) issued to the POTWs contain conditions that ensure that each POTW evaluate its ability to control all sources of wastewater contributed to their system. There is a prescribed and uniform methodology for POTWs to follow to determine the need and extent of controls for non-domestic (i.e., industrial) wastewater sources. The approach involves the development of an Industrial Pretreatment Program, including local limits. The permits issued to POTWs do not include specific terms that address the receipt of certain non-domestic wastewater sources. Rather, the NPDES permits mandate that the POTW assess their ability to accept non-domestic wastewater based on a prescribed methodology, as generally described below:

- EPA recommends that POTWs base their local limits on the maximum allowable headworks loading (MAHL)[2] calculated for each POC. A pollutant's MAHL is determined by first calculating its allowable headworks loading (AHL)[3] for each environmental criterion; the most stringent AHL would be the MAHL.

[2] A MAHL is the estimated maximum loading of a pollutant that can be received at a POTW's headworks without causing pass through or interference. It is the most protective (lowest) of AHLs (see definition) estimated for an individual pollutant.

[3] An AHL is the estimated maximum loading of a pollutant that can be received at a POTW's headworks that should not cause a POTW to violate a particular treatment plant or environmental criterion. AHLs are developed to prevent interference or pass through.

- The MAHL approach enables POTWs to calculate local limits taking into account the portion of the MAHL that is readily controllable (i.e., from industrial users (IUs)) and the portion that is not as easy to control (i.e., from domestic sources and background concentrations). The maximum allowable industrial loading (MAIL) is the portion of the MAHL available to IUs. It is based on sampling data from the collection system and at the POTW. Local limits are based on the allocation of MAILs as uniform concentrations that apply to all IUs, as mass allocations provided individually to each IU, or some combination of the two options.

- Calculating MAHLs is not the appropriate method to evaluate all pollutants. Pollutants may create collection system conditions that can be harmful to workers such as fires, explosions, corrosion, flow obstructions, high temperature, and toxic fumes. To address these issues, EPA recommends that POTWs consider various options. Developing and implementing local limits with the MAHL approach requires the following five basic steps:

    1. Determine the POCs[4]
    2. Collect and analyze data
    3. Calculate MAHLs for each POC
    4. Designate and implement the local limits
    5. Address collection system concerns

It is evident from some comments that there is a poor understanding of the Industrial Pretreatment Program mechanics. The local limits established by the POTW based on system-specific criteria apply to all discharges. That is, separate local limits cannot be established for individual users.

The POTWs that have evaluated the acceptance of treated FGD wastewater have completed analysis that demonstrates compliance with all environmental criteria including protection of water quality standards.

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[4] A POC is any pollutant that might reasonably be expected to be discharged to the POTW in sufficient amounts to pass through or interfere with the works, contaminate its sludge, cause problems in its collection system, or jeopardize its workers.

Page 9, Third Paragraph

> The NPDES permits for the Attleboro, Franklin, and Lowell POTWs were issued prior to 2012, when the Merrimack scrubber came online and began generating scrubber wastewater, and when Merrimack began sending this wastewater to POTWs. All of the information in the record regarding shipments of FGD wastewater from Merrimack to these 3 POTWs constitutes information "not available at the time of permit issuance," 40 C.F.R. § 122.63(a)(2), since the POTW permits were issued before the scrubber wastewater was generated and shipped to the POTWs. Additionally, EPA states in the Fact Sheet that it believes that limits may be needed because the POTWs are not designed to adequately treat the toxic metals in the FGD wastewater, and thus the information "would have justified the application of different permit conditions," *id.*, namely, limits on receiving FGD wastewater.

Treated FGD wastewater from Merrimack Station contains extremely low levels of POCs, specifically arsenic, mercury, and selenium. Typical industrial users contribute POCs in the milligram per liter (parts per million) range while treated Merrimack Station FGD wastewater typically exhibits pollutants in the microgram per liter (parts per billion) and nanograms per liter (parts per trillion) range. POCs at these concentrations and associated low masses (pounds per day) contribute insignificantly to the MAIL of a typical POTW.

For example, Merrimack Station has an agreement in place with the Lowell Regional Wastewater Utility (LRWWU) to accept treated FGD wastewater. Working cooperatively with LRWWU, PSNH determined (i.e., self-certified) that the POCs in its hauled waste stream did include arsenic and mercury.[5] Lowell conducts extensive monitoring to determine all of its POCs and its ability to accept the maximum quantities of these pollutants on a daily basis. These monitoring data are then input into a model that calculates MAHLs and MAILs. Subtracting out the "uncontrolled" domestic contribution, it results in an allowable loading rate for all other non-domestic wastewater source. To illustrate the relatively low levels of POCs contributed by PSNH's treated waste stream, contributions to the LRWWU of hauled waste from Merrimack Station was generally less than 1% of capacity for arsenic and mercury. Specifically, arsenic and mercury have been less than 0.6% and 0.08% of the MAIL, respectively, as conservatively calculated for these two POCs. Merrimack Station's impact to the LRWWU is insignificant with respect to the facility's capacity and ability to manage treated FGD wastewater and ensure that pass-through, inhibition, and interference does not occur.

Persons knowledgeable with the Industrial Pretreatment Program process recognize that introducing a different waste stream does not constitute "new knowledge," but simply requires a revised assessment to determine impacts (if any) to the system and to determine if revised local

[5] Selenium is not a POC in the LRWWU wastewater system because selenium is not introduced to the Lowell POTW in a mass quantity (or concentration) that meets the criteria of a POC. Selenium is typically measured at below detection limits at various points at the POTW including the headworks. Receipt of FGD wastewaters from Merrimack Station has not impacted this reality.

limits are necessary. To complete this assessment, Lowell has established a comprehensive internal monitoring program that has produced a representative and statistically valid database that determines the significance or insignificance of industrial wastewater contributions. In the case of Merrimack Station and its FGD wastewater, impacts to POTW operations and local limits were determined to be negligible.

Page 9, Fourth Paragraph

> Third, EPA should insist that each POTW that has received FGD wastewater from Merrimack Station revise its local pretreatment standards to prohibit Merrimack Station from sending FGD wastewater to the POTW. POTWs must adopt local pretreatment requirements to address local conditions and submit the plan for approval by the relevant permitting authority. *See* 40 C.F.R. § 403.8. The POTW is required to issue a permit, or the equivalent of a permit, to each industrial source discharging to the POTW. EPA should follow through on its suggestion, Fact Sheet at 49, of using local pretreatment standards to address the indirect discharge of FGD wastewater, which contains dangerous toxic pollutants that cannot be adequately treated by POTWs. As noted above, EPA has already found, in the proposed ELG rule, that toxic pollutants in FGD wastewater (including arsenic, mercury, and selenium) pass through POTWs in the absence of effective pretreatment, *see* 78 Fed. Reg. at 34,477, and EPA must not allow POTWs to continue to discharge Merrimack's FGD wastewater without adequate treatment or in a manner that causes or contributes to a violation of state water quality standards. EPA should make it clear in the Fact Sheet for this permitting action that the measures relating to POTWs

Based upon the determinations and analyses described above, there is definitely no legal requirement, nor is there any material reason, for any POTW to revise its Industrial Pretreatment Program to accommodate treated industrial wastewater from Merrimack Station, or for that matter, from another IU. As requested by the Environmental Organizations, and in accordance with applicable regulations and the requirements of their respective NPDES permits, each POTW has already: (1) established any local limits necessary for POCs; (2) issued a permit (or equivalent) to Merrimack Station after evaluating its proposed FGD waste stream; and (3) determined the quality of the treated wastewater from Merrimack Station to be in full compliance with all applicable rules and regulations.

From 40 CFR 403.03, "(T)he term *Pass Through* means a Discharge which exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of a violation of any requirement of the POTW's NPDES permit (including an increase in the magnitude or duration of a violation)." Analyses performed by the POTWs demonstrate that the concentrations and mass of pollutants in treated FGD wastewater will not result in pass through where permits have been issued referencing EPA's definition and standard practices.

Page 10, First Paragraph

> Finally, EPA should urge the State of Maine to take similar actions regarding the S. Portland POTW, namely: investigate whether receiving FGD wastewater from Merrimack Station violated any terms of the existing NPDES permit; revise the NPDES permit to include permit terms to prohibit receiving FGD wastewater if such terms do not exist in the current permit; require the S. Portland POTW to revise its local pretreatment standards, and include such revised conditions in any permit or similar document that the POTW has issued to PSNH. EPA should also ensure that Maine, and other states in New England, take these actions regarding any POTWs that receive FGD wastewater from Merrimack Station in the future.

Similar to the State of New Hampshire and Commonwealth of Massachusetts, EPA and the State of Maine likely see no reasonable basis for deviating from EPA's established guidance regarding the development of an Industrial Pretreatment Program and Local Limits for the reasons stated herein. As explained above, the agency's guidance and regulations already require POTWs to evaluate their ability to control all sources of wastewater contributed to their system through the calculation and utilization of MAHLs and MAILs. The actions proposed by the Environmental Organizations are superfluous.

Exhibit 3

Review of Comments to the Proposed NPDES Permit

for

Public Service of New Hampshire's

Merrimack Station

William Kennedy, P.E.

October 2014

Orion Engineering PLLC

10716 Carmel Commons Blvd., Suite 140
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On April 18th, 2014, Region I of the United States Environmental Protections Agency (EPA) issued a revised draft National Pollution Discharge Elimination System (NPDES) permit for Public Service of New Hampshire's (PSNH) Merrimack Station. This revision follows the initial draft released on September 30th, 2011. Comments to the revised and original draft were entered into the record by various groups. The following is a discussion of selected comments as titled on the EPA Region 1 website (www.epa.gov/region1/npdes/merrimackstation/).

Merrimack NPDES Comments, August 18, 2014

These comments were submitted on behalf of the Conservation Law Foundation, Earthjustice, Environmental Integrity Project and Sierra Club.

Page 1, paragraph 1, states, "The record reflects that Public Service of New Hampshire ("PSNH") has operated a vapor compression and evaporation ("VCE") and crystallizer system since 2012 that can eliminate the discharge of flue gas desulfurization ("FGD" or "scrubber") wastewater." This is an inaccurate statement in so much as the elimination of a discharge stream has not been demonstrated by PSNH, or for that matter any other VCE/crystallizer system in FGD wastewater treatment service. Aquatech's system operating manual specifically identifies the need to periodically purge the Crystallizer Concentrate Tank to remove highly soluble salts that cycle up in concentration within the system. The documented periodic shipment of purge to local POTW's is indicative that elimination has not been demonstrated. Further, the expectation of a zero discharge from the FGD wastewater treatment system is counter to the design intent of the system, which has little to no redundancy of equipment and unit operations to maintain treatment system and generating station reliability.

Paragraph 1 further states, "Based on PSNH's installation and successful operation of the VCE and crystallizer system, EPA properly concluded that eliminating the discharge of Merrimack's FGD wastewater is technologically and economically achievable." This too is an inaccurate statement. As explained above, the elimination of FGD wastewater at Merrimack Station is not possible and therefore cannot be technologically achievable. Further, Region 1 did not meet its obligation to do a comprehensive economic evaluation of cost per toxic weighted pollutant equivalent (TWPE) removed. Casting aside the Region's erroneous approach that since the system was installed there was no added cost, EPA failed to consider the cost of redundant operations required for system reliability. In addition, had EPA accurately evaluated the capital and operations cost per TWPE removed, it would have shown that they far exceed any prior treatment cost in 1981 dollars for any industry.

In the section titled, "Factual Background," (page 2) there are several errors. Region 1 did not "issue" a permit in 2011. A draft was released for comment. Had an NPDES permit actually been issued in the many years since the expiration of the 1992 permit, PSNH would have been in a position to apply for a permit modification and have not been forced into the position to install the VCE system. Further, the Region did not appropriately consider the industry wide applicability of VCE, nor evaluate the cost effectiveness of the technology based on TWPE removed.

References and considerations of a proposed rule, i.e. the Steam Electric Power Generating effluent guidelines and standards (40 CFR Part 423), 78 Fed. Reg. 34,432 (June 7, 2013)(SEEG), is not reasonable as the anticipated rule has yet to be promulgated, consideration and response to comments are still on going and agency internal reviews are still underway. In so much as the proposed SEEG presented a multitude of BAT options under review, it is disingenuous to reference a single section of one option. The 1982 SEEGs continue to be in force until such time as they have been properly revised.

In so much as VCE/crystallization has not been demonstrated, at Merrimack Station or elsewhere, to achieve a zero liquid discharge in FGD service over a reasonable operational period, the inclusion of this technology in a BPJ determination of BAT is far from reasonable. Had PSNH demonstrated "successful operation of a zero-liquid discharge system" the discharge of a purge stream to POTWs would not be necessary. This is obviously in contradiction of empirical data. While PSNH has indeed been successful in operating and tuning the VCE/crystallizer system to reduce the volume of discharge, as designed, "no discharge" operations have not been demonstrated. The use of the term "ZLD" is problematic and confusing in the context of a BAT discussion, as it is not a technology.

Page 5, paragraph 3, makes reference to a VCE installation at Duke Energy's Roxboro Station. There is no installation underway or current plan to proceed with a VCE system in FGD wastewater treatment service at Roxboro Station.

Page 6, paragraph 1, refers to PSNH and Burns & McDonnell's commendable efforts to adjust and tune the VCE/crystallizer system to optimize performance. While it is agreed that this optimization has taken place and continues, the goal is to improve reliability and further reduce the required rate of purge from the system. In no way has a zero, meaning no, liquid discharge been demonstrated over a reasonable operational period.

Page 7, paragraph 3, mentions that there are municipal drinking water intakes downstream of the facility. The proposed concentration based limits of the constituents of concern identified in the 2011 draft permit for the FGD wastewater stream, without accounting for any assimilation or attenuation by the receiving body, are well below drink water standards.

Page 12, paragraph 1, also discusses the impact of bromide on THM formation. There are no surface water limits specific to bromide. The variables influencing THM formation, which are well documented in the literature, are:

1. Water temperature;
2. System residence time;
3. Chlorine dosing used to maintain minimum system sanitizer concentrations;
4. Total Organic Carbon (TOC) concentrations;

To a lesser degree, the availability of bromides in the source water and exposure to sunlight/UV radiation are seen to impact THM formation. EPA identified over chlorination of TOC laden waters by municipal drinking water systems as a concern for THM formation in the 1970's, long before the introduction of wet FGD scrubbers. In later rule makings on THMs in drinking water, EPA identified smaller municipalities as being challenged to meet the ever more stringent requirements of THM reduction. Bromides in the source water contribute to increased THM concentrations in systems that are already challenged primarily due to bromoform having nearly twice the molecular weight of chloroform. THMs are regulated on a mass based concentration rather than on a molar basis. Be that as it may, the presence of bromide in the source water, is not a root cause for municipalities being challenge with the recent changes in THM limits in drinking water. Many municipalities when challenged with high TOC concentrations in the source water and low capacity factors, resulting in extended system residence times, have followed EPA's recommendation, going back nearly 40 years, to discontinue the use of chlorine as a residual disinfection agent in drinking water.

<u>CLF Comments on NPDES Permit NH0001465; Exhibit 02, 24 February 2012</u>

These comments were submitted on behalf of the Conservation Law Foundation by J. Koon. It appears that the author has no direct experience and little more than a cursory knowledge-base grounded in a patchwork of limited publically available information that ignore the details and complexities associated with the FGD water matrix and the application of VCE technology to the same in a power plant setting.

There are several conclusions, summarized on page 1 of the report, that need to be challenged.

1. TWPE reduction is not the factor used in BPJ-BAT determination, but rather the cost per TWPE. EPA has never determined a technology for any industry to be cost effective that had a cost greater than $404 per TWPE removed.
2. While VCE is an available technology for certain, limited power plant applications, it has not been successfully utilized in FGD service to achieve a reliable zero liquid discharge.
3. A comparison of the cost of treatment to site operating revenue is not germane as the economically reasonable evaluation benchmark is cost per TWPE removed. From an accounting perspective, costs, as they relate to affordability, are typically compared to net income rather than gross operating revenue.
4. Since 1982, and certainly since 2005, EPA has been unable to determine what in fact is BAT for FGD wastewater treatment. Over these many years, EPA has offered up several alternatives for consideration, but has yet to propose a BAT that has met EPA internal review criteria.

5. The evaluation of adverse implications does not include the lack of redundancy of the system design. The system design intent was for volume reduction rather than zero discharge.
6. The evaluation of parasitic load as being "very small" is not quantified. Further discussion of parasitic load as a percentage of generation is not germane. The impact of parasitic load should be evaluated on a basis of cost of energy and the impact of additional fuel requirements.
7. The evaluation of air emissions and solid waste generation is not quantified. A comparison of VCE solids generation to weight of ash and gypsum is not relevant. Land fill space is based on volume not mass. Ash and gypsum have potential beneficial uses.
8. The design of the VCE system was based on the concept of volume reduction, without being a requisite operation for generation reliability. The design does not include the redundancy of equipment and unit operations necessary to achieve consistent, reliable zero discharge operations, assuming that operation without a minor purge stream can even be demonstrated.
9. The sampling and monitoring limits proposed by the author indicate a lack of background and familiarity with the FGD water matrix and EPA's study efforts over the past several years. The October 2009, Steam Electric Power Generating Point Source Category: Final Detailed Study Report (EPA 821-R-09-008) ("Study Report") clearly shows in Tables 4-8 through 4-10, that reduction of specific characteristics of the water, i.e. TSS, arsenic, mercury and selenium, are effective surrogates for any number of additional constituents. Yttrium for example, which the author included in the lengthy list of proposed analytes, was eventually removed from EPA's study list when it was shown that there did not exist a reasonable expectation that the element would be found in detectable concentrations in the water matrix. EPA's *Technical Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (2013 TDD), EPA-821-R-13-002, EPA-HQ-OW-2009-0819-2257 (April 2013) discusses the use of surrogate constituents, and how sufficient reduction of one constituent indicates a reduction of another using the treatment systems under review.

The comparison of systems related to TWPE reduction is flawed. It does not exclusively use site specific values, but rather industry average concentrations to determine TWPE removal for a given flow rate. This is certainly contrary to a site specific BPJ determination. The removal for physical/chemical plus biological is not representative of optimized operation of a physical/chemical treatment system as detailed in Figure 4-6 of EPA's Study Report   The calculation also does not take into consideration the advanced design and operation of the Merrimack physical/chemical treatment system which includes soda ash softening, elevated pH precipitation of boron along with a host of additional metals and the enhanced mercury arsenic removal system (EMARS).

Section 4-2 of Koon's report discusses the availability of VCE technology. The history of VCE usage within the power industry for other applications is not relevant as the chemistry and operational issues are very different than that of FGD waters. The operational experience of the Italian VCE sites in FGD service is dated. Those systems do not operated continuously in a zero discharge configuration and do have reliability issue with fouling of the heat exchange surfaces.

Table-3 of Koon's report lists Capital Cost of various installations. These appear to be equipment costs rather than the more appropriate values of total installed cost (TIC). Industry experience and EPRI's FGD WWTS costing model show TIC to typically be three to five times equipment cost.

The energy impacts of operating a VCE system in FGD service failed to note energy consumption per volume of water treated, i.e. MW per 1000 gallons of water. This energy and its related cost is a significant fraction of the station's net operating margin. Coal fired stations operate in a manner to maximize net electric generation per thermal unit of fuel consumed. Fractional improvements in this ratio are key factors in maintaining operational viability and a competitive advantage in the market. Koon's attempt to marginalize any energy impacts associated with operating a VCE system are therefore improper.

Koon's discussion of the disposal of solid wastes from a treatment system references Wylie 2008. This paper specifically discusses solids generated from an FGD waste water solids removal system, which are primarily gypsum fines. Nowhere in the Wylie paper is the characterization of solids resulting from a VCE operation presented or discussed.

It is of interesting note that the Koon references Jacobs 2011a pg 67, for the proposition that a reduced discharge, i.e., zero to five gpm, is expected and then argues that BAT, thus configured, should be VCE. This somewhat describes the system installed by PSNH.

In Section 5 of Koon's report, periodic monitoring of untreated FGD wastewater is discussed. It is suggested that this monitoring of an in-process stream be included in the NPDES permit. Such monitoring is outside the purview of the permitting authority, as are arguably the setting of limits at internal outfalls. *See Iowa League of Cities v. EPA*, 711 F.3d 844, 877–88 (8th Cir. 2013) (citing *Am. Iron & Steel Ins. v. EPA*, 115 F.3d 979, 996 (D.C. Cir. 1997)) (both holding that EPA lacks statutory authority to set internal limits, as distinguished from limits at the point of discharge to "waters of the United States").

The proposed discharge limits are indicative a lack of familiarity of how NPDES permits are written, the sampling techniques, and analytical methods required to obtain reliable data. The following points are representative of this fundamental lack of understanding:

1. If there is a zero discharge then there are no limits.
2. BPT for pH is 6-9 not 7-9.
3. Composite sampling is not used for low level mercury.
4. VOC's would not be in the FGD matrix.
5. EPA has acknowledged, June 2010 Hanlon memo, that published methods, as written, may not be sufficiently sensitive to accurately and consistently measure low level metals in the FGD matrix.

Conclusion:

The term Zero Liquid Discharge has been inappropriately used to describe the vapor compression evaporation and crystallization system installed at Merrimack Station. The installed VCE system is designed to reduce the volume of treated water generated by the enhanced physical chemical treatment system. It is this same enhanced physical chemical treatment that should be considered as BAT, based on the available analytical data, the degree of TWPE removal, and the fact that FGD wastewater is currently classified as a low volume waste.

Exhibit 4

Redacted

CONFIDENTIAL BUSINESS INFORMATION

THIS DOCUMENT CONTAINS PROPRIETARY, COMPANY CONFIDENTIAL INFORMATION SUBJECT TO BUSINESS CONFIDENTIALITY CLAIM UNDER 40 C.F.R. PART 2 AND COMPARABLE STATE LAW

ASSESSMENT OF 2007 RESPONSE TO UNITED STATES ENVIRONMENTAL PROTECTION AGENCY CWA § 308 LETTER

PSNH MERRIMACK STATION UNITS 1 & 2
BOW, NEW HAMPSHIRE

Prepared for
Public Service Company of New Hampshire

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October 2014

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LIST OF ATTACHMENTS

1 Introduction

1.1 Background

Public Service Company of New Hampshire's (PSNH's) Merrimack Station electrical generating facility in Bow, New Hampshire is seeking a renewal of its existing National Pollutant Discharge Elimination System (NPDES) permit. To this end, an engineering and biological assessment was prepared by Enercon Services, Inc. (ENERCON) and Normandeau Associates, Inc. (Normandeau) and submitted by PSNH to the United States Environmental Protection Agency (EPA) in November 2007 ("2007 Response") that responded to EPA's request for certain technology and fisheries information to support development of the new permit for Merrimack Station.

Following a meeting with PSNH, Normandeau, and ENERCON regarding the 2007 Response in December 2008, EPA requested that PSNH further evaluate several technologies in more detail, and submit a supplement to the 2007 Response. The 2009 Supplemental Alternative Technology Evaluation ("2009 Report") presented this additional information to EPA. Technologies evaluated included wedgewire screens, aquatic filter barriers, fine mesh traveling screens, and upgraded fish handling and return systems (FHRSs).

Subsequent to this, EPA submitted a request for information which in some cases explained items in previous EPA requests, and in other cases requested additional information not previously requested to ensure items were presented clearly. In addition, EPA requested information regarding certain assumptions and/or calculations that were used as the basis for the information provided in the 2007 Response.

The information requested was submitted by PSNH to EPA in January 2010. ENERCON created a report that individually reviewed each information request, provided clarification of the information provided in the 2007 Response, and, where necessary, conducted new analysis to respond to EPA's information request. After receiving this information, EPA issued a draft NPDES permit for Merrimack Station in September 2011. During the comment period for the draft permit, PSNH provided comments to EPA in February 2012 ("2012 Response") (Ref. 5.12).

This assessment of the original 2007 Response is provided to identify changes that have occurred since the 2007 Response was provided. These changes include regulatory changes, environmental and biological changes, and technological changes. It is possible that cumulative effect of these changes will be a change to the Best Technology Available (BTA) for Merrimack Station. This is especially possible because the way in which the impingement and entrainment BTA is determined has changed with issuance of the new Clean Water Act (CWA) Section 316(b) regulations.

1.2 Executive Summary

This report serves as an additional assessment regarding potential technologies for reducing entrainment at Merrimack Station. Changes in regulations, changes in technologies, and changes in cost since the time of the 2007 Response are discussed, with a focus on additional study and analysis that has yet to be performed. The primary conclusions of this report are summarized below:

- The most significant regulatory change with regard to cooling water intakes that has occurred since the 2007 Response is the finalizing of the CWA Section 316(b) rule for existing facilities. Existing power generating facilities that are designed to withdraw greater than 2 million gallons per day (MGD) of water from waters of the United States, and that use at least 25 percent of this water exclusively for cooling purposes, are subject to the BTA standard for impingement mortality unless a *de minimis* demonstration can be made or an exemption is given for a low capacity utilization factor. Per the evaluation contained in Attachment 1, the impingement rate at Merrimack Station is *de minimis* and does not require further controls as stated in the rule.

- Facilities that have an actual intake flow (AIF) of 125 MGD or greater must submit §122.21(r)(9) through (r)(13) to EPA as to aid in determination of BTA for entrainment on a site-specific basis. Merrimack Station's AIF is currently less than 125 MGD; however, given the potential for the flow rates to increase closer to the DIF in the near future, this document preemptively evaluates potential technologies with a specific focus on reducing entrainment abundance.

- Wedgewire screens remain an available technology for reducing entrainment abundance at Merrimack Station. The Johnson Screens Half Intake Screen System provides screens that are specifically designed for shallow water applications, and could be used to optimize the design presented in the 2009 Report. Additionally, recent studies have been performed that have increased the understanding on the critical performance characteristics contributing to the biological effectiveness of wedgewire screens. A site-specific study is recommended to determine the optimal slot width for wedgewire screens and to accurately measure the ambient current directions and velocities. This would allow for an optimized slot width and through-screen velocity to minimize entrainment, while also gaining a better understanding of the potential for screen fouling and frazil ice formation.

- Aquatic filter barriers (AFBs) remain an available technology for reducing entrainment abundance at Merrimack Station. The conceptual design presented in the 2009 Report included an approximately 3,500-ft long barrier in the Merrimack River. This large size was required to achieve the target through-screen velocity of 0.5 fps. However, a design optimized for entrainment reduction is not necessarily required to meet the 0.5 fps through-screen velocity requirement. Laboratory testing has been performed on AFB systems over a range of flow rates, and the results have shown that performance of AFBs is highly species-specific. Therefore, a site-specific study is recommended to determine the allowable flow rate per square foot. The allowable flow rate per square foot may significantly exceed that which was evaluated in the 2009 Report, which would lead to a significantly reduced length.

- Facilities that are subject to the BTA standard for entrainment compliance are required to submit a Comprehensive Technical Feasibility and Cost Evaluation Study under §122.21(r)(10). A portion of this submittal is required to discuss available sources of process water, gray water, waste water, reclaimed water, or other waters of appropriate quantity and quality for use as some or all of the cooling water needs of the facility. An investigation of alternative sources of cooling water has not yet been performed for Merrimack Station. Granite Ridge, a nearby power plant to Merrimack Station, successfully uses gray water for cooling. Investigation of potential alternative sources of water is required to comply with §122.21(r)(10), and is therefore recommended.
- Variable speed pumps (VSPs) remain an available technology for reducing entrainment abundance at Merrimack Station. The 2007 Report briefly discussed the use of VSPs, which may aid in reducing intake flows for the Station during certain times of the year. However, the extent to which this flow reduction can be achieved has not yet been determined. A detailed analysis of the plant thermal heat balance is recommended to determine the extent to which flow reductions can be achieved at Merrimack Station using VSPs.
- The cost estimates provided in the 2007 Response and 2009 Report are outdated and are required to be revised. For technologies and designs that have not experienced significant change, the costs should be updated to 2014 dollars using appropriate construction cost index estimation factors. For technologies and designs that have experienced changes since they were last discussed, new Class 5 estimates per ASTM E2516-11 (Ref. 5.10) should be performed that considers construction and engineering costs. It is recognized that the cost for certain materials and proprietary technologies may scale differently than what the cost indices will capture; however, given that these are Class 5 cost estimates per ASTM E2516-11 (Ref. 5.10), general cost index estimation factors are typically used.
- Several of the evaluations required to determine BTA for entrainment, including the Benefits Valuation Study and the Non-Water Quality Environmental and Other Impacts Assessment, have not yet been performed for Merrimack Station.

In summary, the analyses and studies performed to date have determined several feasible technologies for Merrimack Station. There are other technologies that may be feasible but have not yet been fully evaluated. Of the technologies deemed feasible, detailed assessments and studies (as shown in Attachment 2) necessary to determine BTA have not yet been performed. Therefore, if the EPA Director does determine that entrainment abundance and reduction controls must be further evaluated, it is premature to state that a BTA for entrainment has been determined.

2 Clean Water Act Section 316(b)

The most significant regulatory change that has occurred regarding cooling water intakes since the 2007 Response is the finalizing of the CWA Section 316(b) rule for existing facilities. The new 316(b) rule (referred to hereafter as "the rule") was pre-published by EPA on May 19, 2014, with final publication in the Federal Register occurring on August 15, 2014. The regulation became effective on October 14, 2014.

Clean Water Act Section 316(b) requires that NPDES permits for facilities with cooling water intake structures (CWISs) ensure that the location, design, construction, and capacity of the structures reflect the BTA to minimize harmful impacts to the environment. Existing large electric-generating facilities were addressed in the 2004 Phase II rule, but this was subsequently remanded on January 25, 2007. Several alterations have been made to the rule since the 2007 Response that may impact the technology assessment for Merrimack Station as a part of the NPDES permit renewal process. This is because the new final CWA 316(b) rule contains changes to the way in which facilities will meet the impingement and entrainment mortality standards.

The remainder of this section includes information taken from the 316(b) rule; citations are not provided after each sentence or paragraph for brevity. This Section provides a summary-level discussion on the new rule. For exact language and further detail, 40 CFR Parts 122 and 125 of the Federal Register should be consulted. Note that, for example, 40 CFR Part 122 and §122 are used interchangeably in this report for brevity.

2.1 Impingement Compliance

Existing power generating facilities that are designed to withdraw greater than 2 MGD of water from waters of the United States, and that use at least 25 percent of this water exclusively for cooling purposes, are subject to the BTA standard for impingement mortality. Compliance with the BTA standard for impingement mortality may be achieved using any one of seven options delineated in the rule, as described below in Section 2.1.1. Certain facilities may be exempt from the impingement mortality standard if they are determined to have *de minimis* rates of impingement or operate with a low capacity utilization factor. The impingement rate for a facility would be deemed *de minimis* based on impingement abundance numbers or age 1 equivalent[1] abundance in relation to mean annual intake flows.

[1] Age-1 equivalents are defined in the rule as the number of individual organisms of different ages impinged and entrained by facility intakes, standardized to equivalent numbers of 1-year old fish. A conversion rate between all life history stages and age 1 is calculated using species-specific survival tables based on the life history schedule and age-specific mortality rates.

2.1.1 Compliance Options

Option #1 – §125.94(c)(1): Operate a closed-cycle recirculating system as defined at §125.92. This is essentially a pre-approved technology requiring no demonstration, or only a minimal demonstration, that the flow reduction and control measures function as EPA envisions. Submittal of the information delineated in §122.21(r)(2) through (r)(6) and §122.21(r)(8) is required as a part of the permit application process. The monitoring required must include measuring cooling water withdrawals, make-up water flows, and blowdown flows. The facility is required to monitor actual intake flows (the average volume of water withdrawn on an annual basis) and cycles of concentration to confirm that make-up and blowdown flows have been minimized. Biological compliance monitoring is not required.

Option #2 – §125.94(c)(2): Operate a CWIS that has a maximum through-screen design intake velocity of 0.5 fps. This is a pre-approved technology requiring no demonstration, or only a minimal demonstration, that the flow reduction and control measures function as EPA envisions. Submittal of the information delineated in §122.21(r)(2) through (r)(6) and §122.21(r)(8) is required as a part of the permit application process. The facility must submit information demonstrating that the maximum design intake velocity passing through the screens cannot exceed 0.5 fps. This maximum water velocity must be achieved during all conditions, including periods of minimum water source elevations and during periods of maximum head loss across the screens. Biological compliance monitoring is not required.

Option #3 – §125.94(c)(3): Operate a CWIS that has a maximum through-screen intake velocity of 0.5 fps. The facility must submit information demonstrating that the maximum intake velocity as water passes perpendicularly through the screen does not exceed 0.5 fps. Submittal of the information delineated in §122.21(r)(2) through (r)(6) and §122.21(r)(8) is required as a part of the permit application process. This method is similar to Option #2 (design velocity) except that the intake's maximum design velocity can exceed 0.5 fps as long as the intake is operated in a manner such that the actual, measured velocity does not. One example given in the rule is a facility that was originally designed with an intake velocity of 1.0 fps, but has achieved an actual intake velocity 0.5 fps by retiring a portion of the plant. Monitoring of the velocity at the screen face or immediately adjacent to the screen face (not the approach velocity) must be conducted daily, or a calculation must be performed demonstrating this. Additionally, the facility may be granted permission to exceed the low velocity compliance alternative for brief periods of time, such as during backwashing or back-flushing. Biological compliance monitoring is not required.

Option #4 – §125.94(c)(4): Operate an offshore velocity cap as defined in §125.92 that is installed before the effective date of the rule. This is a pre-approved technology requiring no demonstration, or only a minimal demonstration, that the control measures function as EPA envisions. Submittal of the information delineated in §122.21(r)(2) through (r)(6) and §122.21(r)(8) is required as a part of the permit application process. The velocity cap must be located a minimum of 800 ft offshore, and must contain devices such as bar racks to exclude marine animals. Additionally, the velocity cap must be designed to change the direction of the water withdrawn from vertical to horizontal, and intake flow must be monitored daily. Biological compliance monitoring is not required. If facilities choose to construct a velocity cap at an offshore location after the effective date of the rule, they would be utilizing compliance options #6 or #7 below.

Option #5 – §125.94(c)(5): Operate a modified traveling screen that meets the definition at §125.92(s). The definition requires those features of a traveling water screen that provide an appropriate level of fish protection including:

- Collection buckets that minimize turbulence;
- Guard rails or barriers to prevent loss of fish from the collection system;
- Smooth or soft screen panel materials that protect fish from descaling;
- Continuous or near-continuous rotation of screens and operation of collection equipment to recover impinged fish as soon as practical;
- Low-pressure wash or vacuum to remove collected organisms from the screen; and
- An FHRS with sufficient water flow to return fish directly to the source waterbody in a manner that does not promote re-impingement of the fish, or a large vertical drop.

For this option, the facility is required to submit a site-specific impingement technology performance optimization study that includes two years of biological sampling. The study must demonstrate that the operation of the modified traveling screens has been optimized to minimize impingement mortality. EPA notes in the rule that modified traveling screens include, but are not limited to modified Ristroph screens with a FHRS, dual flow screens with smooth mesh, and rotary screens with fish returns or vacuum returns. Submittal of the information delineated in §122.21(r)(2) through (r)(6), §122.21(r)(6)(i), and §122.21(r)(8) is required as a part of the permit application process.

Option #6 – §125.94(c)(6): Operate any systems of technologies, best management practices, and/or operational measures that the Director determines is the BTA for impingement reduction. This option allows the facility to choose the technologies, practices, and operational measures that it believes will meet the impingement mortality standard. The facility is required to submit a site-specific impingement study including two years of biological data collection demonstrating that the operation of the system of technologies, operational measures and best management practices has been optimized to minimize impingement mortality. The estimated reductions in impingement must be based on comparison of the system to a once-through cooling system with a traveling screen whose point of withdrawal from the surface of the water is located at the shoreline of the source waterbody. Submittal of the information delineated in §122.21(r)(2) through (r)(6), §122.21(r)(6)(ii), and §122.21(r)(8) is required as a part of the permit application process.

Option #7 – §125.94(c)(7): Achieve the specified impingement mortality standard. This option requires that the facility achieve a 12-month impingement mortality performance of all life stages of fish and shellfish of no more than 24 percent mortality, including latent mortality, for all non-fragile species. The rule contains specific requirements relating to how impingement shall be calculated. Compliance may be demonstrated for either the entire facility or for each individual CWIS. Submittal of the information delineated in §122.21(r)(2) through (r)(6), and §122.21(r)(8) is required as a part of the permit application process.

2.1.2 Information Submittals

The items below are required to be submitted to EPA as a part of the permit renewal process based on the impingement compliance alternative selected by the facility. Note that the descriptions below are summary-level only; the rule itself should be consulted for more detailed information regarding the compliance requirements.

- §122.21(r)(2) Source Water Physical Data: This submission is required to characterize the facility and evaluate the type of waterbody that is potentially affected by the CWIS. Information including size and shape of the water body, depth, salinity and temperature regimes, and other documentation is listed in the rule as being potentially applicable data to be included in this submission. This was previously submitted to EPA in April 2005 and in the 2007 Response as discussed in Attachment 1.
- §122.21(r)(3) Cooling Water Intake Structure Data: This submission is used to characterize the CWIS and evaluate the potential for impingement and entrainment of aquatic organisms. The submission should include a description of the configuration of each cooling water intake structure, DIFs, daily hours of operation, months of operation, and engineering drawings of the intake structure, and other information related to the cooling water intake system. This was previously summarized for each intake and submitted to EPA in April 2005 and in the 2007 Response as discussed in Attachment 1.
- §122.21(r)(4) Source Water Baseline Biological Characterization Data: Facilities are required to characterize the biological community in the vicinity of the CWIS and to characterize the operation of the CWIS. This was previously summarized and provided to EPA in several submittals as described in Attachment 1.
- §122.21(r)(5) Cooling Water System Data: This submission should describe operation of the cooling water system(s) and its relationship to the CWIS, the proportion of design flow that is used for each purpose, description of reductions in total water withdrawal, the number of days the system is in operation, any seasonal changes in the operation of the system, and a description of any existing impingement and entrainment technologies along with their performance. This was

previously provided to EPA in October 2005 and in the 2007 Response as described in Attachment 1.

- §122.21(r)(6) Chosen Method of Compliance with Impingement Mortality Standard: The facility must identify which compliance alternative it has chosen to meet the impingement mortality standard. Facilities choosing to comply by operating a modified traveling screen (under Option #5) must submit an impingement technology performance optimization study under § 122.21(r)(6)(i). Similarly, facilities choosing to comply by operating a system of technologies (under Option #6) that will achieve the impingement mortality standard must submit a impingement technology performance optimization study under §122.21(r)(6)(ii).
- §122.21(r)(7) is addressed under Section 2.2, Entrainment Compliance.
- §122.21(r)(8) Operational Status: The facility must provide descriptions of each unit's operating status includes age of the unit, capacity utilization for the previous five years, any major upgrades completed in the past 15 years, a description of any completed or scheduled uprates, Nuclear Regulatory Commission (NRC) re-licensing status for nuclear facilities, plans or schedules for decommissioning or replacement of units, and a description of future production schedules for manufacturing facilities. This was previously provided to EPA in October 2005 and in the 2007 Response as described in Attachment 1.

2.2 Entrainment Compliance

For entrainment compliance, the rule does not prescribe a single nationally applicable entrainment performance standard, but instead requires that the BTA entrainment requirement be established on a site-specific basis.

All existing facilities must submit §122.21(r)(7) and §122.21(r)(8) to EPA. Facilities that have an AIF of 125 MGD or greater must submit §122.21(r)(9) through (r)(13) to EPA as described below to aid in determination of BTA for entrainment. The requirement to submit §122.21(r)(9) through §122.21(r)(13) may be waived on a site-specific basis.

The list of items below are required to be submitted to EPA as a part of the permit renewal process based on the AIF requirements above. The rule does not require that any of the information in this Section be submitted by facilities that have an AIF of 125 MGD or less. Note that the descriptions below are summary-level only; the rule itself should be consulted for more detailed information regarding the compliance requirements.

- §122.21(r)(7) Entrainment Performance Studies: The permit applicant must submit a description of any entrainment-related biological studies conducted at the facility and provide a summary of any conclusions or results. Studies that are older than 10 years or conducted at other facilities must contain an explanation of why the data are still relevant and representative of conditions at the facility. New studies are not required to fulfill this requirement.

- §122.21(r)(9) Entrainment Characterization Study: A two-year entrainment data collection study is required, including complete documentation of the data collection period and the frequency of entrainment characterization, and an identification of the organisms sampled. An entrainment characterization study was performed at Merrimack Station from June 29, 2005 through June 28, 2007, and provided the basis for conclusions in the 2007 Response.
- §122.21(r)(10) Comprehensive Technical Feasibility and Cost Evaluation Study: The facility must submit an engineering study of the technical feasibility and incremental costs of candidate entrainment control technologies. The study must include an evaluation of the technical feasibility of closed-cycle cooling, fine-mesh screens with a mesh size of 2 mm or smaller, reuse of water or alternate sources of cooling water, and any other entrainment reduction technologies. The 2007 Response provided a technical feasibility and cost evaluation study for a few impingement and entrainment reduction technologies.
- §122.21(r)(11) Benefits Valuation Study: The facility must submit a detailed discussion on the benefits of the candidate entrainment reduction technologies evaluated in (r)(10) using data from the Entrainment Characterization Study in (r)(9). Benefits should be quantified in physical or biological units and monetized using appropriate economic valuation methods. This study has not been performed as described in Section 3.6.
- §122.21(r)(12) Non-Water Quality Environmental and Other Impacts Assessment: The facility must submit a detailed discussion of the changes in non-water quality environmental and other factors attributed to the technologies, operational measures, or both, as applicable. These changes may include impacts such as additional energy consumption, air pollutant emissions, noise, safety concerns, potential for plumes, icing, availability of emergency cooling water, grid reliability, etc. This study has not been performed as described in Section 3.6.
- §122.21(r)(13) Peer Review: The facility must provide for a peer review of the permit application studies required under §122.21(r)(10) through §122.21(r)(12).

2.3 Compliance for Merrimack Station

Because Merrimack Station withdraws greater than 2 MGD of water from waters of the United States, and uses at least 25 percent of this water exclusively for cooling purposes, it is subject to the 316(b) rule in general. There are several technologies evaluated in this report, demonstrating ways in which Merrimack Station may be able to achieve compliance with this rule.

From Attachment 1, based the most recent and relevant intake flows from 2011 through 2013 applied to the weekly impingement rates from the 2005-2007 characterization study, the impingement rate at Merrimack Station is approximately 0.27 percent of the national average of facilities surveyed throughout the United States that had performed impingement characterization studies during the 2004 through 2007 period. Therefore, based on the evaluation performed in Attachment 1, Merrimack Station has a *de minimis* rate of impingement (see Attachment 1 for justification) and does not require further controls as stated in the rule.

Based on operating data from 2011 – 2013, the current AIF for Merrimack Station is approximately 113.8 MGD, which falls below the threshold of 125 MGD for submittal of information regarding entrainment. However, given the potential for the flow rates to increase closer to the DIF in the near future, this document preemptively evaluates potential technologies with a specific focus on reducing entrainment abundance.

3 Engineering Assessment

Based on the evaluation in Attachment 1 showing that the impingement rate at Merrimack Station is *de minimis*, this section does not evaluate impingement-reducing technologies as no further controls are required. Although Merrimack Station's AIF is currently less than the 125 MGD threshold, it may increase in the future above the threshold. Therefore, this section preemptively evaluates potential technologies with a specific focus on reducing entrainment abundance.

3.1 Wedgewire Screens

Wedgewire screens are designed to reduce entrainment and impingement by excluding organisms from passing through the screen and by achieving low velocities due to the large size of the screens. Hydraulic bypass also occurs as a result of the shape of the screen, particularly when oriented in the direction of prevailing flow. Additionally, due to the round shape of the screens, the velocity pulling the organisms toward the screen is quickly dissipated, increasing the avoidance by organisms.

Wedgewire screens were evaluated in both the 2007 Response and the 2009 Report, including a high-level conceptual design in the 2009 Report. A range of possible slot sizes was given, but an optimal slot size was not determined. Due to this, the number of screens was not precisely determined, as the slot size affects the number of screens required for a given intake flow rate. Generally, however, a large number of screens were evaluated due to the small diameter of the screens. Because the water depth in the region in front of the CWISs is only 6 – 10 ft, 2-ft diameter cylindrical wedgewire (CWW) screens were evaluated in the 2009 Report. Reference 5.3 states that at least one-half the diameter of the CWW screens should be provided as clearance above and below the screens. With a minimum water depth of 6 ft in front of the CWIS, the maximum recommended screen diameter would have been 3 ft. Therefore, as discussed in the 2012 Response (Ref. 5.12), based on currently available bathymetry data, water depth is not an issue for 2-ft diameter CWW screens in this area. As the result of this restriction, many wedgewire screens were presented in the design, which would occupy a large area of the river. However, other wedgewire screens are available besides those of the cylindrical shape that can improve the design.

A relatively new technology that could be investigated for Merrimack Station is the Johnson Screens Half Intake Screen System. These screens are marketed as a solution for shallow water intakes, and can be installed in water that is half the depth of traditional intake screen systems (Ref. 5.4). The screen contains one curved, semi-circular surface, and one downward-facing flat surface, as shown below in Figure 3-1.

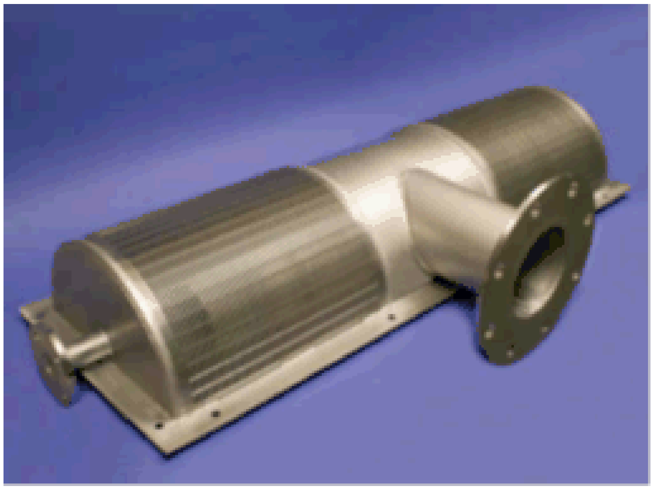

Figure 3-1: Johnson Screens Half Intake Screen System (Ref. 5.4)

One benefit to using half-cylindrical screens is that larger diameter screens can be utilized since the screens are flush with the bottom. This would likely result in fewer screens being required. Standard sizes for the half-cylindrical screens range from 12 – 96 in. diameter intake screens (Ref. 5.4). The number of screens would be determined by the size and slot width of the screens, in addition to the design through-screen velocity. A design through-screen velocity of 0.5 fps was used in the 2009 Report; however, since Merrimack Station is not subject to the BTA standard for impingement mortality as the result of a *de minimis* demonstration (see Attachment 1), this is no longer a design requirement. The slot size and design through-screen velocity can be optimized for biological efficacy and practicality of design. For the 2009 Report, a specific slot size was not selected, but a range of 1.5 – 9 mm was evaluated. Additional information that was not available at the time of the 2007 Response and 2009 Report can be utilized to further optimize the wedgewire screen design to reduce the number of screens required, thus increasing feasibility and practicality.

Recent studies (occurring subsequent to the 2007 and 2009 Reports) have been performed which have increased the understanding on the performance characteristics of wedgewire screens that can be used to increase biological efficacy of wedgewire screens. Recent research in a laboratory flume [redacted] and in the Hudson River Estuary [redacted] has demonstrated that the performance of CWW screens is related to three factors: physical exclusion by the slot width, behavioral avoidance of the intake flow by the fish, and the hydraulic bypass due to sweeping flow of river currents along the surface of the wedgewire screen in a direction perpendicular to the slot openings (i.e., parallel to the slot width). Wedgewire screens with slot widths of 2, 3, 6, and 9 mm were tested at flume velocities of

0.25, 0.50, and 1.0 fps, with through-slot velocities of 0.25 and 0.50 fps for a total of 24 combinations of slot width, flume velocity, and through-slot velocity. Physical exclusion exhibited a direct relationship to greatest body depth, and fish (eggs, larvae, or juveniles) with a greatest body depth larger than the slot width were physically excluded. Behavioral avoidance was typically higher for the smaller slot widths, and a lower through-slot velocity. Overall, avoidance and hydraulic bypass were higher at higher ratios of sweeping velocity to through-slot velocity, particularly when this ratio exceeded 1:1. These mechanistic studies demonstrated that hydraulic bypass and avoidance were the prevailing modes of effectiveness of cylindrical wedgewire screens. Exclusion also operated to reduce entrainment of organisms larger than the slot width. Therefore, an ambient current velocity of 1 fps is not necessarily required for wedgewire screens to be effective, as was presumed previously. This may allow for extension of the operating period for wedgewire screens beyond the April – July timeframe that was determined in the 2009 Report.

Based on these findings, it is recommended that a detailed study be performed to optimize the slot width for Merrimack Station. Additionally, the through-screen velocity can be designed to match that of the expected ambient currents. An optimal slot width would be that which allows for the most entrainment reduction without significant increases in the rates of fouling or clogging. Additionally, further insight can be gained on frazil ice formation to precisely quantify the available months for wedgewire screen operation. As discussed in the 2009 Report, wedgewire screens are susceptible to frazil ice formation during winter months. Therefore, the wedgewire screens would not be operated during the winter months. Based on the months in which entrainment abundance is highest, and based on the results of site-specific testing, a precise operating period would be determined based on all of the above.

A detailed study of the ambient river current direction and velocities using Acoustic Doppler Current Profiler (ADCP) or similar technology is recommended to precisely characterize the orientation of the screens and design through-slot velocities for optimal performance. Additionally, an optimal location may exist that would maximize the average sweeping current velocities. Once the ambient current velocities in front of the CWIS are well understood, the design through-screen velocity can be selected to achieve the 1:1 ratio of sweeping to through-screen velocity based on results from the studies performed. Once the optimum slot size and through-screen velocities are determined, a half intake screen system would be designed using larger diameter screens, up to 6-ft diameter screens. In combination with the potential for higher through-screen velocities, this would significantly reduce the number of screens required. A reduction in the number of screens required would serve to alleviate concerns regarding the large number of screens proposed in the 2009 Report, and the large area of the river that would be occupied by the wedgewire screens. Concerns related to interrupting recreational activities, and obstructing large areas of the river both during construction and in the final configuration, would be alleviated to an extent. As noted in Attachment 1, deployment of wedgewire screens with through-screen velocities above 0.5 fps may reduce impingement.

As noted above, a 1:1 ratio of sweeping flow to through-screen velocity is generally required for wedgewire screens to be effective. Because this requirement is less stringent than the 1 fps ambient current criteria evaluated in the 2009 Report, the operating period for the wedgewire screens can likely be extended to include periods of the year in which lower river flows have historically occurred. Additionally, the wedgewire screening system can be operated in parallel with a backup, or auxiliary intake system, that would allow for a continuous supply of water to Merrimack Station in the event that sudden blockage of the screens occurs. If such a system were included as a part of the design, the wedgewire screens could be operated during periods in which blockage may be expected. The water levels within the intake bay would be monitored continuously; and if necessary, the auxiliary intake system would be initiated to maintain plant operation. This would also prevent a large pressure differential from building up across the blocked screens, eliminating the potential for screen damage due to blockage. This would also serve to increase the potential operating period for wedgewire screens beyond the April – July timeframe that was determined in the 2009 Report.

The additional hydraulic resistance of the wedgewire screens and associated piping would also be a consideration. At low water levels, the submergence of the circulating water pumps may be challenged. Based on the results of site-specific studies, a realistic blockage factor would be applied to the wedgewire screens to ensure that sufficient screening area exists to maintain sufficient submergence for the circulating water pumps. Vortex suppression features, such as grating or modified features beneath the suction of the pumps may be required based on the expected intake water level. This would be evaluated during detailed design.

3.2 Aquatic Filter Barriers

As discussed in the 2007 Response and 2009 Report, AFBs are barriers that employ a filter fabric designed to allow for passage of water into a CWIS but exclude aquatic organisms. These systems are designed to be placed some distance from the CWIS within the source waterbody, and act as a filter that is impermeable to fish, shellfish, and ichthyoplankton. Therefore, it holds the potential for being an effective technology to reduce entrainment.

The 2009 Report evaluated implementation of an AFB system at Merrimack Station based on achieving a velocity of 0.5 fps through the filter. Because of the fine mesh size of AFBs, the small open area percentage led to a very large surface area needed to meet this intake velocity requirement. The 2009 Report estimated that a length of approximately 3,500 ft would be required to achieve this design velocity. This would potentially restrict activities on the water body due to the large amount of surface area that would be taken up by the AFB.

Because this assessment is focused solely on entrainment-reducing technologies, the AFB would not be required to achieve a through-screen velocity of 0.5 fps for impingement reduction purposes. This removes one of the design requirements that had previously served as a primary mechanism for selection of the very large size of AFB evaluated at Merrimack Station in the 2009 Report. Table 3-1 of the 2009 Report listed basic design considerations for the AFB system, including the flow per square foot. The conceptual design in the 2009 Report evaluated an AFB system with a flow of approximately 9 gpm/ft^2. However, AFB systems have been tested and shown to be effective at higher flow rates. Reference 5.9 tested the biological effectiveness of an AFB system using flow rates of 10 – 20 gpm/ft^2. The biological tests indicated that the ability of the AFB to prevent entrainment does decrease with increased flow rates; however, it was noted that the performance is highly species-specific. Pressure differential across the barrier was also noted to increase. This is an effect that would need to be evaluated for acceptability at Merrimack Station.

A study is recommended to determine an optimized perforation opening size and flow rate for an AFB system at Merrimack Station based on site-specific biological conditions and water source characteristics such as debris loading and biological fouling. An optimal perforation opening size and through-screen velocity would be determined based on maintaining a low level of entrainment while not increasing the impingement rate of entrainable organisms. Assuming that a flow rate between 10 – 20 gpm/ft^2 would provide sufficient entrainment reduction with acceptable biological fouling and pressure differential behavior, while not increasing the impingement rate, the length required for the AFB system could be considerably reduced. This would alleviate concerns regarding the length of the barrier and the large river area that would be occupied.

Additionally, a site-specific study would allow for further insight into the allowable months of operation for an AFB. As discussed in the 2009 Report, AFBs are susceptible to damage from ice floes and ice formation on the fabric panels during winter months. In order to avoid damage to the AFB system, it would need to be removed during the winter months. Based on the months in which entrainment abundance is highest, and based on the results of site-specific testing, a precise operating period would be determined.

3.3 Alternative Water Sources

As discussed in Section 2.2, facilities that are subject to the BTA standard for entrainment compliance are required to submit a Comprehensive Technical Feasibility and Cost Evaluation Study under §122.21(r)(10). A portion of this requirement includes discussion of available sources of process water, gray water, waste water, reclaimed water, or other waters of appropriate quantity and quality for use as some or all of the cooling water needs of the facility. Additionally, alternative sources of water, such as well water, are required to be investigated. Neither the 2007 Response nor the 2009 Report evaluated available alternative cooling water sources. Alternative water source usage is desirable in that it would reduce the amount of water withdrawn from the Merrimack River, thereby reducing entrainment mortality. Several alternative water sources that may hold promise at Merrimack Station are discussed in the subsections below.

3.3.1 Gray Water

Gray water can be wastewater, sewage, or other water streams that are discharged by another facility. A review of available gray water sources near Merrimack Station has not been performed, therefore it is not possible to state at this time whether this represents a feasible technology to reduce entrainment mortality by replacing a portion of the intake flow for the existing once-through system. However, there are several examples of successful uses of gray water for cooling purposes at power plants, including the largest power plant in the United States, and at least one nearby facility located on the Merrimack River.

Palo Verde Nuclear Generating Station is a three-unit nuclear power plant located near Phoenix, Arizona, and is the largest power plant in the United States by net generation (Ref. 5.14). The source of cooling water makeup for Palo Verde, including a source of makeup for the essential spray ponds, is treated sewage effluent primary from the city of Phoenix 91st Avenue treatment facility with effluent input capability also from other smaller facilities en route. The effluent is conveyed from the treatment facility to Palo Verde through approximately 35 miles of pipeline, and is treated at an onsite reclamation facility to meet the plant water quality requirements. Onsite makeup reservoirs provide for a continuous water supply in the event of temporary interruptions in the normal water source. Groundwater from onsite wells is used for other plant water uses as well (Ref. 5.15).

Granite Ridge is a 752 megawatt natural gas, combined-cycle power plant in nearby Londonderry, NH. The facility uses gray water from the nearby Manchester Sewage treatment plant to supplement its cooling water. Granite Ridge discharges the water to the Merrimack River following use (Ref. 5.8). A similar system, whereby wastewater from a nearby facility is used for direct cooling purposes, may be possible at Merrimack Station to reduce the AIFs and entrainment mortality if such a facility exists nearby.

The potential for gray water use at Merrimack Station to reduce the intake flow from the river for once-through cooling would be investigated by evaluating NPDES permits for other facilities proximal to Merrimack Station. Only facilities within a realistic distance would be investigated. The permitting implications of discharging another facility's wastewater would also need to be explored to ensure that Merrimack Station is not required to further treat the effluent beyond what the parent facility currently discharges.

3.3.2 Groundwater Wells

The development of groundwater supplies to reduce or replace the use of direct surface water withdrawals can be a viable option if the hydrogeologic conditions are favorable for the development of large capacity production wells. Source water for large capacity ground water supplies rely heavily on direct surface water recharge to the aquifer. The advantage of large capacity wells constructed near a surface water recharge source is primarily twofold:

- Reduced intake flows directly from the source water system; and
- Improved and/or stable water quality such as turbidity, total suspended solids, and temperature.

Generally there are two types of large capacity wells that are designed and constructed for this type of application; vertical wells and horizontal collector wells (radial wells). Because large yields are usually needed to reduce or eliminate surface water as the primary source of water, a sound understanding of the local hydrogeologic conditions is required as part of the design efforts associated with either vertical or radial collector wells.

Vertical Wells

The technology for constructing large capacity vertical wells is widely available. Depending on the local hydrogeologic conditions, vertical wells can produce between 1 – 5 MGD. In order to develop wells with larger pumping capacities, well casings would need to have diameters of 24 to 36 in. and be sufficiently deep to take advantage of local drawdown characteristics. In addition, a nearby source or recharge needs to be available.

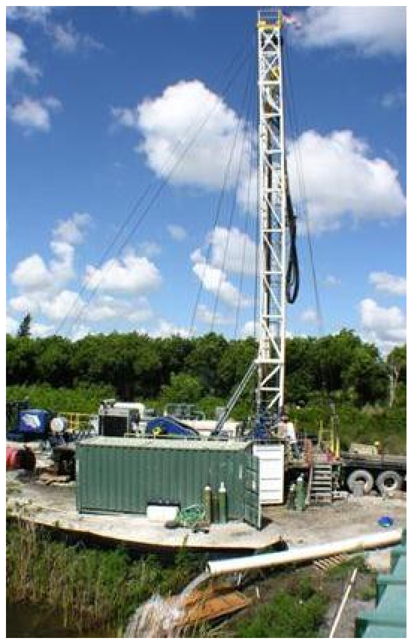

Figure 3-2: Vertical well during construction

The advantages of vertical wells are:

- Common well construction with many companies are available to construct these types of wells;
- Stable water quality and potentially improved water quality over surface water intakes; and

The disadvantages of vertical wells are:

- Each well is limited in terms of yield by the available drawdown in the aquifer and consistent source of recharge to the aquifer.

- If the desired yield is large, it can take a large number of vertical well to develop the necessary capacity and a large land area depending on the spacing requirements.
- There can be significant O&M associated with a large number of vertical wells.

In summary, vertical wells are a technology that could be explored to provide between 1 – 5 MGD of water per well, based on site-specific conditions. A study is recommended to investigate local hydrogeologic conditions to determine whether this technology is viable for Merrimack Station to reduce intake flows from the Merrimack River.

Radial Collector Wells

Radial collector wells consist of a vertical caisson with a diameter of 13 ft. or larger that is sunk to the base of the aquifer. Screens are projected from the caisson horizontally in a radial pattern. These screens extend as much as 250 ft. from the caisson in sand and gravel aquifer system. Typically, collector wells are designed to take full advantage of surface water recharge from a river or other source such as the ocean. Screens are projected under the river and water is filtered through the river bed, significantly improving water quality. If favorable hydrogeologic conditions are present, yields from radial collector wells can be greater than 40 MGD from a single well. To provide pumping redundancy and efficiency, several pumps can installed within the caisson of a radial well.

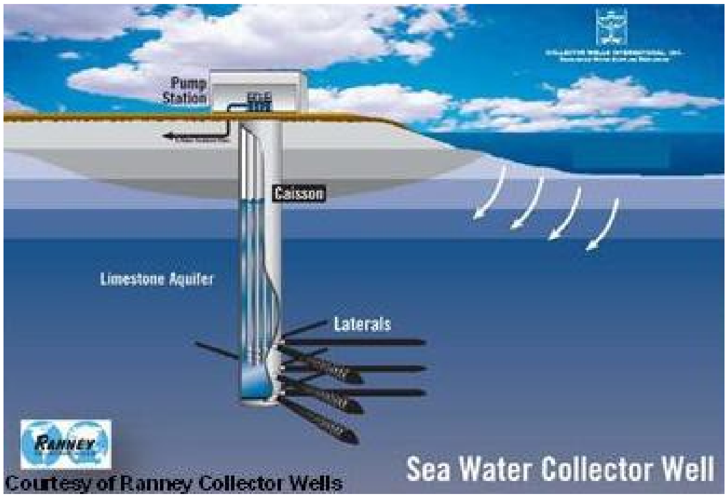

Figure 3-3: Diagram of a radial collector well

Advantages of radial collector wells are:

- High yield from a single well
- Water quality is stable and may improve over surface water intakes
- O&M is less than vertical wells on a per-gallon basis; and

Disadvantages of radial collector wells are:

- More expensive to construct than single vertical wells; however, this cost is made up in increased yield and long-term O&M;
- Wells are heavily dependent on direct surface water recharge to maintain large yields.

Grand Gulf Nuclear Generating Station, located on the Mississippi River, uses four radial wells to provide well water to the plant service water system during normal operation and normal shutdown conditions. The radial well system provides makeup to the standby service water system, but the radial well system is not nuclear safety-related. The radial wells are large reinforced concrete caissons installed vertically, that extend into the loose sediments adjacent to the Mississippi River. Water is derived from the Mississippi River via induced infiltration and enters the caisson through horizontal screened pipes (called laterals) that extend radially from the caisson into the sediments. Water is collected in the radial wells and pumps into a single underground main header which supplies the plant service water system during normal operation. During startup of the wells, the radial well collector flow may be diverted to the river to purge any sand or sediment that has collected in the wells from the laterals. Each of the four radial wells has two pumps, rated up to 5,000 gpm each. Therefore, up to 40,000 gpm (~58 MGD) can be collected from these wells if all pumps run at full capacity (Ref. 5.11).

In summary, radial collector wells are a technology that could be explored to provide up to 40 MGD of water per well based on site-specific conditions. A study is recommended to investigate local hydrogeologic conditions to determine whether this technology is viable for Merrimack Station to reduce intake flows from the Merrimack River.

3.3.3 Summary and Recommendations

A study is recommended to investigate possible sources of alternative cooling water to reduce the water withdrawn from the Merrimack River. Potential technologies include gray water, radial wells, and groundwater wells as discussed above. If a study is not performed in the near-term, the study may be required to be performed as a part of the 316(b) rule submittal process regardless.

3.4 Variable Speed Pumps

The 2007 Response briefly discussed VSPs as a potential technology for reducing intake flows from the Merrimack River on a seasonal basis. Several other methods for reducing the intake flows were explored, including two-speed pumps and throttling of the pump discharge; however, the use of VSPs is expected to be more cost-effective and provide a higher degree of operational flexibility. The four circulating water pump motors would be replaced with single-speed pump motors and variable frequency drives. The variable frequency drive would adjust the frequency of the alternating current power source supplied to the motor, thus controlling the speed of the motor and the resulting flow rate. A primary advantage of VSPs is that flow rate can be controlled over a continuous rather than discrete range (i.e., all possible speeds within the operating range are available).

Reductions in flow may be possible using VSPs at Merrimack Station, which will aid in reducing the AIFs for the Station during certain times of the year. However, the extent to which this flow reduction can be achieved has not been thoroughly studied. Permitting limitations and operational constraints limit the amount of flow that can be reduced on a site-specific basis. An analysis would be required to determine the allowable flow reduction that will maintain compliance with the NPDES permit limits while allowing for an appropriate buffer. A buffer is necessary because the Station cannot operate directly on the limit at all times. An instantaneous variation or transient would cause the limitation to be exceeded. Reducing cooling water intake flow reduces the efficiency of plant cooling systems. This reduces condenser cooling and negatively impacts power plant heat cycle efficiency in most cases. Additionally, there are condenser design criteria that need to be maintained during plant operation – the reduction of flow using VSPs would need to be evaluated against the condenser design criteria.

Detailed thermal analyses of the plant heat balances have not been performed. Due to the reduced condenser cooling efficiency, higher condenser pressures and condensate temperatures would result, impacting overall thermal efficiency of the Station. As mentioned in the 2012 response (Ref. 5.12), the impact to Station thermal efficiency cannot be precisely determined without detailed modeling of the plant power conversion system using a software program such as Performance Evaluation of Power System Efficiency (PEPSE) or General Electric's GateCycle plant performance monitoring software. Since the Station currently does not use VSPs, operational data on the performance of the Station across various condenser flow rates does not exist. The modelling software would enable one to take current plant configuration and operating parameters, and vary certain inputs to predict outputs such as power generation, and equipment operating parameters.

For VSPs, the PEPSE or GateCycle model of Merrimack Station would be run over a range of circulating water inlet temperatures, and at several different flow rates for each temperature. If a model of the Station does not currently exist, one would be created based on plant configuration and operating parameters and baselined against observed operating outputs to ensure that realistic model outputs are being achieved. Once the model is run over a range of circulating water temperatures and flow rates, analytical relations would be developed to allow for interpolation of plant performance operating data based on an input temperature and flow rate. A limiting parameter, such as a maximum condenser operating pressure, or maximum hotwell temperature, would be defined as the limiting parameter. Once this limiting parameter is defined, a maximum allowable flow reduction at each inlet circulating water temperature would be determined. With this information known, historical water temperature data would be used to characterize the performance of the Station over a period of multiple years.

This type of analysis would allow for precise characterization of the limitations of VSPs due to the plant heat cycle and condenser limitations, and determine the amount of cooling water flow required at various river temperature conditions. This would also allow for characterization of the allowable flow reductions to maintain compliance with the NPDES permit. Therefore, a detailed analysis is recommended to determine the potential entrainment benefits for VSPs.

3.5 Updates to Cost Estimates

The project engineering and construction cost estimates that were previously provided in Attachment 4 of the 2007 Response are out-of-date due to changes in construction cost indices, and advancements and lessons learned for each of the technologies. Furthermore, given the aforementioned recommended studies and conceptual designs for certain technologies (wedgewire screens, AFBs, etc.), the construction and engineering cost estimates should be revisited based on the refined conceptual designs.

The cost estimates that were previously provided in Attachment 4 of the 2007 Response are required to be updated. The cost estimate for technologies where no significant advances to the technology have been made, and where no changes are made to the conceptual design, should be reviewed and updated to 2014 dollars using construction cost index estimation factors. It is recognized that the cost for certain materials and proprietary technologies will scale differently than what the cost indices will capture; however, given that these are Class 5 cost estimates per ASTM E2516-11 (Ref. 5.10), use of general cost index estimation factors is an acceptable practice. For technologies where the conceptual design is revised to incorporate advances and lessons learned, a new Class 5 estimate per ASTM E2516-11 (Ref. 5.10) should be performed that considers construction and engineering costs.

3.6 Additional CWA 316(b) Requirements

In determining the BTA for entrainment mortality, certain information is required to be submitted to EPA that will aid in making an informed decision that incorporates site-specific conditions and characteristics. Certain technologies may be more cost beneficial or prohibitive based on certain characteristics of the facility in question, and there may be local or regional characteristics that rule out certain technologies. For example, a facility with a high capacity utilization factor may receive more benefit from a certain technology on a per-dollar basis than a similar facility with a low capacity utilization factor. A facility that is located near residential or commercial areas may face more difficulty in permitting a cooling tower due to icing or fogging concerns that may arise due to interaction with the surrounding roads, bridges, etc.

For this reason, the rule requires facilities with a DIF of greater than 125 MGD to submit additional information to characterize entrainment and assess the costs and benefits of installing various potential technological and operational controls. As discussed in Section 2.2, these facilities must submit information under §122.21(r)(11) Benefits Valuation Study, and under §122.21(r)(12) Non-Water Quality Environmental and Other Impacts Assessment. The Benefits Valuation Study would use data from §122.21(r)(9) to evaluate the benefits of each candidate technology evaluated in §122.21(r)(10). The benefits are to be quantified in physical or biological units and monetized using appropriate economic valuation methods. This would include incremental changes in the impingement mortality and entrainment of individual fish and shellfish for the exposed life stages, estimation of changes in stock and harvest levels of commercial and recreational species, and description of any economic monetization methods used. The study must also identify other benefits to the environment and nearby community, including improvements for mammals, birds, and other organisms and aquatic habitats. This evaluation is required to be peer reviewed by a qualified person or organization with the appropriate credentials. At this point, no such Benefits Valuation Study has been performed for any of the candidate technologies discussed. Therefore, it would be premature to state that a BTA for entrainment has been fully evaluated.

The facility is also required to submit an evaluation of Non-Water Quality Environmental and Other Impacts under §122.21(r)(12). The facility must discuss the changes in environmental and other factors not water quality-related that are attributed to the candidate technologies or operational measures. Potential impacts that are to be evaluated include, but are not limited to, the following:

- Energy consumption;
- Air pollution or emissions and their health and environmental impacts;
- Noise;
- Safety concerns, such as the potential for plumes and icing;
- Grid reliability;
- Plant reliability, including availability of cooling water;
- Consumptive water use;
- Impacts of construction, including navigation, traffic, noise, safety, air emissions, water ecology (sediment, underwater noise), nighttime lighting;
- Aesthetic impacts, both permanent and during construction;
- Environmental justice;
- Archaeological and historic resources;
- Other permitting impacts.

Without such an evaluation, it is possible that a technology that is better from a CWA perspective, but worse from an overall environmental perspective, could be prescribed as BTA for entrainment. Therefore, the rule requires a comprehensive evaluation of non-water quality related environmental impacts. Similar to the Benefits Evaluation Study, a peer review is required by a qualified person or organization holding the appropriate credentials. At this point, no such Non-Water Quality Environmental and Other Impacts Assessment has been performed for any of the candidate technologies discussed. Therefore, it would be premature to state that a BTA for entrainment has been fully evaluated.

4 Conclusion

According to the evaluation contained in Attachment 1, Merrimack Station has a *de minimis* rate of impingement. As described in the rule, these facilities with *de minimis* rates of impingement do not require further controls to address impingement mortality. Therefore, the candidate technologies evaluated for complying with the new 316(b) rule should not include consideration for impingement reduction.

The current AIF for Merrimack Station is below the threshold of 125 MGD for submittal of information regarding entrainment. However, given the potential for the flow rates to increase closer to the DIF in the near future, potential technologies are preemptively evaluated with the sole focus on reducing entrainment abundance. Given that essentially all of the entrainment occurs over a few months during the spring and summer (Ref. 5.1, p. 89), there are technologies available such as wedgewire screens or AFBs that could be seasonally deployed and provide substantial decreases in entrainment abundance comparable to closed-cycle cooling. Other technologies such as VSPs and alternative water sources may be available to provide reductions in intake flow from the Merrimack River to further reduce entrainment abundance; however, thorough evaluation of these technologies to quantify their effectiveness has not been performed. Given the likelihood that similar entrainment reduction to closed-cycle cooling can be achieved by these alternative technologies, additional study is warranted on these technologies as described in this report.

5 References

5.1 Response to United States Environmental Protection Agency CWA §308 Letter, PSNH Merrimack Station Units 1 & 2. November 2007.

5.2 Supplemental Alternative Technology Evaluation, PSNH Merrimack Station Units 1 & 2. October 2009.

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5.4 Johnson Screens Half Intake Screen System: A Solution for Shallow Water Intakes. http://www.johnsonscreens.com/content/half-screen-intake-flyer-us-english. Accessed October 3, 2014.

[redacted]

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5.8 Granite Ridge Energy Power to Londonderry and New England. http://www.londonderrynh.net/2009/08/granite-ridge-energy-power-to-londonderry-and-new-england/10474. Accessed October 5, 2014.

5.9 EPRI Technical Report 1005534, Laboratory Evaluations of an Aquatic Filter Barrier (AFB) for Protecting Early Life Stages of Fish. December 2004.

5.10 ASTM E2516-11, "Standard Classification for Cost Estimate Classification System," ASTM International, 2011.

5.11 Grand Gulf Nuclear Station Updated Final Safety Analysis Report (UFSAR). May 28, 2013.

5.12 Response to Environmental Protection Agency's Draft NPDES Permit, PSNH Merrimack Station Units 1 & 2. February 2012.

5.13 Clean Water Act NPDES Permitting Determinations for the Thermal Discharge and Cooling Water Intake Structures at Merrimack Station in Bow, New Hampshire. NPDES Permit No. NH 0001465.

5.14 U.S. Energy Information Administration (EIA), Largest Utility Plants by Net Generation (2012 Data). http://www.eia.gov/energyexplained/index.cfm?page=electricity_-in_the_united_states#tab3. Accessed October 16, 2014.

5.15 Palo Verde Nuclear Generating Station Units 1, 2, and 3. Updated Final Safety Analysis Report. Revision 14, June 2007. Accession Number: ML072250202.

Attachment 1: Update of Impingement Abundance and Mortality Assessment for Merrimack Station Response Supplement to United States Environmental Protection Agency CWA §308 Letter

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R-22240.038

October 2014

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Executive Summary

- The final 316b regulations (published 15 August 2014 and effective 14 October 2014) were reviewed with respect to their applicability to Merrimack Station.
- Annual total impingement abundance was reduced by 54% from 3,978 fish based on weekly impingement rates obtained from the impingement characterization study performed from 29 June 2005 through 28 June 2007 to 1,834 fish based on the three most recent years of AIF records (1 January 2011 through 31 December 2013) from Merrimack Station.
- By comparison with the largest data base of reported annual impingement rates presently available from 166 electric generating facilities representative of all source water bodies throughout the continental United States and Hawaii (EPRI 2011), and using annual total impingement rates for the three most recent years of AIF (1 January 2011 through 31 December 2013), impingement abundance at Merrimack Station of 0.27% of the national average is *de minimis*.
- [redacted] If a compliance option for entrainment reductions is needed to satisfy the BTA standards at Merrimack Station, a site-specific study would be performed to determine the ambient current flow and direction, debris loading, and biological efficacy of a partial-scale system during the 13-week period of peak entrainment from mid-May through the first week of August.
- The biological efficacy of an Aquatic Filter Barrier (AFB) as BTA for reducing entrainment abundance at Merrimack Station was evaluated by comparison with a four year study in the Hudson River estuary at Lovett Station. If a compliance option for entrainment reductions is needed to satisfy the BTA standards at Merrimack Station, a site-specific study of a partial-scale AFB would be performed to determine if similar biological efficacy to the Lovett AFB would be expected if an AFB was installed and operated at Merrimack Station during the 13-week period of peak entrainment from mid-May through the first week of August.

1.0 Introduction

Public Service Company of New Hampshire (PSNH) operates Merrimack Station using a once-through cooling water intake structure (CWIS) to obtain condenser cooling water from the Hooksett Pool section of the Merrimack River in Bow, New Hampshire, under an existing National Pollutant Discharge Elimination System permit (NPDES Permit NH0001465) issued by the United States Environmental Protection Agency (USEPA). On December 30, 2004, the USEPA sent an information request letter to PSNH under Section 308 of the Clean Water Act (CWA) regarding the Station's compliance with CWA §316(b), 33 U.S.C. §1326(b) (§308 Letter). In the §308 Letter, USEPA requested submission of a Proposal for Information Collection (PIC), and PSNH submitted this PIC in April 2005 describing impingement and entrainment studies proposed for Merrimack Station as requested by USEPA (PSNH 2005). PSNH performed impingement and entrainment studies during June 2005 through June 2007, and summarized the results in a final report (Normandeau 2007). USEPA also requested certain technology information from PSNH to support their evaluation of Merrimack Station's NPDES renewal application. In November 2007, PSNH submitted a response ("the 2007 Response") prepared by ENERCON Services, Inc. (ENERCON) and Normandeau Associates, Inc. (Normandeau) (PSNH 2007). The 2007 Response evaluated the engineering feasibility and estimated the biological effectiveness of certain technologies and operational measures that would be generally expected to reduce impingement mortality and/or entrainment mortality of fish and shellfish withdrawn from the Merrimack River in the cooling water used by Merrimack Station.

Following a meeting with PSNH, Normandeau, and ENERCON regarding the 2007 Response in December 2008, USEPA requested that PSNH further evaluate several technologies in more detail, and submit a supplement to the 2007 Response. The 2009 Supplemental Alternative Technology Evaluation ("the 2009 Response", PSNH 2009) presented this additional information to USEPA. Technologies evaluated included wedgewire screens, aquatic filter barriers, fine mesh traveling screens, and upgraded fish handling and return systems.

Subsequent to this, USEPA submitted a request for information which in some cases explained items in previous USEPA requests, and in other cases requested additional information not previously requested to ensure items were presented clearly. In addition, USEPA requested information regarding certain assumptions and/or calculations that were used as the basis for the information provided in the 2007 Response. The information requested was submitted to USEPA in January 2010 (PSNH 2010). ENERCON created a report that individually reviewed each information request, provided clarification of the information provided in the 2007 Response, and, where necessary, conducted new analysis to respond to EPA's information request. After receiving this information, USEPA issued a draft NPDES permit for Merrimack Station in September 2011. During the comment period for the draft permit, PSNH provided comments to USEPA in February 2012 ("2012 Response", PSNH 2012).

This assessment of the original 2007 Response is provided to identify changes that have occurred since the 2007 Response was provided. These changes include regulatory changes, environmental and biological changes, and technological changes. It is possible that cumulative effect of these changes will be a change to the Best Technology Available (BTA) for Merrimack Station. This is especially possible because the way in which the impingement and entrainment BTA is determined has changed with issuance of the new Clean Water Act (CWA) Section 316(b) regulations.

The USEPA published the final regulations to establish requirements for cooling water intake structures at existing facilities in the Federal Register on Friday, 15 August 2014 (40CFR Parts 122 and 125; Volume 79, No. 158, pages 48300-48439). The stated purpose of these final §316(b) regulations is to reduce impingement and entrainment of fish and other aquatic organisms at cooling water intake structures used by certain existing power generation and manufacturing facilities for the withdrawal of cooling water. These regulations are applicable to facilities like Merrimack Station that are designed to withdraw more than 2 million gallons per day (MGD) of surface water and use at least 25% of the water withdrawn exclusively for non-contact cooling purposes.

Normandeau reviewed the recent (15 August 2014) publication of the final §316(b) regulations (USEPA 2014) and the three most recent years of actual intake flow (AIF) records for the CWIS to prepare this Attachment 1 update of impingement abundance and mortality response supplement for Merrimack Station. This Attachment 1 Report does not seek to re-evaluate and update all technologies and operational measures examined in the §308 responses, just those options considered most feasible from an engineering perspective for application at Merrimack Station from among the compliance options specified in the final §316(b) regulations.

The objectives of this Attachment 1 response supplement were:

1. Review the final 316b regulations and their applicability to Merrimack Station,
2. Establish the annual impingement abundance of fish at Merrimack Station based on the three most recent years of AIF records (2011 through 2013).
3. Compare the magnitude of annual impingement abundance for Merrimack Station to the national and regional summary of annual impingement abundance provided in the Electric Power Research Institute (EPRI) Technical Report #1019861 (EPRI 2011) to determine if Merrimack Station has a *de minimis* rate of impingement;

4. Propose an evaluation of the potential biological efficacy of wedgewire screens as a Best Technology Available to Minimize Adverse Environmental Impact (BTA) for reducing entrainment abundance at Merrimack Station if a compliance option for entrainment reductions is needed to satisfy the BTA standards at Merrimack Station;
5. Propose an evaluation of the potential biological efficacy of an Aquatic Filter Barrier (AFB) as BTA for reducing entrainment abundance at Merrimack Station if a compliance option for entrainment reductions is needed to satisfy the BTA standards at Merrimack Station;

2.0 Overview of the Final §316(b) Regulations and their Applicability to Merrimack Station

The procedure for demonstrating compliance with §316(b) of the Clean Water Act is specified by 40 CFR §122.21 of the final §316b regulations. There are fourteen requirements specified in the final §316(b) regulations, and the applicable requirements will likely be addressed in the next NPDES permit for Merrimack Station. The table below presents a listing of all of these requirements, and the narrative that follows identifies and briefly explains those requirements that are expected to be applicable to Merrimack Station.

§122.21(r)	Description
(1)	Applicable Facilities Definitions
(2)	Source Water Physical Data
(3)	Cooling Water Intake Structure Data
(4)	Biological Characterization Study
(5)	Cooling Water System Data
(6)	Proposed IM Reduction Plan
(7)	Performance studies
(8)	Operational status
(9)	Entrainment Characterization Study
(10)	Comprehensive Technology Feasibility Plan
(11)	Economic Benefits Evaluation
(12)	Non-Water Quality and Other Environmental Impacts
(13)	Peer Review for r10, r11, or r12
(14)	New Units

Applicable Facilities are defined in §122.21 (r) (1) as existing facilities to which the §316(b) regulations apply because they have a CWIS that supplies cooling water for the purpose of non-contact cooling withdrawn from the surface waters of the United States. Existing facilities are further distinguished into those withdrawing less than 2 MGD, those withdrawing between 2 and 125 MGD, and those withdrawing more than 125 MGD based on the AIF determined from the average intake flows over the three most recent years of operating records. New units at an existing facility are also distinguished from existing units.

Source Water Physical Data required by §122.21 (r) (2) were previously summarized in Section 2 of the PIC for Merrimack Station that was submitted to USEPA in April 2005 (Normandeau 2005) and also summarized in Section 3 of the 2007 Response (PSNH 2007). Source water physical data collected since preparation of the Merrimack PIC includes a thermal stratification study, and current velocity and flow direction data obtained from Hooksett Pool of the Merrimack River during the open water period of 2009, and a quantitative bottom substrate mapping study conducted in Garvins, Hooksett, and Amoskeag Pools of the Merrimack River during the fall of 2010 (Normandeau 2011a). PSNH also provided additional source water physical data in narrative and reports submitted as comments in response to the draft NPDES permit (PSNH 2012). Federal and state agency (NOAA, USGS, NHDES, etc.) and academic (UNH) data bases must also be reviewed to determine if any additional studies have been performed since these previous documents were prepared that describe the hydrological and geomorphological characteristics of the Merrimack River near Merrimack Station.

Cooling Water Intake Structure Data required by §122.21 (r) (3) were previously summarized for each intake (Unit 1 and Unit 2) at Merrimack Station in Section 3 of the PIC that was submitted to USEPA in April 2005 (Normandeau 2005) and also summarized in Section 3 of the 2007 Response (PSNH 2007).

Source Water Baseline Biological Characterization Data §122.21 (r) (4) were previously summarized for Merrimack Station in Section 6 of the PIC that was submitted to USEPA in October 2005 (Normandeau 2005). Since preparation of the Merrimack PIC, additional source water biological characterization data related to the fish community have been collected. A recent fish-related study collected and summarized information on the biocharacteristics of two resident fish species (Yellow Perch and White Sucker) during 2008 (Normandeau 2009), and the community composition of the benthic macroinvertebrate community was assessed during fall 2011 (Normandeau 2012). PSNH also provided additional source water baseline biological data in narrative and reports submitted as comments in response to the draft NPDES permit (PSNH 2012). Current Federal and State agencies (NOAA, USGS, NHFG, etc.) and academic (UNH) data bases must also be reviewed to determine if any new biological characterization studies have been performed since the previous reports were prepared that describe the baseline biological characteristics of the Merrimack River near Merrimack Station.

Cooling Water System Data §122.21 (r) (5) were previously summarized for Unit 1 and Unit 2 at Merrimack Station in Section 4 of the PIC that was submitted to USEPA in October 2005 (Normandeau 2005) and also summarized in Section 3 of the 2007 Response (PSNH 2007). Updated AIFs for each unit at Merrimack Station are provided for the three most recent years of data available (1 January 2011 through 31 December 2013) in Section 3 below.

A Proposed Impingement Mortality Reduction Plan §122.21 (r) (6) is required for Merrimack Station because the AIF for the three most recent years of available cooling water intake flows is above 2 MGD and less than 125 MGD. Compliance options for impingement mortality reductions include selection of one of the following:

1. Closed cycle recirculating system - §125.94(c)(1),
2. Design through-screen intake velocity <0.5 fps - §125.94(c)(2),
3. Actual through-screen intake velocity <0.5 fps - §125.94(c)(3),
4. Have an existing offshore velocity cap >800 feet offshore - §125.94(c)(4),
5. Install modified traveling screens - §125.94(c)(5),
6. Use a combination of technologies and operational measures such as flow reductions or scheduled outages - §125.94(c)(6), or
7. Demonstrate that the existing system meets the impingement mortality performance standard of 24% latent mortality (excluding fragile species) - §125.94(c)(7).

A case can also be made for some facilities that the existing level of impingement is *de minimis* based on impingement abundance numbers or age 1 equivalent abundance in relation to mean annual intake flows.

Entrainment Performance Studies §122.21 (r) (7) were previously performed at Merrimack Station and were submitted to USEPA to allow the Director to establish technology-based requirements for entrainment. Site-specific studies describing the efficacy of various technologies to reduce entrainment abundance, through-system entrainment survival studies of eggs and larvae, and entrainment abundance analyses were also provided previously and are considered relevant to, and representative of, the current conditions at Merrimack Station. Studies older than ten years may not be accepted if the source water body has changed significantly over that time period. An entrainment abundance and survival (through CWIS) characterization study was performed at Merrimack Station from 29 June 2005 through 28 June 2007 (Normandeau 2007), which provided the basis for an evaluation of the entrainment reduction performance of various alternative technologies or operational measures as described in Section 8 and Attachment 6 of the 2007 Response (PSNH 2007).

Operational Status §122.21 (r) (8) must be described for each unit at Merrimack Station. This information was previously summarized for Unit 1 and Unit 2 at Merrimack Station in

Section 4 of the PIC that was submitted to USEPA in October 2005 (Normandeau 2005) and also summarized in Section 3 of the 2007 Response (PSNH 2007). Updated operational status has been reviewed (by ENERCON) and any fundamental changes described for each unit at Merrimack Station by examining station records for the period since the two previous reports were prepared.

An Entrainment Characterization Study §122.21 (r) (9) was performed at Merrimack Station from June 2005 through June 2007 (Normandeau 2007) and is therefore considered current and complete. Furthermore, based on the observed AIF for Merrimack Station of less than 125 MGD for the most recent three-year period (1 January 2011 through 31 December 2013), an entrainment reduction is not currently required.

A Comprehensive Technical Feasibility Plan and Cost Evaluation Study §122.21 (r) (10) is also not required because this plan and study is applicable to facilities required to evaluate entrainment reductions, and the observed AIF of less than 125 MGD for the most recent three-year period (1 January 2011 through 31 December 2013) should exempt Merrimack Station from the entrainment reduction requirement of the new §316(b) regulations. The technical feasibility and costs of various impingement and entrainment reduction technologies considered candidates for application to Merrimack Station were described in the 2007 Response (PSNH 2007) and in subsequent responses.

An Economic Benefits Evaluation Study §122.21 (r) (11) is also not required because this study is applicable to facilities required to evaluate entrainment reductions, and the observed AIF of less than 125 MGD for the most recent three-year period (1 January 2011 through 31 December 2013) exempts Merrimack Station from the entrainment reduction requirement of the new §316(b) regulations.

The Non-Water Quality Environmental and Other Impacts Assessment §122.21 (r) (12) must be described for the impingement mortality reduction plan selected for Merrimack Station under §122.21 (r) (6) above. The non-water quality environmental and other impacts were described for the technologies considered candidates for application to Merrimack Station in the 2007 Response (PSNH 2007) and in subsequent responses. This assessment is not required for entrainment reductions, because the observed AIF of less than 125 MGD for the most recent three-year period (1 January 2011 through 31 December 2013) exempts Merrimack Station from the entrainment reduction requirement of the new §316(b) regulations.

A Peer Review §122.21 (r) (13) is specified for facilities that must provide studies to address entrainment and the applicable sections of §122.21 (r) (10) (11) and (12). However, we do not expect Merrimack Station to be required to address these sections because the observed AIF of less than 125 MGD for the most recent three-year period (1 January 2011 through 31

December 2013) exempts Merrimack Station from the entrainment reduction requirement of the new §316(b) regulations.

New Units §122.21 (r) (14) are not proposed for Merrimack Station.

3.0 Impingement Abundance at Merrimack Station during 2005 through 2007 and 2011 through 2013

An impingement characterization study was performed at Units 1 and 2 of Merrimack Station from 29 June 2005 through 28 June 2007, weekly during April through December and on alternate weeks during January through March (Normandeau 2007), providing recent and relevant data for estimating impingement abundance. Merrimack Station weekly AIFs have been reduced by about 50% since the 2005 through 2007 Study, by reducing the operation of Units 1 and 2, making the weekly average AIF from Merrimack Station from 1 January 2011 through 31 December 2013 the most current and appropriate CWIS operating regime to estimate impingement abundance and mortality for compliance with the new §316(b) regulations (Table A1-1).

Weekly impingement rates (density as number of fish impinged per million gallons of water sampled, adjusted for collection efficiency; Appendix Tables B-3 and B-4 of Normandeau 2007) at each Unit (1 or 2) from the 2005 through 2007 Study were multiplied by the associated weekly AIF from Merrimack Station for 1 January 2011 through 31 December 2013 (Table A1-1) to estimate the current weekly and annual impingement abundance of fish for the two units combined (Table A1-2). Fish species impinged at Merrimack Station during the 29 June 2005 through 28 June 2007 Study were also categorized as fragile or non-fragile species according to the specifications of §125.92(m) of the new §316(b) regulations. The only species impinged at Merrimack Station classified as a fragile species was Rainbow Smelt, which accounted for only 2.3% of the total estimated fish impingement over the two-year study (Table A1-3). Annual impingement abundance of total fish at Merrimack Station was reduced by 54% in 2011 through 2013 (compared to the 2005 through 2007 study (Table A1-2) due to the recent flow reductions. No Federally-listed threatened or endangered species were observed in the impingement collections from Merrimack Station (Table A1-3).

4.0 *De Minimis* Annual Impingement Rates at Merrimack Station

Annual impingement rates for Merrimack Station were examined in comparison to other facilities to determine if the existing level of impingement abundance and mortality is *de minimis* based on annual impingement abundance numbers or age 1 equivalent abundance in relation to mean annual intake flows. The new 316(b) regulations (published 15 August 2014, effective 14 October 2014) do not define *de minimis* impingement abundance or mortality as a fixed number of fish or shellfish impinged per year. However, based on a review and evaluation of data submitted under 122.21 (r), the documented rate of fish impingement at the Merrimack Station CWIS may be so low that no additional controls are warranted. Shellfish are not impinged at Merrimack Station and therefore were not considered in this evaluation. Merrimack Station is a candidate for consideration of *de minimis* impingement rates because it employs both trash racks and conventional traveling water screens (but no fish return), and because it reduces intake flows seasonally during the winter months (PSNH 2005). Furthermore, there are no threatened or endangered species present in Hooksett Pool, and no critical habitat is found in the Merrimack River source water body. Therefore, this impingement compliance option is evaluated in this section.

Merrimack Station Unit 1 has a design intake flow of 59,000 gallons per minute (gpm), or 131 cubic feet per second (cfs) (PSNH 2005). Merrimack Station Unit 2 has a design intake flow of 140,000 gpm, or 312 cfs (PSNH 2005). Compared to mean annual Merrimack River flow (MAF) passing by Merrimack Station of 4,927 cfs (1996-2003 average, PSNH 2005), the Unit 1 design intake flow (DIF) withdraws 2.67% of the MAF, and the Unit 2 DIF withdraws 6.33% of the MAF.

Merrimack Station Unit 1 had an AIF of 43,644 gpm during the 2005 through 2007 impingement characterization study (Normandeau 2007), equal to 97 cfs or 1.34% of the MAF of 7,241 cfs for the same period. Merrimack Station Unit 2 had an AIF of 112,662 gpm during the 2005 through 2007 impingement study, equal to 251 cfs or 3.47% of the MAF. During the most recent and relevant three years of Merrimack Station CWIS operations, 1 January 2011 through 31 December 2013, Unit 1 had an AIF of 25,124 gpm, equal to 56 cfs or 1.11% of the MAF of 5,021 cfs for those years. Merrimack Station Unit 2 had an AIF of 53,365 gpm during the 2011 through 2013, equal to 119 cfs or 2.37% of the MAF.

In addition to the Merrimack Station withdrawal rates and analysis of Merrimack River MAF data provided in the previous paragraphs, the following analysis of annual impingement rates supports a conclusion that the annual impingement mortality at Merrimack Station is indeed *de minimis*. The Electric Power Research Institute (EPRI) conducted a national and regional survey of impingement and entrainment of fish and shellfish based the Clean Water Act §316(b) characterization studies performed at large cooling water intakes in response to the 2004 regulations for Phase II facilities (EPRI 2011). Impingement and entrainment sampling performed in response to the 2004 regulations occurred over a four-year period from 2004 through 2007, and most of these studies followed standard methodologies including quality control (QC) and quality assurance (QA) procedures to ensure the accuracy of these data. The resulting national data base of 166 facilities responding to the EPRI survey (including Merrimack Station) provides a basis for comparing the observed impingement abundance and mortality from two years of studies performed at Merrimack Station from 29 June 2005 through 28 June 2007 (Normandeau 2007) to annual impingement rates at these other facilities during a comparable period. This national data base is robust with respect to the source water bodies represented, providing annual total impingement abundance for CWISs withdrawing once-through cooling water from the Great Lakes, Northeast coast, mid-Atlantic coast, Southeast coast and Gulf of Mexico, West coast, Midwestern reservoirs, Southeastern reservoirs, Southwestern cooling lakes, large rivers, small rivers, and Hawaii (EPRI 2011). Merrimack Station was considered to be located on a small river in this national survey. Annual total impingement rates ranged from a high of 69,000,000 fish to a low of 126 fish based on AIF, with a mean annual impingement rate of 1,483,331 fish (S.E. = 541,844) among all 166 facilities in the EPRI national data base.

The Merrimack Station annual impingement rate averaged over the two years of study (29 June 2005 through 28 June 2007) was 3,978 fish for Unit 1 and Unit 2 combined (Table A1-2), ranking 139th among the 166 facilities responding to the EPRI national survey (Figure A1-1). Merrimack Station had an annual total far below (0.27% of) the national average. In terms of rank this 2005 through 2007 annual average impingement rate places Merrimack Station in the lowest 17% of the facilities surveyed throughout the United States that had performed impingement characterization studies during the 2004 through 2007 period (Figure A1-1). Based on the most recent and relevant intake flows from 1 January 2011 through 31 December 2013 applied to the weekly impingement rates from the 29 June 2005 through 28 June 2007 Study (Section 3.0 above), the Merrimack Station annual impingement rate was 1,834 fish for Unit 1 and Unit 2 combined (Table A1-2), which was in the lowest 11% of the facilities surveyed throughout the United States that had performed impingement characterization studies during the 2004 through 2007 period. Therefore, by comparison with the largest data base of reported annual impingement rates presently available from 166 electric generating facilities representative of all source water bodies throughout the continental United States and Hawaii (EPRI 2011), and using annual total impingement rates for the three most recent years of AIF (2011-2013), impingement abundance at Merrimack Station of 0.27% of the national average is *de minimis*.

5.0 Wedgewire Screens as BTA at Merrimack Station

ENERCON (Section 3.1) proposes to preemptively evaluate the engineering feasibility of installing wedgewire screens if a compliance option is needed to satisfy the BTA standards for entrainment reductions at Merrimack Station. Installed wedgewire screens may also provide reductions in impingement mortality at Merrimack Station during their period of operation. [redacted] Entrainment is seasonal at Merrimack Station, and peak entrainment is limited to a

13-week period from mid-May through the first week of August when, on average, 97% of the annual entrainment occurs (Normandeau 2007). Therefore, a site-specific study would be performed to determine the ambient current flow and direction, debris loading, and biological efficacy of a partial-scale system during the 13-week period of peak entrainment from mid-May through the first week of August.

Recent research in a laboratory flume [redacted] and in the Hudson River estuary [redacted] has demonstrated that cylindrical wedgewire screen performance is related to three factors: physical exclusion by the slot width, behavioral avoidance of the intake flow by the fish, and the hydraulic bypass due to sweeping flow of river currents along the surface of the wedgewire screen in a direction perpendicular to the slot openings (i.e., parallel to the slot width). Cylindrical wedgewire screens with slot widths of 2, 3, 6, and 9 mm were tested at flume velocities of 0.25, 0.50, and 1.0 fps, with through-slot velocities of 0.25 and 0.50 fps for a total of 24 combinations of slot width, flume velocity, and through-slot velocity. Physical exclusion exhibited a direct relationship to greatest body depth, and fish (eggs, larvae, or juveniles) with a greatest body depth larger than the slot width were physically excluded. Behavioral avoidance was typically higher for the smaller slot widths, and a lower through-slot velocity. Overall, avoidance and hydraulic bypass were higher at higher ratios of sweeping velocity to through-slot velocity, particularly when this ratio exceeded 1:1. These mechanistic studies demonstrated that hydraulic bypass and avoidance were the prevailing modes of effectiveness of cylindrical wedgewire screens. Exclusion also operated to reduce entrainment of eggs and larvae with limiting dimensions larger than the slot width.

The Merrimack River location of Merrimack Station appears ideal for effective operation of wedgewire screens due to the relatively consistent high sweeping velocity along a predominant north-south axis observed in a preliminary survey performed during the peak entrainment periods of 2009 and 2010. Geo-referenced depth and current data were collected in the vicinity of Station N-5 (Merrimack Station intake) in Hooksett Pool using a SonTek Mini ADP 1.0 MHz Acoustic Doppler Current Profiler (ADCP) and a Trimble DSM-232 GPS during the four week periods from 17 May through 13 June 2009 and from 16 May through 12 June 2010. Data were collected twice weekly (Tuesday and Thursday) during each four week period (eight sampling events per year) and consisted of one daytime set and one nighttime set. The order in which the 10 stations (Figure A1-2) were sampled from the river cross section at Station N-5 was randomized independently within each of the eight daytime and eight nighttime sampling events, to avoid the potential bias of always sampling a particular stratum at the same time of day or night. Velocity data were summarized into seven vertical zones sequentially numbered along the cross section of the Merrimack River at Transect N-5 (Merrimack Station Intake) from the west (Stations 1 and 2 = zone 1) to east (Station 10 = zone 7) (Figure A1-2).

The frequency distribution of the Merrimack River velocities observed near the Merrimack Station intake (Station N-5) reveals that the average sweeping flow from north to south was 88 cm/sec (2.9 fps) along the west bank near the Merrimack Station intake, between 110 and 117 m/sec (3.6 and 3.8 fps) at mid-channel locations, and 75 cm/sec (2.5 fps) on the east bank of the Merrimack River (Table A1-4). A more detailed site-specific ADCP study would be required to characterize the Merrimack River sweeping flows and the consistency of the current direction to assist the engineering design of a half-diameter wedgewire screen array for Merrimack Station entrainment reductions to help maximize the alignment of the long axis of each screen and maximize the sweeping flow to slot flow ratio above 1:1 during the mid-May through July period of peak entrainment abundance.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

6.0 Aquatic Filter Barrier as BTA at Merrimack Station

ENERCON (Section 3.2) has performed a preliminary evaluation of the engineering feasibility of installing an Aquatic Filter Barrier (AFB) to completely surround the two separate CWISs at Merrimack Station if a compliance option is needed to satisfy the BTA standards for entrainment at Merrimack Station. An installed AFB may also provide reductions in impingement mortality at Merrimack Station during the period of effective operation. Accordingly, the narrative in this section describes a previous evaluation of an installed AFB from Lovett Station located on the Hudson River estuary (LMS 1998b, 2005) as an example of the potential biological efficacy of and AFB as BTA for reducing entrainment abundance at Merrimack Station. Entrainment is seasonal at Merrimack Station, and peak entrainment is limited to a 13-week period from mid-May through the first week of August when, on average, 97% of the annual entrainment occurs (Normandeau 2007). Therefore, a site-specific study would be performed to determine the performance characteristics and biological efficacy of a partial-scale AFB system during the 13-week period of peak entrainment from mid-May through the first week of August.

The efficacy of a deployed AFB is directly related to the amount of time it operates as designed. Continuous operation of a deployed AFB during the early May to early August of each year at Merrimack Station will be important for optimizing entrainment reduction benefits. Additionally, the water velocity drawn through the AFB fabric panels should be considered in the site-specific engineering design to reduce the impingement of entrainable life stages of fish (i.e., those that would pass through a mesh with a maximum opening dimension of 0.56 inches). A literature review of recent AFB applications would be performed as part of a complete engineering design and biological feasibility study to determine the relationship between water velocity through the AFB and the likelihood of impingement of fish eggs and larvae on the outer surface of the designed barrier for Merrimack Station relative to the maximum pore size or mesh openings.

The engineering design of the AFB for Merrimack Station must also account for the combination of debris and high ambient current velocities in the Merrimack River for effective operation during the deployment period, and each of these factors may individually or collectively affect the performance of the deployed AFB. To estimate debris loading, data from the traveling screens was quantified continuously in 6-day and 24-hour impingement samples during the 29 June 2005 through 28 June 2007 Study at Merrimack Station (Normandeau 2007, Appendix Table B-2). The highest periods of debris loading in the water filtered through the 3/8-inch traveling screens at Merrimack Station were during the autumn months of October and November 2005, when a maximum of 183 gallons of terrestrial vegetation were collected during 24 hours on 2 November, 158 gallons of terrestrial vegetation were collected during a 24-hour period on 26 October, and 94 gallons of terrestrial vegetation were collected during a 24-hour period on 19 October. Debris loads observed continuously during the 13 week periods of peak entrainment abundance at Merrimack Station from early May through early August averaged 30 gallons per day.

The AFB is permeable to water but it is relatively impermeable to fish and ichthyoplankton and, therefore, is one of only a few technologies capable of reducing both entrainment and impingement of aquatic organisms (USEPA 2004). The AFB system has a patented full-water-depth filter curtain composed of polyethylene or polypropylene fabric panels that is supported by flotation billets at the surface of the water and anchored to the bottom of the water body (LMS 1998b, 2005). The AFB completely surrounds a CWIS, preventing organisms from entering the intake.

The engineering performance of an AFB was evaluated at Lovett Generating Station ("Lovett") in each year 1994 through 2002 with the objectives of designing, installing and testing a full scale system that could be installed and reliably operated at Lovett to exclude fish eggs and larvae from entrainment into Lovett's cooling water intake system (LMS 1996, 1997, 1998a, 1998b, 2005). Biological effectiveness testing began in 2003 with an evaluation of sampling methodology and techniques (ASA 2003), followed by four consecutive years of complete seasonal sampling from May through October of 2004, 2005, 2006, and 2007 (ASA 2004, 2005, 2006, 2007). Lovett ceased operation in 2008 and was dismantled.

Lovett consisted of three fossil-fueled, steam electric units (Units 3, 4, and 5) having net generating capacities of 63 megawatts of electric power (MWe), 197 MWe, and 202 MWe, respectively, for a total of 463 MWe for all three units combined. The once through design cooling water intake flows were 42,000 gallons per minute (gpm) for Unit 3, 104,300 gpm for Unit 4, and 112,000 gpm for Unit 5, for a total of 258,300 gpm. Cooling water for each of the three Lovett units was withdrawn from the Hudson River estuary through shoreline intakes equipped with conventional 3/8-inch mesh traveling screens. The AFB installed and tested at Lovett was made from two layers of non-woven fabric (LMS 1998b) that encircled the shoreline bulkhead containing the CWISs for Unit 3, Unit 4, and Unit 5. The outer layer had 0.5 mm diameter perforations spaced on-center at 6.4 mm, and the inner layer was vented with horizontal 5.1 cm flaps spaced at 0.6 m (LMS 1998b).

Lovett Station was located on the west bank of the Hudson River estuary just north of Stony Point, New York, 41 miles upstream from the southern tip of Manhattan in New York City. Biological effectiveness was determined by comparing the percent difference in density of entrainable-sized ichthyoplankton from pairs of pumped samples collected inside and outside of a deployed AFB enclosing the Lovett CWIS. Post yolk sac larvae was the dominant life stage in all samples, contributing 91% (2,380) of the total ichthyoplankton collected at the test location (2,619) and 94% (17,661) of the total ichthyoplankton collected at the control location (18,730) over the four-year study. The Lovett AFB evaluation focused on six target taxa: Striped Bass, White Perch, river herring (Alewife and Blueback Herring), Bay Anchovy, American Shad, and Atlantic Tomcod. However, only the first four fish taxa were caught in sufficient numbers to estimate the exclusion effectiveness.

The AFB system installed and operated at Lovett during 2004 through 2007 exhibited an average exclusion effectiveness of 79% for all species and life stages of ichthyoplankton combined, with inter-annual variation ranging from a low of 40% in 2004 to a high of 95% in 2007 (Table A1-5). The Lovett AFB was estimated to exclude, on average among the four years, 89% of the Bay Anchovy (inter-annual range 68% to 100%), 89% of the Striped Bass (inter-annual range 85% to 94%), 85% of the White Perch (inter-annual range 62% to 97%), and 52% of the river herring (inter-annual range of -57% to 99%) over the four years of testing. Since no eggs or larvae exposed to the Lovett AFB were smaller than the 0.5 mm perforations of the outer fabric, the 79% overall average percent effectiveness suggests that performance of the Lovett AFB is directly related to its time of deployment with respect to the Hudson River fish spawning season, the proportion of the total intake flow drawn directly through the filtration mesh, and the density of ichthyoplankton in the volume of unfiltered water drawn into the intake when deployment fails. A similar performance to this Lovett AFB would be expected if an AFB was installed and operated effectively at Merrimack Station during the 13-week period of peak entrainment from mid-May through the first week of August. However, a site-specific study of an AFB test panel would be required to estimate the site-specific biological efficacy during the deployment period in the Merrimack River due to the differences in the ichthyoplankton species and river conditions between the two source water bodies.

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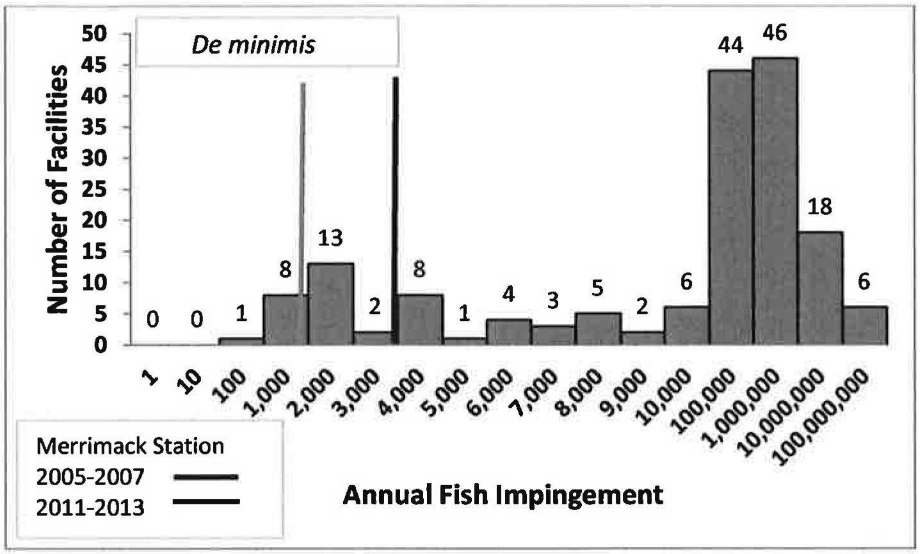

Figure A1-1. Annual fish impingement rates at Merrimack Station in 2005 through 2007 and 2011 through 2013 compared to annual impingement rates from EPRI's national and regional survey of 166 facilities performing Clean Water Act 316(b) characterization studies (EPRI 2011).

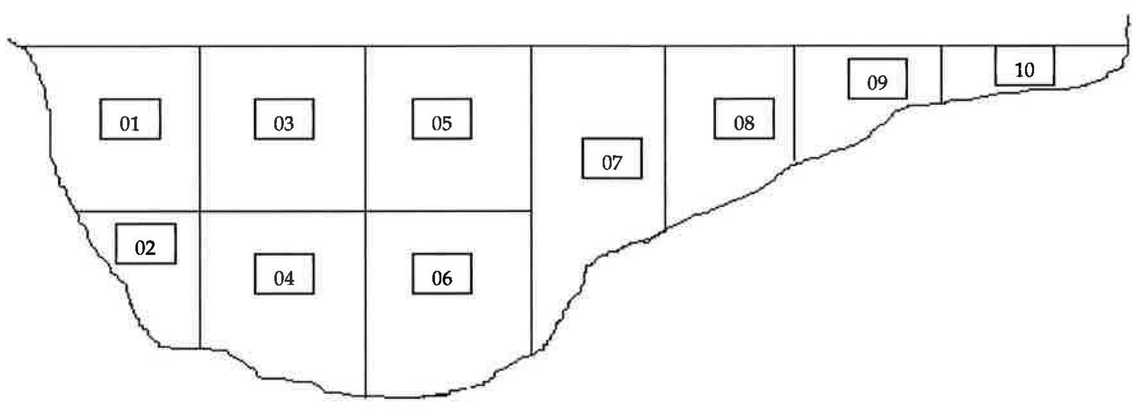

Figure A1-2. Cross sectional area at Station N-5 (Merrimack Station Intake) in the Merrimack River showing the horizontal and vertical subdivisions sampled for river current velocity during 17 May through 13 June 2009 and from 16 May through 12 June 2010. Note: River depth and width are not to scale.

Table A1-1. Merrimack Station's weekly and annual total operating intake flow sampled from 29 June 2005 through 28 June 2007 compared to the corresponding weekly average actual intake flows for 1 January 2011 through 31 December 2013 (both expressed as millions of gallons per week).

Month	Week	2005-2007	2011-2013
January	1	1,794.2	1,565.9
	2	1,740.5	1,450.7
	3	1,574.0	1,524.7
	4	1,506.1	1,279.1
February	5	1,720.2	1,406.1
	6	1,687.4	1,421.3
	7	1,736.6	1,385.2
	8	1,487.7	1,393.7
March	9	1,768.6	1,601.0
	10	1,789.1	1,301.9
	11	1,794.2	1,144.5
	12	1,663.9	927.5
	13	1,788.4	768.7
April	14	1,662.7	437.7
	15	1,786.3	323.6
	16	985.9	236.5
	17	482.1	1.7
May	18	445.9	0.0
	19	400.9	327.4
	20	674.5	295.1
	21	1,658.8	343.7
	22	1,664.6	785.3
June	23	1,790.5	807.6
	24	1,789.1	483.4
	25	1,638.2	759.6
	26	1,794.2	783.6
July	27	1,794.2	1,007.8
	28	1,794.2	1,478.1
	29	1,794.1	1,737.8
	30	1,791.7	1,289.2
August	31	1,789.5	1,227.5
	32	1,706.9	1,252.5
	33	1,793.1	319.3
	34	1,794.2	480.2
	35	1,576.8	161.3
September	36	1,657.9	92.1
	37	1,552.3	205.9
	38	1,388.2	0.0
	39	1,331.0	160.8

(continued)

Table A1-1. (Continued)

Month	Week	2005-2007	2011-2013
October	40	1,720.8	17.5
	41	1,216.1	79.8
	42	1,468.1	161.3
	43	1,693.3	157.6
November	44	1,713.4	4.0
	45	1,758.3	119.2
	46	1,782.0	640.7
	47	1,793.0	876.1
	48	1,636.3	1,336.6
December	49	1,734.1	1,513.3
	50	1,794.2	1,436.2
	51	1,461.9	1,205.9
	52	1,794.2	1,538.0
Annual Total Flow		**82,154.7**	**41,254.2**
Daily Actual Intake Flow		**225.7**	**113.3**

Table A1-2. Weekly and annual total impingement abundance of fish (Adj-I) estimated for Merrimack Station Units 1, 2, and both units combined based on actual average intake flows during 29 June 2005 through 28 June 2007 and during 1 January 2011 through 31 December 2013.

Month	Week #	2005-2007 Abundance			2011-2013 Abundance		
		Unit 1	Unit 2	Total	Unit 1	Unit 2	Total
January	1	4	12	16	4	10	14
	2	17	18	34	14	15	28
	3	34	21	55	32	21	53
	4	19	12	31	15	10	25
February	5	2	2	4	1	2	3
	6	0	18	18	0	17	17
	7	2	42	44	2	33	35
	8	10	22	32	9	21	30
March	9	14	4	18	14	4	18
	10	25	9	34	25	6	31
	11	44	21	65	44	11	55
	12	15	6	21	17	2	19
	13	25	9	33	13	3	17
April	14	12	6	18	7	1	8
	15	8	28	36	2	5	6
	16	4	13	17	0	5	5
	17	0	0	0	0	0	0
May	18	13	0	13	0	0	0
	19	3	0	3	0	12	12
	20	70	8	78	10	10	20
	21	66	62	127	27	9	36
	22	25	22	47	14	10	24
June	23	149	443	593	64	204	268
	24	41	1,330	1,371	4	445	449
	25	15	27	42	5	13	18
	26	11	223	235	3	108	112
July	27	21	44	64	14	23	37
	28	5	35	40	4	29	33
	29	0	22	22	0	22	22
	30	10	6	16	7	4	11
August	31	0	0	0	0	0	0
	32	0	10	10	0	8	8
	33	4	9	13	1	1	3
	34	0	0	0	0	0	0
	35	0	0	0	0	0	0

(continued)

Table A1-2. (Continued)

Month	Week #	2005-2007 Abundance			2011-2013 Abundance		
		Unit 1	Unit 2	Total	Unit 1	Unit 2	Total
September	36	0	14	14	0	0	0
	37	3	0	3	1	0	1
	38	0	8	8	0	0	0
	39	4	16	19	2	0	2
October	40	0	9	9	0	0	0
	41	9	41	50	2	0	2
	42	22	74	96	7	0	7
	43	25	27	52	8	0	8
November	44	22	100	122	0	0	0
	45	8	40	49	2	0	2
	46	0	6	6	0	2	2
	47	2	23	25	2	8	10
	48	55	12	67	82	8	90
December	49	140	90	229	159	70	230
	50	8	28	36	8	20	28
	51	12	7	19	12	5	17
	52	8	11	19	8	9	17
Annual Total		**987**	**2,990**	**3,978**	**648**	**1,186**	**1,834**

[1] Weekly and annual total impingement abundance for fish (Adj-I) was the density sampled (fish/million gallons), corrected for collection efficiency, and multiplied by the weekly actual intake flow (million gallons).

[2] The only fish species observed in the Merrimack Station impingement samples from 2005 through 2007 considered to be a fragile species according to §125.92(m) of the §316(b) regulations was Rainbow Smelt, which only accounted for 2.3% of the total estimated impingement during the two years.

Table A1-3. Fish species annual abundance and percent composition and their designation as a "Fragile Species" by USEPA 316(b) regulations in the Merrimack Station impingement collections (Units 1 and 2 combined) based on actual annual average intake flows during 29 June 2005 through 28 June 2007.

Species	Annual Abundance	Percent of Total	Fragile Species
American Eel	8	0.2	
Banded Sunfish	16	0.4	
Black Crappie	223	5.6	
Bluegill	2,482	62.4	
Brown Bullhead	20	0.5	
Chain Pickerel	8	0.2	
Fallfish	28	0.7	
Golden Shiner	76	1.9	
Largemouth Bass	175	4.4	
Margined Madtom	107	2.7	
Pumpkinseed	131	3.3	
Rainbow Smelt	91	2.3	yes
Redbreast Sunfish	24	0.6	
Rock Bass	8	0.2	
Smallmouth Bass	32	0.8	
Spottail Shiner	302	7.6	
Sunfish family	16	0.4	
Tessellated Darter	28	0.7	
White Perch	12	0.3	
White Sucker	12	0.3	
Yellow Bullhead	12	0.3	
Yellow Perch	167	4.2	
All Species	**3,978**	**100.0**	

Table A1-4. Distribution of Merrimack River current velocity and discharge observed in a cross section at Station N-5 (Merrimack Station intake) in Hooksett Pool during 17 May through 13 June 2009 and from 16 May through 12 June 2010.

Zone	Avg. depth (UNITS)	Avg. Velocity (cm/s)	River Discharge (cfs)	Proportion
1 (west)	2.77	88.0	2,350.6	0.170
2	2.56	109.8	2,706.3	0.196
3	2.27	110.2	2,407.7	0.174
4	1.91	114.5	2,113.0	0.153
5	1.53	116.9	1,721.4	0.125
6	1.33	117.4	1,501.2	0.109
7 (east)	1.41	75.0	1,015.2	0.073
1-7	-	-	13,815.4	1.000

Table A1-5.Summary of annual percent exclusion effectiveness for fish larvae collected by simultaneous pairs of samples taken inside and outside of a deployed AFB at Lovett Station on the Hudson River, New York, from May through October 2004, 2005, 2006 and 2007.

Fish Taxon	Year	Percent of Catch	Percent Effectiveness
Bay Anchovy	2004	34%	68%
	2005	32%	99%
	2006	39%	89%
	2007	52%	100%
	2004-07 Mean	**39%**	**89%**
Striped Bass	2004	35%	85%
	2005	43%	94%
	2006	21%	90%
	2007	22%	88%
	2004-07 Mean	**30%**	**89%**
White Perch	2004	2%	62%
	2005	3%	97%
	2006	8%	89%
	2007	1%	92%
	2004-07 Mean	**4%**	**85%**
River Herring	2004	1%	-57%
	2005	1%	84%
	2006	4%	81%
	2007	2%	99%
	2004-07 Mean	**2%**	**52%**
All Species	2004	100%	40%
	2005	100%	92%
	2006	100%	89%
	2007	100%	95%
	2004-07 Mean	**100%**	**79%**