GSP MERRIMACK LLC

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January 21, 2020

Submitted electronically at www.regulations.gov

Mr. Richard Benware
Engineering and Analysis Division
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue N.W.
Washington D.C. 20460

Re: Comments on EPA's Proposed Rule *Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, 84 Fed. Reg. 64,620 (Nov. 22, 2019), EPA-HQ-OW-2009-0819

Dear Mr. Benware:

GSP Merrimack LLC submits these comments on the U.S. Environmental Protection Agency's ("EPA") proposed rule entitled *Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, published at 84 Fed. Reg. 64,620 (Nov. 22, 2019) ("Proposed Rule"). The Proposed Rule would revise certain provisions of the technology-based effluent limitations guidelines and standards ("ELGs") for the steam electric power generating point source category applicable to flue gas desulfurization ("FGD") wastewater and bottom ash ("BA") transport water. GSP Merrimack supports EPA's Proposed Rule, with the limited, but important, revisions discussed below.

GSP Merrimack is a subsidiary of Granite Shore Power LLC. Granite Shore Power is an independent power producer located in the state of New Hampshire and operates as subsidiaries five power plants with a total capacity of 1,069 megawatts and sells capacity and electricity to the ISO New England ("ISO-NE") wholesale electricity market. With their diverse blend of fuel sources, including coal, Granite Shore Power's subsidiaries provide electricity generation on the coldest days, when there is not enough natural gas supply to satisfy New Hampshire's power demands, and on the warmest days, when electricity consumption is at peak levels.

Merrimack Generation Station ("Merrimack Station"), located along the Merrimack River in Bow, New Hampshire, is the largest of these plants. Merrimack Station has two coal-fired steam units and two kerosene fueled combustion turbine units for a total of 482 MW (winter capacity). The two coal-fired units serve as seasonal and peak demand resources. The two combustion turbine units primarily serve peaking roles, operating during periods of extreme intermittent demand and when generation is needed quickly to maintain electrical system stability on the grid. Merrimack Station plays an important role in providing grid generation diversity, especially during critical winter months when natural gas becomes constrained in ISO-NE. Environmental enhancements at Merrimack Station include supplemental electrostatic precipitators ("ESPs"), selective catalytic reduction systems ("SCRs"), and a common wet flue gas desulfurization system ("FGD Scrubber") that was placed in service in September 2011, reducing the plant's SO_2 emissions by more than 94% and its mercury emissions by more than 80%.

Importantly, Merrimack Station's National Pollutant Discharge Elimination System ("NPDES") permit renewal application is currently pending before EPA Region 1. As part of that pending application, Merrimack Station is currently opted into the Voluntary Incentives Program for FGD wastewater in the existing regulations, and the application is being processed on that basis. Our comments on the Proposed Rule are informed by, and relevant to, the issues presented in that pending permit application.

GSP Merrimack submits these comments to address three primary issues with regard to the Proposed Rule. ***First***, GSP Merrimack supports the addition of a subcategory for "low utilization boilers" ("LUBs") for both FGD wastewater and BA transport water. EPA is correct that cost and energy considerations dictate that such units not be subject to the same technology requirements as other covered units. However, as discussed below, the demonstration for the LUB subcategory should be based on the average of the two-year average net generation of all units at the facility sharing a common treatment system. ***Second***, GSP Merrimack supports the proposed revisions to the Voluntary Incentives Program for FGD wastewater in § 423.13(g)(3)(i). However, for those revisions to serve their purpose, EPA must also revise existing § 423.13(g)(3)**(ii)** to align the date in that subsection with the new proposed December 31, 2028 deadline in proposed subsection (g)(3)(i). Without this additional revision to existing § 423.13(g)(3)**(ii)**, there may be a gap in application of the new regulations. ***Third***, transport water for boiler slag generated in cyclone boilers contains few constituents of concern ("COC") and is materially different than the BA transport water generated by the majority of the industry. GSP Merrimack requests that EPA acknowledge this distinction by granting Merrimack Station (or, more generally, generators of transport water of boiler slag from cyclone boilers) a variance from the best available technology economically achievable ("BAT") effluent limits proposed for BA transport water or creating a BAT subcategory for cyclone boiler slag transport water.

I. The Low Utilization Boiler Subcategory Should Be Finalized with Certain Revisions

GSP Merrimack supports the addition of a subcategory of "low utilization boilers" ("LUB") for both FGD wastewater and BA transport water. As explained in the Proposed Rule, EPA is well within its authority to establish subcategories when supported by the record. 84 Fed. Reg. at 64,624. As EPA notes, there have been changes in the electricity generation sector since the 2015 rule was promulgated that necessitate a LUB subcategory. *Id.* at 64,626. These changes include "availability of abundant and inexpensive natural gas." *Id.* These market forces have caused many coal-fired generating units to shift from baseload operation to seasonal or peaking operation and have changed the economic profile of these units. *Id.* This shift is illustrated by Merrimack Station in New Hampshire. Merrimack Station previously operated as a baseload unit, but in recent years has served as a seasonal and peak demand resource. By way of example, in 2010, the annual capacity factor for Merrimack Station's Units 1 & 2 (both coal-fired) was 69.4%, but in 2019, it fell to 7.9%. Despite its reduced generation, Merrimack Station plays an important role in providing grid generation diversity, especially during critical winter months when natural gas becomes constrained in ISO-NE. Thus, EPA is correct that the "continued operation [of LUBs] is useful, if not necessary, for ensuring electricity reliability in the near term." *Id.* at 64,639.

EPA is correct that these changes in operation at LUBs, and the resulting changes in cost profile, must be accommodated when setting discharge limitations for FGD wastewater and BA transport water for these units. EPA correctly concludes that "the record indicates that disparate costs to meet the proposed FGD wastewater and BA transport water BAT limitations . . . are imposed on boilers with low capacity utilization," *id.* at 64,638, and, further, that "[a]ttempting to pass on the higher costs per MWh produced would make these boilers increasingly uncompetitive," *id.* at 64,639. These cost and non-water quality environmental impact (*e.g.*, premature retirement of these LUBs) considerations provide a well-reasoned basis for the creation of this regulatory subcategory. GSP Merrimack agrees with EPA that "[c]hemical precipitation for FGD wastewater and surface impoundments for BA transport water . . . are the only technologies . . . [that] would not impose such disproportionate costs on this subcategory of boilers." *Id.* EPA is also correct that such cost considerations would impact a Best Professional Judgment ("BPJ") determination for these waste streams. *Id.*

EPA should finalize a LUB subcategory but should make certain changes to the proposed LUB provisions for the subcategory to function as intended. First, the generation threshold should be applied as *the average of* the two-year average net generation from all boilers at the facility sharing a common water treatment system. Because boilers at the same facility often share the same emission control equipment and associated water treatment system (as does Merrimack Station, for example), it would make no sense for these boilers to be subject to different technology requirements where, *averaged together*, their two-year average net generation is below the threshold. Such a situation would involve the same and likely greater cost disparities that EPA cites as the basis for the LUB subcategory. Under our proposed approach, for example, if, at a two-unit facility, Unit 1's two-year average net generation was 900,000 MWh and Unit 2's two-year average net generation was 800,000 MWh, both units would continue to qualify for the subcategory (because the average of their two-year average net generation would be 850,000 MWh). Such a situation may occur, for example, when one unit experiences an extended outage in a given year. Such an occurrence would not justify subjecting one unit to more stringent technology requirements.

Second, the LUB provision should *not* include the "automatic" re-categorization of an LUB during the permit term, as EPA proposes. *Id.* at 64,666 (proposed § 423.13(g)(2)(iii)(B) & § 423.13(k)(2)(iii)(B)). The current regulations and the Proposed Rule recognize that site-specific information is necessary to determine the "as soon as possible" implementation date for the FGD wastewater and BA transport water limitations applicable to the steam electric generation point source category generally and, further, that this date can be longer than two years. *See* 40 C.F.R. § 423.11(t); 84 Fed. Reg. at 64,664-65. There is no basis in the record for abandoning this approach with respect to LUBs that no longer qualify for the subcategory because of increased net generation. The same "as soon as possible" factors should instead be considered at the next permit renewal, meaning that proposed § 423.13(g)(2)(iii)(B) & § 423.13(k)(2)(iii)(B) should be deleted and not finalized. At a minimum, if EPA does retain these provisions, they should be revised to allow for three years or longer for the re-categorized facility to meet the more stringent limitations, consistent with the information in the record, which indicates that not all facilities can meet a two year deadline for the new FGD wastewater or BA transport water limitations. 84 Fed. Reg. at 64,665 n.101.

II. EPA Should Revise Existing § 423.13(g)(3)(ii) to Align the Date with the New December 31, 2028 Deadline in Revised § 423.13(g)(3)(i)

GSP Merrimack agrees with EPA's proposed revision of the Voluntary Incentives Program for FGD wastewater, including the new deadline of December 31, 2028, to meet the more stringent effluent limits.

However, EPA must also revise existing § 423.13(g)(3)(ii) to align the dates in that Voluntary Incentives Program provision with the new December 31, 2028 deadline. At present, § 423.13(g)(3)(ii) provides discharge limitations "before December 31, 2023." That date should be revised to December 31, 2028, so that there is continuity on the national effluent limits applied to a unit that has opted into the Voluntary Incentives Program.

Importantly, § 423.13(g)**(3)(ii)** was <u>not</u> addressed or vacated by the Fifth Circuit's decision in *Southwestern Electric Power Co. v. EPA*, 920 F.3d 999 (5th Cir. 2019) ("*SWEPCo*"), which considered other provisions in the 2015 ELG rule. Specifically, with respect to so-called "legacy wastewater," the Environmental Petitioners in that case <u>expressly</u> requested review and vacatur of <u>only</u> 40 C.F.R. § 423.13(g)(1)(ii), (h)(1)(ii), and (k)(1)(ii)—none of which involve the Voluntary Incentives Program.[1] In subsequent filings with the Court, Environmental Petitioners made clear once again that § 423.13(g)(1)(ii) was not among "[t]he legacy wastewater and leachate provisions that Environmental Groups are challenging in this case[.]"[2] Indeed, the Environmental Petitioners did not challenge *any* aspects of the Voluntary Incentives Program or EPA's rationale for it, and

[1] *See* Brief of Petitioners Environmental Integrity Project, Sierra Club, and Waterkeeper Alliance, Inc. at 66, *Sw. Elec. Power Co. v. EPA*, No 15-60821 (5th Cir. Dec. 5, 2016) (Doc. 00513785014) (Attachment 1).

[2] *See* Response to Sierra Club, Environmental Integrity Project, Waterkeeper Alliance, Inc., and Clean Water Action in Opposition to Respondents' Motion to Govern Further Proceedings at 6 n.3, *Sw. Elec. Power Co. v. EPA*, No 15-60821, (5th Cir. Aug. 18, 2017) (Doc. 00514123143) (Attachment 2).

thus any challenge to § 423.13(g)(3)(ii) was waived.[3] The Fifth Circuit's decision also did not discuss the lawfulness of the Voluntary Incentives Program or § 423.13(g)(3)(ii), and thus cannot be interpreted as vacating that provision.[4]

Indeed, the Fifth Circuit did not consider EPA's distinct rationale for the Voluntary Incentives Program in the 2015 rule, and thus its decision could not, even by implication, have found any provision in § 423.13(g)(3) to be arbitrary and capricious. Evaporative treatment is the model technology for the Voluntary Incentives Program for FGD wastewater. EPA considered identifying that technology as BAT for the industry in promulgating the 2015 rule but ultimately elected to not do so because of the high costs associated with it. 80 Fed. Reg. 67,838, 67,852 (Nov. 3, 2015). Thus, the Voluntary Incentives Program imposes *more stringent* discharge limitations beyond those imposed by the final BAT limitations applicable to the rest of the industry. *Id.* at 67,858. EPA recognized facilities that "opted-in" to the Voluntary Incentives Program would not be able to immediately comply with the more stringent limits. Instead, additional time "to research, engineer, design, procure, construct, and optimize systems capable of meeting the limitations" would be required. *Id.* at 67,858-59. Despite this, EPA elected to promulgate the Voluntary Incentives Program because of the agency's beliefs that the program, as a whole, "furthers the CWA's ultimate goal of eliminating the discharge of pollutants into the Nation's waters." *Id.* at 67,858. The Program represents "reasonable further progress toward the national goal of eliminating the discharge of pollutants." *Id.* (quoting 33 U.S.C. §§ 1251(a)(1), 1311(b)(2)(A)). It is "technology-forcing"[5] insofar as it should "effectively accelerate the research into and demonstration of controls and processes intended to prevent, reduce, and eliminate pollution," consistent with CWA § 104(a)(1). *Id.*

The interim limits in § 423.13(g)(3)(ii) are an essential part of the Voluntary Incentives Program because they, along with the additional time allotted, motivate entities to undertake the research EPA desires. EPA determined these § 423.13(g)(3)(ii) limits are sufficiently protective in the interim—and promulgation of them is justified—because of the considerable benefit the agency and general public will receive through the accelerated research completed by participants in the Voluntary Incentives Program. Nothing in the Fifth Circuit's decision addresses or questions the agency's choice to structure the Voluntary Incentives Program as it did to achieve this ultimate goal, and, indeed, the Court was careful to state that it was *not* "second-guess[ing] [EPA's] weighing of the statutory factors." *SWEPCo*, 920 F.3d at 1022.

Accordingly, the Voluntary Incentives Program, including § 423.13(g)(3)(ii), remains "on the books" and is presently applicable to any and all newly-issued NPDES permits that involve FGD wastewater where the facility has elected to be part of the program. Indeed, Merrimack Station is presently opted-in to the program as part of its pending permit application before EPA Region 1. And, due to the same reasons cited by EPA as justification for the Voluntary Incentives Program, Merrimack Station will require at least until December 31, 2023, to meet the more stringent limitations based on evaporation technology, and perhaps longer due to changes in the Station's ownership and operational profile.[6]

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[3] *See Shami v. Comm'r of Internal Revenue*, 741 F.3d 560, 572 (5th Cir. 2014) ("[I]ssues not raised in a party's opening brief are waived.").

[4] *See Worldcall Interconnect, Inc. v. Fed. Commc'ns Comm'n*, 907 F.3d 810, 825 (5th Cir. 2018), as revised (Nov. 15, 2018) ("We find that WCX did not raise this argument in its petition for review. . . . Therefore, this argument is not properly before this court.").

[5] *See SWEPCo*, 920 F.3d. at 1003 (quoting *NRDC v. EPA*, 822 F.2d 104, 123 (D.C. Cir. 1987)).

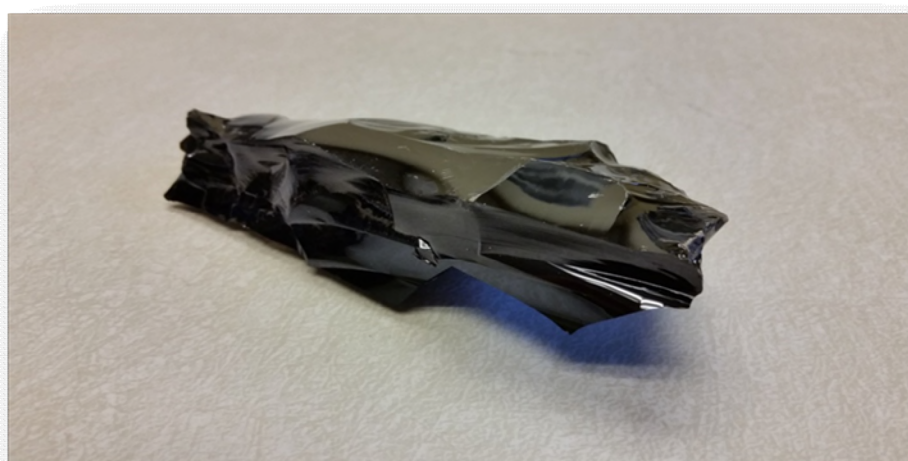
[6] The evidence in the administrative record for the Merrimack Station permit renewal demonstrates that December 31, 2023, is the earliest date by which the more stringent Voluntary Incentives Program limitations could be met at Merrimack Station, for the very reasons EPA cited in the 2015 rule. *See, e.g.,* Letter from Eversource Energy to EPA Region 1 (July 7, 2016), https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/ar/AR-1354.pdf.

For these reasons, EPA should, as part of this current rulemaking, also revise the 2023 date set out in § 423.13(g)(3)(ii) to conform to the new Voluntary Incentives Program deadline of December 31, 2028.

III. GSP Merrimack Requests a Variance or Subcategory for Cyclone Boiler Slag Transport Water.

GSP Merrimack requests a variance for Merrimack Station from the proposed BAT effluent limitations for BA transport water or the creation of a BAT subcategory for cyclone boiler slag transport water because such wastewater contains few COC and is materially different. In the Proposed Rule, EPA classifies all boiler slag (even slag from cyclone boilers) as BA and proposes to subject water used to transport slag to the same effluent limitations applicable to BA transport water. 84 Fed. Reg. at 64,628 n.9. EPA makes this classification with seemingly no consideration for actual, material differences in slag and the associated transport water generated by cyclone boilers and no justification for its conclusion.[7] GSP Merrimack requests that EPA reconsider this proposal by recognizing that boiler slag, and the associated transport water, generated by: (1) cyclone boilers in the industry is materially different; or, alternatively, (2) the cyclone boilers at Merrimack Station is materially different. Differences in this boiler slag and transport water justify a variance from the BAT effluent limits proposed for BA transport water or the creation of a BAT subcategory for such transport water. GSP Merrimack requests such a variance or the promulgation of such a subcategory and offers the following comments and Attachments 3-6 in support.

Both units at Merrimack Station have wet bottom cyclone-fired boilers, which produce slag as an end product. Molten ash from these boilers, once quenched in a tank, becomes slag (shown below)—a stable, inert, glass-like solid compound, which is very different from typical BA targeted in this ELGs rulemaking.



[7] Based on a review of EPA's 2013 proposed rule, 2015 final rule, the Proposed Rule, the associated "Supporting Documents" to these rules (including the agency's 2015 Response to Comments), as well as the associated administrative record available on www.regulations.gov, it does not appear that the record contains any underlying analysis to support EPA's apparent belief that boiler slag from cyclone boilers should be considered the same as BA. EPA's 2015 Response to Comments sets out the agency's general view that treating boiler slag as BA is consistent with EPA's regulatory practices and the technological and economic implications of complying with a rule that treats boiler slag as BA. However, the record does not appear to contain an explanation as to *why* boiler slag from cyclone boilers should be treated as BA despite the fact that such boiler slag is stable, inert, and has very low leaching characteristics and the corresponding slag transport water contains few COC compared to BA transport water generated by the majority of the industry.

This stable, inert solid is conveyed through clinker grinders to reduce the size of the glass-like material, and the resulting slag material is then sluiced, or transported with water, to a collection area where it is dewatered and processed by a third-party company for 100% beneficial reuse as abrasive blasting material and/or roofing shingle aggregate. The decanted wastewater is subsequently discharged from the facility.

The water used to transport boiler slag to the beneficial reuse facility at Merrimack Station contains minute concentrations of COC compared to what is found in typical BA transport water, and perhaps in other forms of cyclone boiler slag transport water generated by the industry. Two laboratory analyses of isolated slag transport water at Merrimack Station have been conducted in the recent past.[8] Both sets of analytical results prove cyclone boiler slag transport water at Merrimack Station is different.

EPA's Technical Development Document for the 2015 ELG rule and this 2019 Proposed Rule each include a table that sets out the industry average concentrations of COCs found in BA transport water.[9] A comparison of these industry average concentrations to the Merrimack Station sampling results further confirms the cyclone boiler slag transport water at Merrimack Station is different. Concentrations in Merrimack Station's analytical results are less than the industry average—across the board. In fact, in many instances the Merrimack Station data is "non-detect," essentially meaning the COC is not even present in the cyclone boiler slag transport water. This comparison further supports GSP Merrimack's request for a variance or separate subcategory.

EPA's toxic-weighted pound equivalent ("TWPE") methodology—which the agency relies upon to prioritize which wastewater streams, and which pollutants within those wastewater streams, warrant regulation—is also instructive and gives further credibility to GSP Merrimack's request. EPA's consultant, ERG, concluded in the 2019 rulemaking documents that the total TWPE/year discharged from 107 coal-fired power plants is 93,800.[10] Note that this TWPE/year number is a drastic reduction from the one EPA advanced in the 2015 rulemaking, which was 481,000 TWPE/year for 115 plants with a dedicated BA pond.[11] These numbers equal an average of approximately 876 and 4,182 TWPE/year, discharged per plant, respectively.

The Electric Power Research Institute ("EPRI") conducted an analysis of the annual TWPE removal expected at Merrimack Station by and through implementation of a treatment technology designed to meet the "no discharge" limitation for BA transport water included in the 2015 ELG Rule.[12] EPRI utilized the two sets of analytical results of Merrimack Station's cyclone boiler slag transport water (Attachments 3 and 4), accounted for COC found in source water, converted the analytical value of the COC to TWPE, totaled all the TWPE

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[8] *See* Letter from Eastern Analytical, Inc. re: Laboratory Report (July 22, 2013) (Attachment 3); Eastern Analytical, Inc. re: Laboratory Report (July 19, 2017) (Attachment 4).

[9] *See* EPA, *Technical Development Document for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, Dock. ID No. EPA-HQ-OW-2009-0819-6432, at 10-22 to 10-23, Table 10-7 (Sept. 2015) ("2015 TDD"); EPA *Supplemental Technical Development Document for Proposed Revisions to the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, Dock. ID No. EPA-OW-2009-0819-8211, at 6-12 to 6-13, Table 6-2 (Nov. 2019) ("2019 TDD"). Note that different industry averages exist elsewhere in EPA's administrative record for this rulemaking. *See, e.g.*, EPA, *Environmental Assessment for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, Dock. ID No. EPA-HQ-OW-2009-0819-6427, at 3-18, Table 3-4 (Sept. 2015). Merrimack Station's analytical data is materially better and different than all of the industry data sets reviewed by GSP Merrimack.

[10] Memorandum from ERG re: Pollutant Loadings Analysis and Supporting Documentation for the 2019 Steam Electric Supplemental Environmental Assessment, EPA-HQ-OW-2009-0819-7733, at 7, Table 4 (Sept. 13, 2019).

[11] *See* 2015 TDD at 10-34 to 10-35, Table 10-14.

[12] *See* EPRI Comments on the Revised Draft Determination of Technology-Based Effluent Limits for Flue Gas Desulfurization Wastewater at Merrimack Station in Bow, New Hampshire, at Appx. B (Dec. 15, 2017) ("2017 EPRI Comments") (Attachment 5).

values, and then multiplied that TWPE total by the estimated annual flow (gallons per year), which was 40 percent of the facility design flow at that time.[13] EPRI ultimately concluded that approximately 192 TWPE/year of discharges from cyclone boiler slag transport water at Merrimack Station would be eliminated. This is less than 22 percent of EPA's 2019 per-facility annual average number and less than 5 percent of EPA's 2015 per-facility annual average number. That makes Merrimack Station's cyclone boiler slag transport water materially different than the industry.

Moreover, operations at Merrimack Station have reduced dramatically in recent years. Thus, the 40 percent of design flow calculation utilized by EPRI inflates the TWPE actually discharged from the facility in recent years. Once baseload, the units at Merrimack Station now serve as seasonal and peak demand resources, critical to grid reliability. Set out in the table below are the discharge flow volumes (million gallons per year) and corresponding annual TWPE values from Merrimack Station's NPDES Outfall No. 003A from the last five years.[14] An average of the annual flows from these five years reduces EPRI's 192 TWPE/year number to 150 TWPE/year. The 2019 TWPE number for Merrimack Station would have been 144 TWPE/year (and this number would have been at its lowest in 2016, with a TWPE/year of 106). These values provide further support that the cyclone boiler slag transport water at Merrimack Station is materially different compared to the industry.

	mg/y	**TWPE/y**
EPRI Reference	584	192
Year		
2019	437	144
2018	666	219
2017	386	127
2016	322	106
2015	474	156
5 year average	457	150

The standards EPA has promulgated for granting a fundamentally different factors ("FDF") variance for individual permit holders also support GSP Merrimack's request for changes in this proposed rule. The regulations explicitly provide that a discharger "may request a variance from otherwise applicable effluent limitations . . . [f]or . . . best available technology economically achievable (BAT)" effluent limitations. 40 C.F.R. § 122.21(m). In deciding whether to grant such a request, a permit writer is to consider:

> (1) The nature or quality of pollutants contained in the raw waste load of the applicant's process wastewater;
>
> (2) The volume of the discharger's process wastewater and effluent discharged;
>
> (3) Non-water quality environmental impact of control and treatment of the discharger's raw waste load;

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[13] *See id.*

[14] Boiler slag transport water is approximately 90 to 95 percent of the total flow through Outfall 003A. This TWPE analysis assumed slag transport water was the entire flow through the Outfall over the five-year period. It therefore overestimates the total TWPEs present in the transport water and the corresponding reductions that could occur if "dry handling" treatment technologies are utilized at Merrimack Station.

(4) Energy requirements of the application of control and treatment technology;

(5) Age, size, land availability, and configuration as they relate to the discharger's equipment or facilities; processes employed; process changes; and engineering aspects of the application of control technology;

(6) Cost of compliance with required control technology.

Id. § 125.31(d). Factors (1) and (2) clearly support GSP Merrimack's request for the reasons already mentioned. Factor (6) also supports GSP Merrimack's request. The regulations provide additional detail on how cost should specifically be considered in evaluating a FDF variance request:

> A request for the establishment of effluent limitations less stringent than those required by national limits guidelines shall be approved only if:
>
> . . .
>
> (3) Compliance with the national limits (either by using the technologies upon which the national limits are based or by other control alternatives) would result in:
>
> (i) A removal cost wholly out of proportion to the removal cost considered during development of the national limits.

Id. § 125.31(b)(3)(i). EPRI analyzed this issue and ultimately determined the cost-to-TWPE removal ratio for "dry handling" treatment technologies at Merrimack Station would be $2,724/TWPE (in 1981 dollars). 2017 EPRI Comments at 3. This is "fundamentally different" from the $314/TWPE EPA formulated for the industry in the 2015 ELG Rule[15] and no one could reasonably argue the costs for Merrimack Station are not "wholly out of proportion to the removal cost considered during development of the national limits."[16]

The attached correspondence submitted to EPA Region 1 as part of the NPDES permit renewal process by the former owner of Merrimack Station, Eversource Energy, describes challenges that would be experienced in attempting to retrofit a "dry handling" treatment technology at the facility.[17] These issues are relevant to factor (5). The costs of "dry handling" technologies—if ultimately required—may also force GSP Merrimack to evaluate the economic viability of the facility (with future market conditions and forecasting critical to this analysis). This is also relevant to factor (5) and could be relevant to factor (4), as well.

In the end, EPA should grant to Merrimack Station or all generators of transport water of boiler slag from cyclone boilers a variance from the BAT effluent limits proposed for BA transport water or create a BAT subcategory for cyclone boiler slag transport water. Such an action is supported by the enclosed analytical sampling data of Merrimack Station's slag transport water, especially when compared to industry average data included in the rulemaking documents. The request is also justified when this data is converted to TWPE.

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[15] *See* EPA, *Regulatory Impact Analysis for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, Dock. ID No. EPA-HQ-OW-2009-0819-5849, at F-12 (Sept. 2015).

[16] EPA has endorsed this cost-to-TWPE removal ratio to justify (at least in part) the LUB regulatory subcategory set out in the Proposed Rule. GSP Merrimack's slag transport water request is therefore consistent with the standards the agency is using with respect to other provisions in this same rulemaking.

[17] *See* Letter from Eversource Energy to EPA Region 1 (Feb. 17. 2017) (designated "Confidential Business Information," in accordance with 40 C.F.R. Part 2) (Attachment 6). Aspects of this February 17, 2017 correspondence were superseded by a subsequent letter. *See* Letter from Eversource Energy to Mr. Mark A. Stein, Sr. Assistant Reg'l Counsel, EPA Region 1 (Apr. 20, 2017), https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/ar/AR-1388.pdf.

EPA relies upon TWPE values heavily in its rulemakings to inform whether additional treatment technology is feasible and justified. No technologies can reasonably be required for cyclone boiler slag transport water, given Merrimack Station's minuscule annual TWPE. GSP Merrimack's request is also supported by the regulatory factors EPA promulgated to evaluate whether to grant an analogous FDF variance. Almost all of these regulatory factors would support granting a variance or subcategory for Merrimack Station and any that arguably do not support such a request are simply neutral or immaterial to the specific situation. Cost is perhaps the most compelling of these regulatory variance factors. Because the slag transport water at Merrimack Station contains so few COC, the removal costs associated with technologies capable of eliminating the remaining COC in the wastewater are without question wholly out of proportion.

For all these reasons, GSP Merrimack respectfully requests that EPA grant to Merrimack Station (or, more generally, generators of transport water of boiler slag from cyclone boilers) a variance from the BAT effluent limits proposed for BA transport water or, alternatively, create a BAT regulatory subcategory for cyclone boiler slag transport water.

We appreciate the opportunity to submit these comments, including our variance requests. Please feel free to contact me with any further questions.

Sincerely,

James S. Andrews
President
GSP Merrimack LLC

Attachment 1

No. 15-60821

IN THE UNITED STATES COURT OF APPEALS
FOR THE FIFTH CIRCUIT

SOUTHWESTERN ELECTRIC POWER COMPANY; UTILITY WATER ACT GROUP; UNION ELECTRIC COMPANY, doing business as Ameren Missouri; WATERKEEPER ALLIANCE, INCORPORATED; ENVIRONMENTAL INTEGRITY PROJECT; SIERRA CLUB; AMERICAN WATER WORKS ASSOCIATION; NATIONAL ASSOCIATION OF WATER COMPANIES; CITY OF SPRINGFIELD, MISSOURI, by and through the Board of Public Utilities; DUKE ENERGY INDIANA, INCORPORATED,

Petitioners,

v.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY; GINA MCCARTHY, in her official capacity as Administrator of the United States Environmental Protection Agency,

Respondents.

Petition for Review of Final Administrative Actions of the
United States Environmental Protection Agency

OPENING BRIEF OF PETITIONERS ENVIRONMENTAL INTEGRITY PROJECT, SIERRA CLUB, AND WATERKEEPER ALLIANCE, INC.

Dated: December 5, 2016 *Counsel listed on following page*

Court should therefore vacate and remand the BAT limits for leachate contained in 40 C.F.R. § 423.13(*l*).

CONCLUSION

For the foregoing reasons, the Court should vacate and remand the following provisions of the final ELG rule:

- The BAT limits for legacy wastewater codified at 40 C.F.R. § 423.13(g)(1)(ii), (h)(1)(ii), and (k)(1)(ii); and
- The BAT limits for leachate codified at 40 C.F.R. § 423.13(l).

Respectfully submitted,

s/Thomas Joseph Cmar
Thomas Joseph Cmar
Earthjustice
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Counsel for Sierra Club, Environmental Integrity Project, and Waterkeeper Alliance, Inc.

Attachment 2

IN THE UNITED STATES COURT OF APPEALS
FOR THE FIFTH CIRCUIT

SOUTHWESTERN ELECTRIC POWER COMPANY, *et al.*, *Petitioners*, v. U.S. ENVIRONMENTAL PROTECTION AGENCY, *et al.*, *Respondents*.	)	No. 15-60821

SIERRA CLUB, ENVIRONMENTAL INTEGRITY PROJECT, WATERKEEPER ALLIANCE, INC., AND CLEAN WATER ACTION'S RESPONSE IN OPPOSITION TO RESPONDENTS' MOTION TO GOVERN FURTHER PROCEEDINGS

Petitioners and Respondent-Intervenors Sierra Club, Environmental Integrity Project, and Waterkeeper Alliance, Inc., and Respondent-Intervenor Clean Water Action (collectively "Environmental Groups") respectfully oppose Respondents' Motion to Govern Further Proceedings (Doc. 00514115266) ("EPA Mot."). Respondents propose an unjustifiable delay in the court's consideration of issues critical to the U.S. Environmental Protection Agency's ("EPA") obligation to protect the public health from toxic water pollution and an unworkable severance of the issues in this case.

same time, the final ELG rule does not go as far as the Clean Water Act requires in compelling the reduction or elimination of pollution: EPA's decision to allow so-called "legacy wastewater" and leachate from power plants to be discharged under 1982-era effluent limitations conflicts with clear evidence in the record that more effective technologies are available and affordable. *See generally* Envtl. Pet'rs' Br. (Doc. 00513785014).[3]

After EPA published the final Steam Electric ELGs rule in the Federal Register on November 3, 2015, petitions for review challenging the rule were consolidated in this Court by order of the Judicial Panel on Multidistrict Litigation on December 8, 2015 (Doc. 00513301255). All of the petitioners filed their opening briefs on December 5, 2016. EPA's response brief was originally due on April 4, 2017, *see* Sept. 28, 2016 Order (Doc. 00513695163), and then May 4, 2017, after the Court approved an unopposed request by EPA to extend that deadline by 30 days, due to an unanticipated need for substitution of counsel (Doc. 00513919648).

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indirect dischargers, compliance with new pretreatment standards is required by November 1, 2018. 40 C.F.R. § 423.16(e)-(i).

[3] The legacy wastewater and leachate provisions that Environmental Groups are challenging in this case do not include an extended compliance timeframe, and so went into effect on the Steam Electric ELGs rule's effective date of January 4, 2016. *See* 40 C.F.R. § 423.13(g)(1)(ii) (legacy FGD wastewater), (h)(1)(ii) (legacy fly ash transport water), (i)(1)(ii) (legacy flue gas mercury control wastewater), (j)(1)(ii) (legacy gasification wastewater), (k)(1)(ii) (legacy bottom ash transport water), (*l*) (leachate).

Attachment 3

Eastern Analytical, Inc.

professional laboratory & drilling services

Allan Palmer
Public Service Company of N.H.
780 North Commercial Street, PO Box 330
Manchester , NH 03105-0330

ACCREDITED IN ACCORDANCE WITH nelac

Subject: Laboratory Report

Eastern Analytical, Inc. ID:	122793
Client Identification:	Confidential
Date Received:	7/23/2013

Dear Mr. Palmer :

Enclosed please find the laboratory report for the above identified project. All analyses were performed in accordance with our QA/QC Program. Unless otherwise stated, holding times, preservation techniques, container types, and sample conditions adhered to EPA Protocol. Samples which were collected by Eastern Analytical, Inc. (EAI) were collected in accordance with approved EPA procedures. Eastern Analytical, Inc. certifies that the enclosed test results meet all requirements of NELAP and other applicable state certifications. Please refer to our website at www.eailabs.com for a copy of our NELAP certificate and accredited parameters.

The following standard abbreviations and conventions apply to all EAI reports:

Solid samples are reported on a dry weight basis, unless otherwise noted
< : "less than" followed by the reporting limit
> : "greater than" followed by the reporting limit
%R : % Recovery

Eastern Analytical Inc. maintains certification in the following states: Connecticut (PH-0492), Maine (NH005), Massachusetts (M-NH005), New Hampshire/NELAP (1012), Rhode Island (269) and Vermont (VT1012).

The following information is contained within this report: Sample Conditions summary, Analytical Results/Data, Quality Control data (if requested) and copies of the Chain of Custody. This report may not be reproduced except in full, without the the written approval of the laboratory.

If you have any questions regarding the results contained within, please feel free to directly contact me or the chemist(s) who performed the testing in question. Unless otherwise requested, we will dispose of the sample(s) 30 days from the sample receipt date.

We appreciate this opportunity to be of service and look forward to your continued patronage.

Sincerely,

Lorraine Olashaw (signature)	8.29.13	19
Lorraine Olashaw, Lab Director	Date	# of pages (excluding cover letter)

SAMPLE CONDITIONS PAGE

EAI ID#: **122793**

Client: **Public Service Company of N.H.**

Client Designation: **Confidential**

Temperature upon receipt (°C): 3.9 **Received on ice or cold packs (Yes/No): Y**

Acceptable temperature range (°C): 0-6

Lab ID	Sample ID	Date Received	Date Sampled	Sample Matrix	% Dry Weight	Exceptions/Comments (other than thermal preservation)
122793.01	Source Grab 1	7/23/13	7/22/13	aqueous		Adheres to Sample Acceptance Policy
122793.02	Source Grab 2	7/23/13	7/22/13	aqueous		Adheres to Sample Acceptance Policy
122793.03	Source Grab 3	7/23/13	7/22/13	aqueous		Adheres to Sample Acceptance Policy
122793.04	Source Grab 4	7/23/13	7/22/13	aqueous		Adheres to Sample Acceptance Policy
122793.05	Source Composite	7/23/13	7/22/13	aqueous		Adheres to Sample Acceptance Policy
122793.06	BAT Grab 1	7/23/13	7/22/13	aqueous		Adheres to Sample Acceptance Policy
122793.07	BAT Grab 2	7/23/13	7/22/13	aqueous		Adheres to Sample Acceptance Policy
122793.08	BAT Grab 3	7/23/13	7/22/13	aqueous		Adheres to Sample Acceptance Policy
122793.09	BAT Grab 4	7/23/13	7/22/13	aqueous		Adheres to Sample Acceptance Policy
122793.1	BAT Composite	7/23/13	7/22/13	aqueous		Adheres to Sample Acceptance Policy
122793.11	Pond	7/23/13	7/22/13	aqueous		Adheres to Sample Acceptance Policy
122793.12	Field Blank	7/23/13	7/22/13	aqueous		Adheres to Sample Acceptance Policy

Samples were properly preserved and the pH measured when applicable unless otherwise noted. Analysis of solids for pH, Flashpoint, Ignitibility, Paint Filter, Corrosivity, Conductivity and Specific Gravity are reported on an "as received" basis.
Immediate analyses, pH, Total Residual Chlorine, Dissolved Oxygen and Sulfite, performed at the laboratory were run outside of the recommended 15 minute hold time.

All results contained in this report relate only to the above listed samples.

References include:

1) EPA 600/4-79-020, 1983

2) Standard Methods for Examination of Water and Wastewater,20th Edition, 1998 and 22nd Edition, 2012

3) Test Methods for Evaluating Solid Waste SW 846 3rd Edition including updates IVA and IVB

4) Hach Water Analysis Handbook, 2nd edition, 1992

LABORATORY REPORT

EAI ID#: **122793**

Client: **Public Service Company of N.H.**

Client Designation: **Confidential**

			Analysis			
Sample ID:	Pond					
Lab Sample ID:	122793.11					
Matrix:	aqueous					
Date Sampled:	7/22/13					
Date Received:	7/23/13	**Units**	**Date**	**Time**	**Method**	**Analyst**
Turbidity	**2.8**	NTU	07/22/13	15:06	180.1	DN

				Analysis			
Sample ID:	Source Composite	BAT Composite					
Lab Sample ID:	122793.05	122793.1					
Matrix:	aqueous	aqueous					
Date Sampled:	7/22/13	7/22/13					
Date Received:	7/23/13	7/23/13	**Units**	**Date**	**Time**	**Method**	**Analyst**
Solids Suspended	< 5	< 5	mg/L	07/25/13	10:20	2540D-97	SCW
Sulfate	**4**	**9**	mg/L	07/24/13	11:58	300.0	KL
Sulfide	< 0.1	< 0.1	mg/L	07/25/13	14:10	8131HACH	SCW
Sulfite	< 2	< 2	mg/L	07/23/13	10:40	377.1	JL

Turbidity analyses were performed in the field.

LABORATORY REPORT

EAI ID#: **122793**

Client: **Public Service Company of N.H.**
Client Designation: **Confidential**

Sample ID:	Source Grab 1	Source Grab 2	Source Grab 3	Source Grab 4		Analysis			
Lab Sample ID:	122793.01	122793.02	122793.03	122793.04					
Matrix:	aqueous	aqueous	aqueous	aqueous					
Date Sampled:	7/22/13	7/22/13	7/22/13	7/22/13					
Date Received:	7/23/13	7/23/13	7/23/13	7/23/13	**Units**	**Date**	**Time**	**Method**	**Analyst**
Turbidity	**2.8**	**1.9**	**1.0**	**1.7**	NTU	07/22/13	11:00	180.1	DN

Sample ID:	BAT Grab 1	BAT Grab 2	BAT Grab 3	BAT Grab 4		Analysis			
Lab Sample ID:	122793.06	122793.07	122793.08	122793.09					
Matrix:	aqueous	aqueous	aqueous	aqueous					
Date Sampled:	7/22/13	7/22/13	7/22/13	7/22/13					
Date Received:	7/23/13	7/23/13	7/23/13	7/23/13	**Units**	**Date**	**Time**	**Method**	**Analyst**
Turbidity	**3.0**	**14**	**5.4**	**3.5**	NTU	07/22/13	10:25	180.1	DN

Turbidity analyses were performed in the field.

QC REPORT

EAI ID#: **122793**

Client: **Public Service Company of N.H.**

Client Designation: **Confidential**

Parameter Name	Blank	LCS	LCSD	Units	Date of Analysis	Limits	RPD	Method
Solids Suspended	< 5	91 (98 %R)	92 (99 %R) (1 RPD)	mg/L	7/25/13	90 - 110	20	2540D-97
Sulfate	< 1	19 (96 %R)	20 (102 %R) (6 RPD)	mg/L	7/24/13	90 - 110	20	300.0
Sulfide	< 0.05	0.4 (90 %R)	0.4 (98 %R) (9 RPD)	mg/L	7/25/13	80 - 120	20	8131HACH
Sulfite	< 2	5 (96 %R)		mg/L	7/23/13	80 - 120		377.1

Samples were analyzed within holding times unless noted on the sample results page.
Instrumentation was calibrated in accordance with the method requirements.
The method blanks were free of contamination at the reporting limits.
The associated matrix spikes and/or Laboratory Control Samples met the above stated criteria.
Exceptions to the above statements are flagged or noted above or on the QC Narrative page.
*/! Flagged analyte recoveries deviated from the QA/QC limits.

LABORATORY REPORT

EAI ID#: **122793**

Client: **Public Service Company of N.H.**

Client Designation: **Confidential**

Sample ID:	Source Composite	BAT Composite	Field Blank	Analytical Matrix	Units	Date of Analysis	Method	Analyst
Lab Sample ID:	122793.05	122793.1	122793.12					
Matrix:	aqueous	aqueous	aqueous					
Date Sampled:	7/22/13	7/22/13	7/22/13					
Date Received:	7/23/13	7/23/13	7/23/13					
Aluminum	**0.08**	**0.23**	< 0.05	AqTot	mg/L	7/24/13	200.8	DS
Antimony	< 0.001	< 0.001	< 0.001	AqTot	mg/L	7/24/13	200.8	DS
Arsenic	< 0.001	< 0.001	< 0.001	AqTot	mg/L	7/24/13	200.8	DS
Barium	**0.008**	**0.009**	< 0.001	AqTot	mg/L	7/24/13	200.8	DS
Beryllium	< 0.001	< 0.001	< 0.001	AqTot	mg/L	7/24/13	200.8	DS
Boron	< 0.05	< 0.05	< 0.05	AqTot	mg/L	7/24/13	200.8	DS
Calcium	**4.2**	**4.6**	< 0.05	AqTot	mg/L	7/24/13	200.8	DS
Cadmium	< 0.001	< 0.001	< 0.001	AqTot	mg/L	7/24/13	200.8	DS
Chromium	< 0.001	< 0.001	< 0.001	AqTot	mg/L	7/24/13	200.8	DS
Copper	**0.030**	**0.001**	< 0.001	AqTot	mg/L	7/24/13	200.8	DS
Cobalt	< 0.001	< 0.001	< 0.001	AqTot	mg/L	7/24/13	200.8	DS
Iron	**0.42**	**0.66**	< 0.05	AqTot	mg/L	7/24/13	200.8	DS
Lead	**0.004**	< 0.001	< 0.001	AqTot	mg/L	7/24/13	200.8	DS
Magnesium	**0.68**	**0.73**	< 0.05	AqTot	mg/L	7/24/13	200.8	DS
Manganese	**0.031**	**0.030**	< 0.005	AqTot	mg/L	7/24/13	200.8	DS
Molybdenum	< 0.001	< 0.001	< 0.001	AqTot	mg/L	7/24/13	200.8	DS
Nickel	< 0.001	< 0.001	< 0.001	AqTot	mg/L	7/24/13	200.8	DS
Potassium	**0.80**	**0.83**	< 0.05	AqTot	mg/L	7/24/13	200.8	DS
Selenium	< 0.001	< 0.001	< 0.001	AqTot	mg/L	7/24/13	200.8	DS
Silver	< 0.001	< 0.001	< 0.001	AqTot	mg/L	7/24/13	200.8	DS
Sodium	**9**	**10**	< 5	AqTot	mg/L	7/24/13	200.8	DS
Thallium	< 0.001	< 0.001	< 0.001	AqTot	mg/L	7/24/13	200.8	DS
Titanium	< 0.005	**0.010**	< 0.005	AqTot	mg/L	7/24/13	200.8	DS
Zinc	**0.013**	< 0.005	< 0.005	AqTot	mg/L	7/24/13	200.8	DS
Tin	< 0.01	< 0.01	< 0.01	AqTot	mg/L	8/1/13	200.8	DS
Strontium	**0.031**	**0.034**	< 0.005	AqTot	mg/L	8/2/13	200.8	DS

QC REPORT

EAI ID#: **122793**

Client: **Public Service Company of N.H.**

Client Designation: **Confidential**

Parameter Name	Blank	LCS	LCSD	Units	Date of Analysis	Limits	RPD	Method
Aluminum	< 0.05	11 (96 %R)		mg/L	7/24/13	85 - 115	20	200.8
Antimony	< 0.001	0.95 (95 %R)		mg/L	7/24/13	85 - 115	20	200.8
Arsenic	< 0.001	0.98 (98 %R)		mg/L	7/24/13	85 - 115	20	200.8
Barium	< 0.001	0.91 (91 %R)		mg/L	7/24/13	85 - 115	20	200.8
Beryllium	< 0.001	1.1 (106 %R)		mg/L	7/24/13	85 - 115	20	200.8
Boron	< 0.05	0.96 (96 %R)		mg/L	7/24/13	85 - 115	20	200.8
Calcium	< 0.05	11 (102 %R)		mg/L	7/24/13	85 - 115	20	200.8
Cadmium	< 0.001	0.91 (91 %R)		mg/L	7/24/13	85 - 115	20	200.8
Chromium	< 0.001	0.92 (92 %R)		mg/L	7/24/13	85 - 115	20	200.8
Copper	< 0.001	0.89 (89 %R)		mg/L	7/24/13	85 - 115	20	200.8
Cobalt	< 0.001	0.92 (92 %R)		mg/L	7/24/13	85 - 115	20	200.8
Iron	< 0.05	11 (98 %R)		mg/L	7/24/13	85 - 115	20	200.8
Lead	< 0.001	0.87 (87 %R)		mg/L	7/24/13	85 - 115	20	200.8
Magnesium	< 0.05	10 (95 %R)		mg/L	7/24/13	85 - 115	20	200.8
Manganese	< 0.005	0.95 (95 %R)		mg/L	7/24/13	85 - 115	20	200.8
Molybdenum	< 0.001	0.97 (97 %R)		mg/L	7/24/13	85 - 115	20	200.8
Nickel	< 0.001	0.92 (92 %R)		mg/L	7/24/13	85 - 115	20	200.8
Potassium	< 0.05	11 (103 %R)		mg/L	7/24/13	85 - 115	20	200.8
Selenium	< 0.001	0.99 (99 %R)		mg/L	7/24/13	85 - 115	20	200.8
Silver	< 0.001	0.11 (107 %R)		mg/L	7/24/13	85 - 115	20	200.8
Sodium	< 5	11 (96 %R)		mg/L	7/24/13	85 - 115	20	200.8
Strontium	< 0.005	0.46 (93 %R)		mg/L	8/2/13			200.8
Tin	< 0.01	1.0 (101 %R)		mg/L	8/1/13	85 - 115	20	200.8
Thallium	< 0.001	0.88 (88 %R)		mg/L	7/24/13	85 - 115	20	200.8
Titanium	< 0.005	0.96 (96 %R)		mg/L	7/24/13	85 - 115	20	200.8
Zinc	< 0.005	1.0 (105 %R)		mg/L	7/24/13	85 - 115	20	200.8

Samples were analyzed within holding times unless noted on the sample results page.
Instrumentation was calibrated in accordance with the method requirements.
The method blanks were free of contamination at the reporting limits.
The associated matrix spikes and/or Laboratory Control Samples met the above stated criteria.
Exceptions to the above statements are flagged or noted above or on the QC Narrative page.
*/! Flagged analyte recoveries deviated from the QA/QC limits.

QC REPORT

EAI ID#: **122793**

Client: **Public Service Company of N.H.**

Client Designation: **Confidential**

Parameter Name	MS/MSD Parent ID	MS/MSD Parent	Matrix Spike	MSD	Units	Date of Analysis	Limits	RPD	Method
Aluminum	122804.02	0.12	10 (92 %R)	10 (93 %R) (1 RPD)	mg/L	7/24/13	70-130	20	200.8
Antimony	122804.02	< 0.001	0.93 (93 %R)	0.96 (96 %R) (3 RPD)	mg/L	7/24/13	70-130	20	200.8
Arsenic	122804.02	< 0.001	0.96 (96 %R)	0.96 (96 %R) (0 RPD)	mg/L	7/24/13	70-130	20	200.8
Barium	122804.02	0.009	0.90 (89 %R)	0.93 (92 %R) (3 RPD)	mg/L	7/24/13	70-130	20	200.8
Beryllium	122804.02	< 0.001	0.94 (94 %R)	0.95 (95 %R) (1 RPD)	mg/L	7/24/13	70-130	20	200.8
Boron	122804.02	< 0.05	1.0 (100 %R)	1.0 (103 %R) (3 RPD)	mg/L	7/24/13	70-130	20	200.8
Calcium	122804.02	13	23 (87 %R)	23 (92 %R) (6 RPD)	mg/L	7/24/13	70-130	20	200.8
Cadmium	122804.02	< 0.001	0.89 (89 %R)	0.90 (90 %R) (1 RPD)	mg/L	7/24/13	70-130	20	200.8
Chromium	122804.02	< 0.001	0.86 (86 %R)	0.87 (87 %R) (1 RPD)	mg/L	7/24/13	70-130	20	200.8
Copper	122804.02	0.001	0.82 (82 %R)	0.84 (84 %R) (2 RPD)	mg/L	7/24/13	70-130	20	200.8
Cobalt	122804.02	< 0.001	0.86 (86 %R)	0.87 (87 %R) (1 RPD)	mg/L	7/24/13	70-130	20	200.8
Iron	122804.02	0.27	11 (94 %R)	11 (93 %R) (1 RPD)	mg/L	7/24/13	70-130	20	200.8
Lead	122804.02	< 0.001	0.85 (85 %R)	0.85 (85 %R) (0 RPD)	mg/L	7/24/13	70-130	20	200.8
Magnesium	122804.02	1.2	11 (88 %R)	11 (90 %R) (2 RPD)	mg/L	7/24/13	70-130	20	200.8
Manganese	122804.02	0.036	0.91 (88 %R)	0.91 (88 %R) (0 RPD)	mg/L	7/24/13	70-130	20	200.8
Molybdenum	122804.02	< 0.001	0.95 (95 %R)	0.98 (98 %R) (3 RPD)	mg/L	7/24/13	70-130	20	200.8
Nickel	122804.02	< 0.001	0.85 (85 %R)	0.85 (85 %R) (0 RPD)	mg/L	7/24/13	70-130	20	200.8
Potassium	122804.02	0.97	11 (95 %R)	12 (97 %R) (2 RPD)	mg/L	7/24/13	70-130	20	200.8
Selenium	122804.02	< 0.001	0.96 (96 %R)	0.97 (97 %R) (1 RPD)	mg/L	7/24/13	70-130	20	200.8
Silver	122804.02	< 0.001	0.80 (80 %R)	0.80 (80 %R) (0 RPD)	mg/L	7/24/13	70-130	20	200.8
Sodium	122804.02	< 5	14 (90 %R)	14 (91 %R) (1 RPD)	mg/L	7/24/13	70-130	20	200.8
Strontium	122793.10	0.034	0.14 (101 %R)	0.13 (98 %R) (3 RPD)	mg/L	8/2/13		20	200.8
Tin	122793.05	< 0.01	0.11 (106 %R)	0.11 (108 %R) (2 RPD)	mg/L	8/1/13	70-130	20	200.8
Thallium	122804.02	< 0.001	0.85 (85 %R)	0.86 (86 %R) (1 RPD)	mg/L	7/24/13	70-130	20	200.8
Titanium	122804.02	< 0.005	1.0 (102 %R)	1.0 (103 %R) (1 RPD)	mg/L	7/24/13	70-130	20	200.8
Zinc	122804.02	0.006	0.97 (96 %R)	0.98 (97 %R) (1 RPD)	mg/L	7/24/13	70-130	20	200.8

Samples were analyzed within holding times unless noted on the sample results page.
Instrumentation was calibrated in accordance with the method requirements.
The method blanks were free of contamination at the reporting limits.
The associated matrix spikes and/or Laboratory Control Samples met the above stated criteria.
Exceptions to the above statements are flagged or noted above or on the QC Narrative page.
*/! Flagged analyte recoveries deviated from the QA/QC limits.

LABORATORY REPORT

EAI ID#: **122793**

Client: **Public Service Company of N.H.**

Client Designation: **Confidential**

Sample ID:	Source Grab 1	Source Grab 2	Source Grab 3	Source Grab 4	Units	Date of Analysis	Method	Analyst
Lab Sample ID:	122793.01	122793.02	122793.03	122793.04				
Matrix:	aqueous	aqueous	aqueous	aqueous				
Date Sampled:	7/22/13	7/22/13	7/22/13	7/22/13				
Date Received:	7/23/13	7/23/13	7/23/13	7/23/13				
Temperature	**25**	**26**	**26**	**26**	°C	7/22/13	SM2550B	JG
Field pH	**6.8**	**6.8**	**6.8**	**6.8**	SU	7/22/13	SM4500H	JG
Field DO	**7.5**	**7.6**	**7.4**	**7.6**	mg/L	7/22/13	SM4500O	JG

Sample ID:	BAT Grab 1	BAT Grab 2	BAT Grab 3	BAT Grab 4	Units	Date of Analysis	Method	Analyst
Lab Sample ID:	122793.06	122793.07	122793.08	122793.09				
Matrix:	aqueous	aqueous	aqueous	aqueous				
Date Sampled:	7/22/13	7/22/13	7/22/13	7/22/13				
Date Received:	7/23/13	7/23/13	7/23/13	7/23/13				
Temperature	**26**	**29**	**29**	**30**	°C	7/22/13	SM2550B	JG
Field pH	**6.6**	**7.2**	**6.0**	**5.8**	SU	7/22/13	SM4500H	JG
Field DO	**7.5**	**7.2**	**7.2**	**7.1**	mg/L	7/22/13	SM4500O	JG

LABORATORY REPORT

EAI ID#: **122793**

Client: **Public Service Company of N.H.**

Client Designation: **Confidential**

Sample ID: Pond

Lab Sample ID: 122793.11

Matrix: aqueous

Date Sampled: 7/22/13

Date Received: 7/23/13

		Units	Date of Analysis	Method	Analyst
Temperature	**28**	°C	7/22/13	SM2550	JG
Field pH	**6.2**	SU	7/22/13	SM4500	JG
Field DO	**8.2**	mg/L	7/22/13	SM4500	JG

August 27, 2013

Service Request No: R1305350

Mr. Jeff Gagne
Eastern Analytical, Inc.
25 Chenell Drive
Concord, NH 03301

Laboratory Results for: Confidential/122793

Dear Mr. Gagne:

Enclosed are the results of the sample(s) submitted to our laboratory on July 24, 2013. For your reference, these analyses have been assigned our service request number **R1305350**.

All analyses were performed according to our laboratory's quality assurance program. The test results meet requirements of the NELAP standards except as noted in the case narrative report. All results are intended to be considered in their entirety, and ALS Environmental (ALS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report. The measurement uncertainty of the results included in this report is within that expected when using the prescribed method(s) for analysis of these samples, and represented by Laboratory Control Sample control limits. Any events, such as QC failures, which may add to the uncertainty are explained in the report narrative.

Please contact me if you have any questions. My extension is 7473. You may also contact me via email at Deb.Patton@alsglobal.com.

Respectfully submitted,

ALS Group USA Corp. dba ALS Environmental

Deb Patton
Project Manager

ADDRESS 1565 Jefferson Rd, Building 300, Suite 360, Rochester, NY 14623 PHONE 585-288-5380 | FAX 585-288-8475
ALS GROUP USA, CORP. Part of the ALS Group An ALS Limited Company

CASE NARRATIVE

This report contains analytical results for the following samples:
Service Request Number: R1305350

Lab ID	Client ID
R1305350-001	SOURCE COMPOSITE
R1305350-002	BAT COMPOSITE
R1305350-003	FIELD BLANK

All samples were received in good condition unless otherwise noted on the cooler receipt and preservation check form located at the end of this report.

All samples were preserved in accordance with approved analytical methods.

All samples have been analyzed by the approved methods cited on the analytical results pages.

All holding times and associated QC were within limits.

No analytical or QC problems were encountered.

All sampling activities performed by ALS personnel have been in accordance with "ALS Field Procedures and Measurements Manual" or by client specifications.

ALS Environmental

REPORT QUALIFIERS AND DEFINITIONS

U Analyte was analyzed for but not detected. The sample quantitation limit has been corrected for dilution and for percent moisture, unless otherwise noted in the case narrative.

J Estimated value due to either being a Tentatively Identified Compound (TIC) or that the concentration is between the MRL and the MDL. Concentrations are not verified within the linear range of the calibration. For DoD: concentration >40% difference between two GC columns (pesticides/Arclors).

B Analyte was also detected in the associated method blank at a concentration that may have contributed to the sample result.

E Inorganics- Concentration is estimated due to the serial dilution was outside control limits.

E Organics- Concentration has exceeded the calibration range for that specific analysis.

D Concentration is a result of a dilution, typically a secondary analysis of the sample due to exceeding the calibration range or that a surrogate has been diluted out of the sample and cannot be assessed.

* Indicates that a quality control parameter has exceeded laboratory limits. Under the "Notes" column of the Form I, this qualifier denotes analysis was performed out of Holding Time.

H Analysis was performed out of hold time for tests that have an "immediate" hold time criteria.

Spike was diluted out.

+ Correlation coefficient for MSA is <0.995.

N Inorganics- Matrix spike recovery was outside laboratory limits.

N Organics- Presumptive evidence of a compound (reported as a TIC) based on the MS library search.

S Concentration has been determined using Method of Standard Additions (MSA).

W Post-Digestion Spike recovery is outside control limits and the sample absorbance is <50% of the spike absorbance.

P Concentration >40% (25% for CLP) difference between the two GC columns.

C Confirmed by GC/MS

Q DoD reports: indicates a pesticide/Aroclor is not confirmed (≥100% Difference between two GC columns).

X See Case Narrative for discussion.

MRL Method Reporting Limit. Also known as:
LOQ Limit of Quantitation (LOQ)
The lowest concentration at which the method analyte may be reliably quantified under the method conditions.

MDL Method Detection Limit. A statistical value derived from a study designed to provide the lowest concentration that will be detected 99% of the time. Values between the MDL and MRL are estimated (see J qualifier).

LOD Limit of Detection. A value at or above the MDL which has been verified to be detectable.

ND Non-Detect. Analyte was not detected at the concentration listed. Same as U qualifier.

ACCREDITED IN ACCORDANCE WITH nelac

Rochester Lab ID # for State Certifications[1]

NELAP Accredited	Maine ID #NY0032	New Hampshire ID # 294100 A/B
Connecticut ID # PH0556	Nebraska Accredited	
Delaware Accredited	Nevada ID # NY-00032	North Carolina #676
DoD ELAP #65817	New Jersey ID # NY004	Pennsylvania ID# 68-786
Florida ID # E87674	New York ID # 10145	Rhode Island ID # 158
Illinois ID #200047		Virginia #460167

[1] Analyses were performed according to our laboratory's NELAP-approved quality assurance program and any applicable state or agency requirements. The test results meet requirements of the current NELAP/TNI standards or state or agency requirements, where applicable, except as noted in the laboratory case narrative provided. For a specific list of accredited analytes, refer to http://www.alsglobal.com/en/Our-Services/Life-Sciences/Environmental/Downloads/North-America-Downloads

ALS Group USA, Corp. dba ALS Environmental

Analytical Report

Client: Eastern Analytical, Inc.
Project: Confidential/122793
Sample Matrix: Water

Service Request: R1305350
Date Collected: 7/22/13
Date Received: 7/24/13

Units: ng/L
Basis: NA

Analysis Method: 1631E

Mercury, Total

Sample Name	Lab Code	Result	Q	MRL	Dilution Factor	Date Extracted	Date Analyzed	Note
SOURCE COMPOSITE	R1305350-001	2.0		1.0	1	NA	8/25/13 14:18	
BAT COMPOSITE	R1305350-002	3.3		1.0	1	NA	8/25/13 14:23	
FIELD BLANK	R1305350-003	1.0	U	1.0	1	NA	8/25/13 14:27	
Method Blank	R1305350-MB	1.0	U	1.0	1	NA	8/25/13 13:45	

Client: Eastern Analytical, Inc.
Project: Confidential/122793
Sample Matrix: Water

Service Request: R1305350
Date Analyzed: 8/25/13

Lab Control Sample Summary
Inorganic Parameters

Units: ng/L
Basis: NA

Lab Control Sample
R1305350-LCS

Analyte Name	Method	Result	Spike Amount	% Rec	% Rec Limits
Mercury, Total	1631E	5.09	5.0	102	80 - 120

Results flagged with an asterisk (*) indicate values outside control criteria.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Environmental

CHAIN OF CUSTODY/LABORATORY ANALYSIS REQUEST FORM 09315

1565 Jefferson Road, Building 300, Suite 360 • Rochester, NY 14623 | +1 585 288 5380 +1 585 288 8475 (fax) PAGE 1 OF 1

Project Name: CONFIDENTIAL
Project Number: 122793
Project Manager: JEFF GAGNE
Report CC:
Company/Address: EASTERN ANALYTICAL, INC
85 CHENELL DRIVE
CONCORD NH 03301
Phone #: 603/228-0525
Email: Customerservice@eailabs.com
Sampler's Signature: [signature]
Sampler's Printed Name: Jeff Gagne

ANALYSIS REQUESTED (Include Method Number and Container Preservative)

CLIENT SAMPLE ID	FOR OFFICE USE ONLY LAB ID	SAMPLING DATE	SAMPLING TIME	MATRIX	NUMBER OF CONTAINERS	GC/MS VOAs o 8260 o 624 o CLP	GC/MS SVOAs o 8270 o 625	GC VOAs o 8021 o 601/602	PESTICIDES o 8081 o 608	PCBs o 8082 o 608	METALS, TOTAL (List in comments below)	METALS, DISSOLVED (List in comments below)								REMARKS/ ALTERNATE DESCRIPTION
PRESERVATIVE											H-1									
Source Composite		7/22/13	15:30	AQ	4						✓									Lab Composite
BAT Composite		7/22/13	16:15	|	1						✓									Provide MS/MSD
Field Blank		7/22/13	15:20	|	1						✓									

Preservative Key
0. NONE
1. HCL
2. HNO_3
3. H_2SO_4
4. NaOH
5. Zn. Acetate
6. MeOH
7. $NaHSO_4$
8. Other ______

SPECIAL INSTRUCTIONS/COMMENTS
Metals
Hg via 1631E

See QAPP ☐

TURNAROUND REQUIREMENTS
____ RUSH (SURCHARGES APPLY)
____ 1 day ____ 2 day ____ 3 day
____ 4 day ____ 5 day

REQUESTED REPORT DATE
STD- ASAP without surcharge.

REPORT REQUIREMENTS
____ I. Results Only
✓ II. Results + QC Summaries (LCS, DUP, MS/MSD as required)
____ III. Results + QC and Calibration Summaries
____ IV. Data Validation Report with Raw Data

Edata ____ Yes ____ No

R1305350 5
Eastern Analytical, Inc.
Confidential

PO # 40504

BILL TO: EASTERN ANALYTICAL
25 CHENELL DR
CONCORD, NH 03301

STATE WHERE SAMPLES WERE COLLECTED NH

RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY	RELINQUISHED BY	RECEIVED BY
Jeff Gagne	Jennifer Lane	Jennifer Lane	UPS		
Signature: [signature]	Signature: [signature]	Signature: [signature]	Signature: UPS	Signature	Signature: [signature]
Printed Name: Jeff Gagne	Printed Name	Printed Name	Printed Name	Printed Name	Printed Name: John Sesard
Firm: EAI	Firm: EAI	Firm: EAI	Firm: UPS	Firm	Firm: ALS
Date/Time: 7/22/13 1930	Date/Time: 7/23/13 800	Date/Time: 7/23/13 1530	Date/Time: 7/23/13 1530	Date/Time	Date/Time: 7/24/13 0710

Distribution: White - Lab Copy; Yellow - Return to Originator

ALS

Cooler Receipt and Preservation Check Form

Project/Client Eastern Analytical Inc. Folder Number R1305380

Cooler received on 7/24 by: JFS COURIER: ALS (UPS) FEDEX VELOCITY CLIENT

1. Were custody seals on outside of cooler? YES (NO)
2. Were custody papers properly filled out (ink, signed, etc.)? (YES) NO
3. Did all bottles arrive in good condition (unbroken)? (YES) NO
4. Did VOA vials, Alkalinity, or Sulfide have significant* air bubbles? YES NO (N/A)
5. Were **Ice** or **Ice packs** present? (YES) NO
6. Where did the bottles originate? ALS/ROC, (CLIENT)
7. Soil VOA samples received as: Bulk Jar Encore TerraCore Lab5035set (N/A)
8. Temperature of cooler(s) upon receipt: 1.7 ____ ____ ____ ____

Is the temperature within 0° - 6° C?: (Y) N Y N Y N Y N Y N

If No, Explain Below Date/Time Temperatures Taken: 7/24/13 7:33

Thermometer ID: (IR GUN#3) / IR GUN#4 Reading From: (Temp Blank) / Sample Bottle

If out of Temperature, note packing/ice condition &Client Approval to Run Samples:

All Samples held in storage location R002	by JFS	on 7/24	at 7:34
5035 samples placed in storage location ____	by ____	on ____	at ____

PC Secondary Review: [signature]

Cooler Breakdown: Date: 7/24/13 Time: 9:22 by: JFS

1. Were all bottle labels complete (*i.e.* analysis, preservation, etc.)? (YES) NO
2. Did all bottle labels and tags agree with custody papers? (YES) NO
3. Were correct containers used for the tests indicated? (YES) NO
4. Air Samples: Cassettes / Tubes Intact Canisters Pressurized Tedlar® Bags Inflated (N/A)

Explain any discrepancies:

pH	Reagent	YES	NO	Lot Received	Exp	Sample ID	Vol. Added	Lot Added	Final pH
≥12	NaOH								
≤2	HNO_3								
≤2	H_2SO_4								
<4	$NaHSO_4$								
Residual Chlorine (-)	For TCN Phenol and 522			If present, contact PM to add ascorbic acid Or sodium sulfite (522)					
	$Na_2S_2O_3$	-	-						
	Zn Aceta	-	-						
	HCl	*	*	MS2800 29 H	7/14				

*Not to be tested before analysis – pH tested and recorded by VOAs or GenChem on a separate worksheet

Yes = All samples OK

No = Samples were preserved at lab as listed

PM OK to Adjust: ________

Bottle lot numbers: 718810 8010

Other Comments:

PC Secondary Review: [signature]

*significant air bubbles: VOA > 5-6 mm : WC >1 in. diameter

P:\INTRANET\QAQC\Forms Controlled\Cooler Receipt r6.doc 11/6/12 j22793

	200.8 ICPMS
Parameters	RL (ug/L)
Sb	1
As	1
Be	1
Cd	1
Cr	1
Co	1
Cu	1
Pb	1
Mo	1
Ni	1
Se	1
Ag	1
Tl	1
Sn*	50
Sr*	5
Ti*	5
Zn*	5

	200.7 ICPAE
Parameters	RL (ug/L)
Al	50
B	50
Ba	50
Ca	50
Fe	50
Mg	50
Mn	5
Na	5000
K	50

	1631E
Parameters	RL (ug/L)
Hg	0.1

Subcontract to ALS(NY)

Separate calibration curve

Page 1 of 2

Chain-of-Custody Record

Bold Fields Required. Please Circle Requested Analysis.

For 122793

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				VOC				SVOC					TCLP	Metals		Inorganics								Micro		Other				
Sample I.D.	**Sampling Date/Time** *If Composite, Indicate Both Start & Finish Date/Time	**Matrix** (see below)	**Grab/*Composite**	524.2 / 524.2 BTEX 524.2 MTBE only	8260B 624 VTICs / 1,4 Dioxane EDB DBCP	8021B BTEX HALOS	8015B GRO MEGRO MAVPH	8270D 625 SVTICs / ABN A BN PAH	TPH8100 L1 L2	8015B DRO MEDRO MAEPH	PEST 608 PCB 608 / PEST 8081A PCB 8082	Oil & Grease 1664 TPH 1664	TCLP 1311 ABN Metals / VOC Pest Herb	Dissolved Metals (list below)	(Total Metals) (list below)	TS (TSS) TDS Spec. Con.	Br Cl F (SO4) / NO_2 NO_3 NO_3NO_2	BOD CBOD T. Alk.	TKN NH_3 T. Phos. O. Phos.	pH T. Res. Chlorine	COD Phenols TOC DOC	Total Cyanide (Total Sulfide)	Reactive Cyanide Reactive Sulfide / Flashpoint Ignitability	Total Coliform E. Coli / Fecal Coliform	Enterococci / Heterotrophic Plate Count	Field pH, DO, Temp	Field Turbidity	Sulfite	# of Containers	**Notes** MeOH Vial #
Source Grab 1	7/22/19 11:00	SW	G																							✓	✓		Ø	
Source Grab 2	7/22/19 12:30	|	|																							✓	✓		Ø	
Source Grab 3	7/22/19 13:45	|	|																							✓	✓		Ø	
Source Grab 4	7/22/19 15:30	|	|																							✓	✓		Ø	
Source Composite	7/22/19 15:30	|	C												✓	✓	✓					✓						✓	16	
BAT Grab 1	7/22/19 10:25	WW	G																							✓	✓			
BAT Grab 2	7/22/19 12:05	|	G																							✓	✓			
BAT Grab 3	7/22/19 14:25	|	G																							✓	✓			
BAT Grab 4	7/22/19 16:00	|	G																							✓	✓			
BAT Composite	7/22/19 16:15	|	C												✓	✓	✓					✓						✓	13	
Preservative															H	-	-					Na								

Matrix: A-Air; S-Soil; GW-Ground Water; SW-Surface Water; DW-Drinking Water; WW-Waste water

Preservative: H-HCL; N-HNO_3; S-H_2SO_4; Na-NaOH; M-MEOH

Project Manager: Allan Palmer

Company: PSNH

Address: 780 N. Commercial St.

City: Manchester **State:** NH **Zip:** 03105

Phone: 634-2439 Ext.:

Fax:

E-Mail: ALLAN.PALMER@NU.COM

Site Name: CONFIDENTAL

Project #: EAI#4219

State: (NH) MA ME VT Other:

Regulatory Program: NPDES: RGP POTW Stormwater or GWP, Oil Fund, Brownfield or Other:

Quote #: PO #:

Date Needed: Std

QA/QC Reporting Level A (B) C OR Presumptive Certainty

Reporting Options Prelims: Yes or No If Yes: Fax or PDF

Electronic Options No Fax E-Mail PDF Equis

Temp. 3.9 °C Ice? (Yes) No

Sampler(s): J. Gagne, D. Nevison/EAI

Relinquished By:	Date:	Time:	Received By:
[signature]	7/22/13	930	
	7/23/13	800	[signature]

Metals: 8 RCRA 13 PP Fe, Mn Pb, Cu

Other Metals: See attached List

Dissolved Metals Field Filtered? Yes No

Notes: (ie: Special Detection Limits, Billing Info, If Different) LAB composite Source grabs for TSS, SO4, SO3, S2, Metals. Hg 1631E pres. w/ HCl. Please run metals via methods specified.

Site History:

Suspected Contamination:

Field Readings:

eastern analytical, inc. *professional laboratory services* 25 Chenell Drive | Concord, NH 03301 | Tel: 603.228.0525 | 1.800.287.0525 | Fax: 603.228.4591 | E-Mail: customerservice@eailabs.com | www.eailabs.com

(WHITE: Original GREEN: Project Manager)

Page 2 of 2

Chain-of-Custody Record

Bold Fields Required. Please Circle Requested Analysis.

Fo 122793

19

				VOC				SVOC					TCLP	Metals		Inorganics									Micro		Other				
Sample I.D.	**Sampling Date/Time** *If Composite, Indicate Both Start & Finish Date/Time	**Matrix (see below)**	**Grab/*Composite**	524.2 524.2 BTEX 524.2 MTBE only	8260B 624 VTICs 1, 4 Dioxane EDB DBCP	8021B BTEX HALOS	8015B GRO MEGRO MAVPH	8270D 625 SVTICs ABN A BN PAH	TPH8100 L1 L2	8015B DRO MEDRO MAEPH	PEST 608 PCB 608 PEST 8081A PCB 8082	Oil & Grease 1664 TPH 1664	TCLP 1311 ABN Metals VOC PEST Herb	Dissolved Metals (List Below)	Total Metals (List Below)	TS TSS TDS Spec. Con.	Br Cl F SO_4 NO_2 NO_3 NO_3NO_2	BOD CBOD T. Alk.	TKN NH_3 T. Phos. O. Phos.	pH T. Res. Chlorine	COD Phenols TOC DOC	Total Cyanide Total Sulfide	Reactive Cyanide Reactive Sulfide Flashpoint Ignitability	Total Coliform E. Coli Fecal Coliform	Enterococci Heterotrophic Plate Count	Field pH, DO, Temp	Field Turbidity			# of Containers	**Notes** MeOH Vial #
Pond	7/22/19 1506	WW	G																							✓	✓			Ø	
Field Blank	7/22/19 1520	AQ	G												✓															2	
Matrix: A-Air; S-Soil; GW-Ground Water; SW-Surface Water; DW-Drinking Water; WW-Waste water. Preservative: H-HCL; N-HNO_3; S-H_2SO_4; Na-NaOH; M-MEOH															H																

Project Manager: Allan Palmer
Company: PSNH
Address: 780 N. Commercial St.
City: Manchester State: NH Zip: 03105
Phone: 634-2439 Ext.:
Fax:
E-Mail: allan.palmer@nu.com
Site Name: Confidential
Project #: EAI F429
State: (NH) MA ME VT Other:
Regulatory Program: NPDES: RGP POTW Stormwater or GWP, Oil Fund, Brownfield or Other:
Quote #: PO #:

Date Needed:

QA/QC Reporting Level A (B) C or Presumptive Certainty

Reporting Options Prelims: Yes or No If Yes: Fax or PDF

Electronic Options No Fax E-Mail PDF Equis

Temp. 3.9 °C Ice? (Yes) No

Sampler(s): J. Gagne, D. Newton/EAI

Relinquished By:	Date:	Time:	Received By:
[signature]	7/22/13	1930	[signature]
	7/23/13	800	[signature]

Metals: 8 RCRA 13 PP Fe, Mn Pb, Cu
Other Metals: see attached Metals List
Dissolved Metals Field Filtered? Yes No
Notes: (ie: Special Detection Limits, Billing Info, If Different)

Site History:
Suspected Contamination:
Field Readings:

Attachment 4

Eastern Analytical, Inc.
professional laboratory and drilling services

Allan Palmer
Eversource Energy
780 North Commercial Street, PO Box 330
Manchester , NH 03105-0330

Subject: Laboratory Report

Eastern Analytical, Inc. ID:	171205
Client Identification:	Merrimack Station Slag Sluice
Date Received:	7/19/2017

Dear Mr. Palmer :

Enclosed please find the laboratory report for the above identified project. All analyses were performed in accordance with our QA/QC Program. Unless otherwise stated, holding times, preservation techniques, container types, and sample conditions adhered to EPA Protocol. Samples which were collected by Eastern Analytical, Inc. (EAI) were collected in accordance with approved EPA procedures. Eastern Analytical, Inc. certifies that the enclosed test results meet all requirements of NELAP and other applicable state certifications. Please refer to our website at www.eailabs.com for a copy of our NELAP certificate and accredited parameters.

The following standard abbreviations and conventions apply to all EAI reports:

Solid samples are reported on a dry weight basis, unless otherwise noted
< : "less than" followed by the reporting limit
> : "greater than" followed by the reporting limit
%R : % Recovery

Eastern Analytical Inc. maintains certification in the following states: Connecticut (PH-0492), Maine (NH005), Massachusetts (M-NH005), New Hampshire/NELAP (1012), Rhode Island (269) and Vermont (VT1012).

The following information is contained within this report: Sample Conditions summary, Analytical Results/Data, Quality Control data (if requested) and copies of the Chain of Custody. This report may not be reproduced except in full, without the the written approval of the laboratory.

If you have any questions regarding the results contained within, please feel free to directly contact me or the chemist(s) who performed the testing in question. Unless otherwise requested, we will dispose of the sample(s) 30 days from the sample receipt date.

We appreciate this opportunity to be of service and look forward to your continued patronage.

Sincerely,

Lorraine Olashaw (signature)	8.1.17	5
Lorraine Olashaw, Lab Director	Date	# of pages (excluding cover letter)

SAMPLE CONDITIONS PAGE

EAI ID#: **171205**

Client: **Eversource Energy**

Client Designation: **Merrimack Station Slag Sluice**

Temperature upon receipt (°C): 1.2

Acceptable temperature range (°C): 0-6

Received on ice or cold packs (Yes/No): Y

Lab ID	Sample ID	Date Received	Date Sampled	Sample Matrix	% Dry Weight	Exceptions/Comments (other than thermal preservation)
171205.01	Slag Composite	7/19/17	7/19/17	aqueous		Adheres to Sample Acceptance Policy
171205.02	Slag Grab	7/19/17	7/19/17	aqueous		Adheres to Sample Acceptance Policy

Samples were properly preserved and the pH measured when applicable unless otherwise noted. Analysis of solids for pH, Flashpoint, Ignitability, Paint Filter, Corrosivity, Conductivity and Specific Gravity are reported on an "as received" basis.
Immediate analyses, pH, Total Residual Chlorine, Dissolved Oxygen and Sulfite, performed at the laboratory were run outside of the recommended 15 minute hold time.
All results contained in this report relate only to the above listed samples.

References include:
1) EPA 600/4-79-020, 1983
2) Standard Methods for Examination of Water and Wastewater, 20th Edition, 1998 and 22nd Edition, 2012
3) Test Methods for Evaluating Solid Waste SW 846 3rd Edition including updates IVA and IVB
4) Hach Water Analysis Handbook, 2nd edition, 1992

LABORATORY REPORT

EAI ID#: **171205**

Client: **Eversource Energy**

Client Designation: **Merrimack Station Slag Sluice**

Sample ID: Slag Composite

Lab Sample ID: 171205.01
Matrix: aqueous
Date Sampled: 7/19/17
Date Received: 7/19/17

		Units	Analysis Date	Analysis Time	Method	Analyst
Solids Suspended	**12**	mg/L	07/20/17	13:00	2540D-97	ATA
Solids Dissolved	**520**	mg/L	07/21/17	16:10	2540C-97	ATA
Sulfate	**8**	mg/L	07/21/17	6:48	300.0	KD
Nitrate/Nitrite-N	< 0.5	mg/L	07/20/17	9:04	353.2	KD
TKN	**0.6**	mg/L	07/21/17	13:16	$4500N_{org}C/N$	SEL

Sample ID: Slag Grab

Lab Sample ID: 171205.02
Matrix: aqueous
Date Sampled: 7/19/17
Date Received: 7/19/17

		Units	Analysis Date	Analysis Time	Method	Analyst
Sulfide	< 0.1	mg/L	07/20/17	15:00	8131HACH	ATA
Sulfite	< 2	mg/L	07/19/17	16:54	377.1	CJJ
Turbidity	**5**	NTU	07/19/17	16:15	180.1	AMB

LABORATORY REPORT

EAI ID#: **171205**

Client: **Eversource Energy**

Client Designation: **Merrimack Station Slag Sluice**

Sample ID: Slag Composite

Lab Sample ID:	171205.01					
Matrix:	aqueous					
Date Sampled:	7/19/17	**Analytical Matrix**	**Units**	**Date of Analysis**	**Method**	**Analyst**
Date Received:	7/19/17					
Aluminum	**0.67**	AqTot	mg/L	7/21/17	200.8	DS
Antimony	< 0.001	AqTot	mg/L	7/21/17	200.8	DS
Arsenic	**0.002**	AqTot	mg/L	7/21/17	200.8	DS
Barium	**0.015**	AqTot	mg/L	7/21/17	200.8	DS
Beryllium	< 0.001	AqTot	mg/L	7/21/17	200.8	DS
Boron	< 0.05	AqTot	mg/L	7/21/17	200.8	DS
Calcium	**4.4**	AqTot	mg/L	7/21/17	200.8	DS
Cadmium	< 0.001	AqTot	mg/L	7/21/17	200.8	DS
Chromium	**0.002**	AqTot	mg/L	7/21/17	200.8	DS
Copper	**0.005**	AqTot	mg/L	7/21/17	200.8	DS
Cobalt	< 0.001	AqTot	mg/L	7/21/17	200.8	DS
Iron	**1.1**	AqTot	mg/L	7/21/17	200.8	DS
Lead	**0.002**	AqTot	mg/L	7/21/17	200.8	DS
Magnesium	**0.75**	AqTot	mg/L	7/21/17	200.8	DS
Manganese	**0.047**	AqTot	mg/L	7/21/17	200.8	DS
Mercury	< 0.0001	AqTot	mg/L	7/21/17	200.8	DS
Molybdenum	**0.001**	AqTot	mg/L	7/21/17	200.8	DS
Nickel	**0.002**	AqTot	mg/L	7/21/17	200.8	DS
Potassium	**0.91**	AqTot	mg/L	7/21/17	200.8	DS
Selenium	< 0.001	AqTot	mg/L	7/21/17	200.8	DS
Silver	< 0.001	AqTot	mg/L	7/21/17	200.8	DS
Sodium	**12**	AqTot	mg/L	7/21/17	200.8	DS
Thallium	< 0.001	AqTot	mg/L	7/21/17	200.8	DS
Titanium	**0.032**	AqTot	mg/L	7/21/17	200.8	DS
Zinc	**0.010**	AqTot	mg/L	7/21/17	200.8	DS
Strontium	**0.037**	AqTot	mg/L	7/25/17	200.8	DS
Tin	< 0.005	AqTot	mg/L	7/25/17	200.8	DS

LABORATORY REPORT

EAI ID#: **171205**

Client: **Eversource Energy**

Client Designation: **Merrimack Station Slag Sluice**

Sample ID: Slag Composite

Lab Sample ID: 171205.01
Matrix: aqueous
Date Sampled: 7/19/17
Date Received: 7/19/17

		Units	Date of Analysis	Method	Analyst
Field pH	**6.2**	SU	7/19/17	SM4500H	JG

Sample ID: Slag Grab

Lab Sample ID: 171205.02
Matrix: aqueous
Date Sampled: 7/19/17
Date Received: 7/19/17

		Units	Date of Analysis	Method	Analyst
Temperature	**28**	°C	7/19/17	SM2550B	JG
Field pH	**6.0**	SU	7/19/17	SM4500H	JG
Field DO	**7.2**	mg/L	7/19/17	SM4500O	JG

CHAIN-OF-CUSTODY RECORD

171205

5

PSCNH1

Sample IDs	Date/Time *Composites need start and stop dates/times*	Matrix	Parameters and Sample Notes	# of containers
~~BAT~~ Composite Slag AMB	7/18/17 0915 to 7/19/17 0915	aqueous Grab or (Comp)	AqTot/NO3NO2/TKN/SO4/TDS/TSS/ICPMets.Sb.As.Be.Cd.Cr.Co.Cu.Pb.Mo.Ni.Se.Ag.Tl.Sn.Sr.Ti.Zn.Al.B.Ba.Ca.Fe.Mg.Mn.Na.K.Hg/FieldpH	4
☐ **Sampler confirms ID and parameters are accurate**			*Circle preservative/s:* HCL (HNO$_3$) (H_2SO_4) NaOH MEOH $Na_2S_2O_3$ (ICE)	Dissolved Sample Field Filtered ☐
~~BAT~~ Grab Slag AMB	7/19/17 09:00	~~aqueous~~ (Grab) or Comp	AqTot/FieldDO/FieldpH/FieldTemp/Turb/S2/SO3	4
☐ **Sampler confirms ID and parameters are accurate**			*Circle preservative/s:* HCL HNO$_3$ H_2SO_4 (NaOH) MEOH $Na_2S_2O_3$ (ICE)	Dissolved Sample Field Filtered ☐

Please ensure this auto COC is accurate, adheres to permit or sampling requirements for this sampling event, and modify as necessary.

EAI Project ID

Project Name Merrimack Station Slag Sluice

State NH

Client (Pro Mgr) Allan Palmer

Customer Eversource Energy

Address 780 North Commercial Street, PO

City Manchester NH 03105-0330

Phone 669-4000 **Fax** Choose one:

Email: allan.palmer@eversource.com

Direct 634-2439

Results Needed by: Preferred date ____________

Notes:

Composite = 24hr time composite

QC deliverables

☒ A ☐ A+ ☐ B ☐ B+ ☐ C ☐ PC

ReportingOptions

☒ HC ☐ NO FAX

☒ EDD PDF ☐ Partial FAX

☒ EDD email ☐ PDF Invoice

☒ PDF prelim, NO FAX ☐ EQUIS

☐ e-mail Login Confirmation

PO# 02291429

Quote#:

Temp 10 °C

Ice Y ☒ N ☐

Samples Collected by: J. Gagne / EAI

Relinquished by	Date/Time	Received by
[signature]	7/19/17 1345	[signature]

Attachment 5

ELECTRIC POWER RESEARCH INSTITUTE

December 15, 2017

Ms. Sharon DeMeo
U.S. Environmental Protection Agency – Region 1
Office of Ecosystem Protection, Industrial Permits Branch
5 Post Office Square, Suite 100
Boston, MA 02109-3912

Subject: Comments on the draft determination of technology-based effluent limits for flue gas desulfurization and bottom ash wastewater at Public Service of New Hampshire Merrimack Station

Dear Ms. DeMeo:

The Electric Power Research Institute (EPRI) appreciates the opportunity to provide comments to the U.S. Environmental Protection Agency on the draft determination of technology-based effluent limits for flue gas desulfurization (FGD) and bottom ash wastewater at Public Service of New Hampshire Merrimack Station. EPRI focused our analyses on the physical/chemical and vapor compression evaporation (VCE) FGD wastewater treatment and bottom ash discharge ban cost effectiveness assessment.

If you have any questions, please contact me at 650 855 2362 or pchu@epri.com.

Sincerely,

Paul Chu
Senior Program Manager
Environment Sector
EPRI

EPRI Comments on the Revised Draft Determination of Technology-Based Effluent Limits for Flue Gas Desulfurization Wastewater at Merrimack Station in Bow, New Hampshire

PREPARED FOR:	U.S. Environmental Protection Agency - Region 1
PREPARED BY:	Electric Power Research Institute
DATE:	December 15, 2017

Introduction

The Electric Power Research Institute (EPRI) was established in 1973 as an independent, nonprofit center for public interest energy and environmental research. EPRI brings together member organizations, the Institute's scientists and engineers, and other leading experts to work collaboratively on solutions to the challenges of electric power. These solutions span nearly every area of power generation, delivery, and use, including health, safety, and environment. EPRI has been active in characterizing flue gas desulfurization (FGD) wastewaters and evaluating treatment technologies since 2006. This work includes characterization of FGD wastewaters, evaluation of mercury and selenium chemistry in FGD wastewaters, and the evaluation of physical/chemical, biological, and vapor compression evaporation (VCE) wastewater treatment approaches. (The term VCE in this document is used to describe the thermal treatment consisting of a Brine Concentrator followed by a crystallizer system).

EPRI is providing technical comments to Region 1 of the U.S. Environmental Protection Agency (EPA) on the draft permit for wastewater discharges for the Public Service of New Hampshire (PSNH) Merrimack Station. On February 28, 2012, EPRI provided technical comments to an earlier, proposed permit dated September 30, 2011. These earlier comments focused on the cost-effectiveness evaluation for physical/chemical and biological treatment for FGD wastewater. On August 14, 2014, EPRI provided technical comments to an earlier, proposed permit dated April 18, 2014. These comments focused on the cost-effectiveness evaluation for physical/chemical and evaporative treatment for FGD wastewater.

The Merrimack Station has cyclone coal-fired boiler and air emission control systems including a selective catalytic reduction (SCR) and electrostatic precipitator (ESP), as well as the wet FGD.

FGD Wastewater and Bottom Ash Transport Water Treatment Cost-Effectiveness Evaluation

EPRI reviewed the Statement of Substantial New Questions for Public Comment regarding Merrimack Station (National Pollutant Discharge Elimination System [NPDES] Permit No. NH0001465). The following comments are presented in response to the Statement's request for comment on how the 2015 Steam Electric ELGs should be applied to set the Final Permit's requirements for Merrimack Station's FGD and bottom ash (slag) wastewater. The term 'bottom ash' is used herein although the type of boiler at Merrimack (cyclone coal-fired boiler) produces a bottom ash material more commonly referred to as slag.

EPRI believes it is important to assess the cost effectiveness of wastewater technologies by comparing their estimated pollutant reductions to the costs of the technologies. This is a standard mechanism used by EPA to evaluate proposed effluent limitations guidelines, and it provides a useful metric for examining whether application of further technologies is warranted. In the case of Merrimack, EPRI's analysis demonstrates that certain technologies are not cost-effective, as described below.

To evaluate the cost effectiveness of FGD wastewater treatment, EPRI used EPA's cost effectiveness methodology and considered three types of treatment: (1) Physical/chemical treatment; (2) incremental vapor compression/evaporation (VCE) and crystallizer to be added on to the physical/chemical treatment; and (3) an incremental addition of a drum dryer. The pollutant removals and costs for FGD treatment are included in **Table 1**. The supporting calculation details are provided in Appendix **A**.

Physical/chemical treatment (i.e., clarification and chemical precipitation, followed by an EMARS [Enhanced Mercury and Arsenic Removal System] absorber; termed at Merrimack the Primary Wastewater Treatment System [PWWTS]) is the first level evaluated, using sample results from the site's current operation. Incremental VCE and Crystallizer removal is defined here as the removal of all pollutants in the effluent from the physical/chemical treatment process. This is done because although the crystallizer generates a liquid brine, it is currently managed in a way that avoids discharge to a receiving water body. Because completely eliminating liquid discharge with the VCE and Crystallizer is challenging, an evaluation is also done of the costs and benefits of adding a drum dryer to manage the crystallizer brine as a contingency plan in case the station is not able to get the thermal evaporation system to fully eliminate a liquid brine.

The results of the FGD wastewater cost effectiveness analysis show that, for Merrimack, all technologies beyond physical/chemical treatment are not cost effective. This is not surprising, because physical/chemical treatment at Merrimack removes approximately 90 percent of the total pollutants in the wastewater. The table below compares the Merrimack results using EPA's standard cost-effectiveness metric of costs per toxic weighted pound equivalents (TWPEs) to the highest value cost per TWPE ever established by EPA in any effluent guideline rulemaking (Electrical and Electronic Components, at $404/TWPE) to EPA's estimated cost effectiveness value for the entire 2015 Steam Electric Effluent Limitations Guidelines (ELG) Rule.

Cost Effectiveness Analysis	Cost Effectiveness Ratio (1981 Dollars per TWPE)
EPRI Merrimack: Physical/Chemical	300 (170 if only O&M costs are considered)
EPRI Merrimack: Incremental VCE and Crystallizer	4,208 (1,889 if only O&M costs are considered)
EPRI Merrimack: Incremental Drum Dryer	588
EPA: Electrical and Electronic Components [1]	404
EPA: 2015 Steam Electric ELG Rule [2]	136

Even the cost of physical/chemical treatment alone at Merrimack is well beyond the cost effectiveness ratio EPA derived for the entire 2015 ELG Rule. And the cost effectiveness ratio for incremental VCE and crystallizer technology at Merrimack is more than 10 times the highest value cost effectiveness ratio ever promulgated by EPA.

Based on EPRI's calculations, approximately 90 percent of PSNH Merrimack's total pollutant removal (calculated as toxic weighted pound equivalents [TWPE]) from FGD wastewater treatment is

[1] *Regulatory Impact Analysis for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, USEPA, 2015. Page F-10.

[2] *Regulatory Impact Analysis for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, USEPA, 2015. Page F-12.

accomplished by the physical/chemical wastewater treatment system. Only 10 percent of the total pollutant removal can be attributed to the VCE system.

EPRI also conducted an evaluation of the cost effectiveness of bottom ash transport water treatment using remote settling of bottom ash and a closed-loop reuse of the ash/slag transport water. The cost effectiveness calculations were performed by estimating the pollutant removals for each technology and comparing these removals with the costs of the technologies.

The pollutant removals and costs for the closed-loop bottom ash transport water system are included in **Table 2.** The supporting calculation details for bottom ash are provided in **Appendix B.**

The cost/TWPE ratio of closed-loop bottom ash handling system is $2,724 /TWPE (in 1981 dollars). The following table compares this Merrimack site-specific, wastestream specific cost per TWPE to various EPA cost effectiveness values.

Cost Effectiveness Analysis	Cost Effectiveness Ratio (1981 Dollars per TWPE)
EPRI: Merrimack Bottom Ash Closed-Loop System	$2,797
EPA: Electrical and Electronic Components[3]	$404
EPA: 2015 Steam Electric ELG Rule[4]	$136
EPA: 2015 ELG Bottom Ash Closed-Loop, Zero Discharge [5]	$314

The Merrimack site-specific cost effectiveness ratio is more than eight times the cost effectiveness ratio EPA estimated for treatment of the bottom ash transport water wastestream in the 2015 rule. These numbers should be comparable, but because of Merrimack's low pollutant loadings and high costs, retrofitting a closed-loop bottom ash transport water system at Merrimack is not at all cost effective.

Challenges of FGD Wastewater Systems

Merrimack has operated their FGD wastewater treatment facility since 2012. The operation consists of a Primary Wastewater Treatment System (PWWTS) comprised of a softening and metals removal process, followed by an EMARS (Enhanced Mercury and Arsenic Removal System) absorber. The downstream Secondary Wastewater Treatment System (SWWTS) is composed of a brine concentrator, a crystallizer system (consisting of two crystallizer bodies in a two-effect arrangement) and an Oberlin belt press filter, which evaporate the PWWTS effluent to a solid waste stream, leaving only a small liquid residual. The latter is used for fly ash wetting before being transported to an off-site landfill for disposal.

There is a total of five or six facilities worldwide that have a FGD evaporative wastewater treatment train consisting of softening/metals removal, a brine concentrator, a crystallizer and an Oberlin belt filter process train. With the exception of the Merrimack system, all others operating with FGD wastewater are located in Italy and burn the low-chloride and low-sulfur coal (< 1% sulfur and ~350 mg/kg chlorine), obtained from the same source in Africa. Merrimack has the distinction of operating the only such FGD

[3] *Regulatory Impact Analysis for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, USEPA, 2015. Page F-10.
[4] *Regulatory Impact Analysis for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, USEPA, 2015. Page F-12.
[5] *Regulatory Impact Analysis for the Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, USEPA, 2015. Page F-12.

evaporative system treating wastewater generated from burning higher chloride and sulfur (~2.6% sulfur and ~1,000 mg/kg chlorine), Eastern Appalachian coal.

The composition of FGD scrubber waters varies widely and is, in great part, a function of the coal composition, including the chloride content. Other influencing factors are air pollution controls, site-specific process variables, including makeup water chemistry, the type of limestone reagent and the scrubber vessel metallurgy.

After partial softening and metals removal in the PWWTS, the FGD purge is fed to the SWWTS for volume reduction. As water evaporates in the brine concentrator only calcium sulfate and silica precipitate, leaving the soluble salts to concentrate 5 to 8 times. With additional evaporation in the crystallizer, sodium chloride, sodium sulfate and other moderately soluble salts reach their respective solubility limits and begin to crystallize. As the slurry passes through the Oberlin filter, the crystals, along with a small amount of moisture content associated with the solids, are removed while the filtrate, containing the salts of high solubility like nitrates and some halogens, is returned to the crystallizer. This cycle continues to remove crystallized solids but causes the highly soluble salts to stay in solution and build up in concentration. While the small level of moisture content associated with the filtered solids may result in a sufficient wasting of the various soluble species to keep the crystallizers in Italy in balance, the same is not so for the Merrimack plant.

Unless controlled by purging of a small liquor stream, the increasing salinity of the recirculating slurry will cause the boiling point and thus the operating temperature in the crystallizer to rise in excess of 50°F producing an extremely hostile operating environment of high corrosion and potential interference with the overall crystallization process.

Purging of the crystallizers for nitrate and TDS management is standard procedure for conventional power plants that are fed with tertiary sewage water. These plants either have a separate liquor purge, which typically goes to a waste hauler, or, if using a centrifuge for dewatering, is incorporate into the centrifuge cake, which is much wetter compared to that from an Oberlin filter.

Nitrates in tertiary sewage feed, conventional power plant and FGD wastewaters can vary from relatively low to high levels, ranging from a few to 1,500 mg/l in some FGD wastewater evaporative treatment system feed waters. Given that the overall concentration factors of a brine concentrator plus the crystallizer is 15 to 30 times, nitrate levels in excess of 25,000 mg/l are possible even with crystallizer purging. Without such TDS management, nitrates and other soluble salts will rapidly build up until either purged or driven to reach their very high solubility limits with the aforementioned, detrimental consequences. When present at elevated concentrations in the FGD wastewater evaporative treatment system feed, as is the case at Merrimack, crystallizer purging is, therefore, a necessary operating procedure.

In conclusion, operating experience at Merrimack has shown that a small liquor purge is required to keep their crystallizer chemistry in balance, to manage the critical levels of the highly soluble salts and nitrates, and to keep within the process design envelope. Using this technique, the operational problems encountered during the initial FGD wastewater evaporative treatment system operation have been reduced so that Merrimack has been able to operate this "one-of-a-kind", U.S. FGD wastewater treatment system since 2012.

Bottom Ash Transport Water – Challenges of Closed-Loop Operation

EPRI research at sites that have attempted to operate closed-loop bottom ash handling systems has identified several challenges to implementation and operation. Challenges include balancing the water flows into and out to keep the water balance neutral and maintaining water quality in the closed-loop.

Challenges with closing the water balance to eliminate discharge (i.e., having more flow into a closed-loop bottom ash handling system than flows out) stem from the inclusion of non-transport waters in the closed-loop system, including water from storm events. Several non-transport process waters around the hopper or dewatering system come into contact with ash transport water, forcing these waters to be managed in the closed-loop system. Some of these waters (such as hopper cooling water or hopper seal trough water) can be supplied with recirculated ash transport water, but it may not be feasible for others because of water quality or other reasons. Examples include pump seal water, which may not be able to use the recirculated ash water due to solids content abrading the pump seals. Rain water entering the loop through floor drains and uncovered tanks also increase the flows into the overall water balance.

Some water uses in the recirculated ash loop may require additional equipment or modifications, such as:

- Heat exchangers if the recirculated water temperature is too high for equipment limitations and personnel safety
- Storage tanks to store excess water from boiler tube leaks, large maintenance events, or stormwater

Going to closed loop typically requires capturing any significant transport water loss to building sumps by modifying and rerouting sumps near the boiler or modifying the ash hopper design. Additionally, modifications typically are needed to prevent non-transport wastewaters from mixing with the ash transport water to prevent further adding of water to the closed-loop bottom ash handling system.

As each transport of ash leads to contaminants from the ash partitioning into the water, and clean water evaporates from the closed loop, the water quality in the loop can worsen. This is partially offset by contaminants leaving the loop in water entrained in the ash, but EPRI has noted through research at numerous sites that there are challenges in controlling water quality conditions, such as:

- Small and/or less-dense particles not removed by the remote dewatering system can cause plugging in pipes and nozzles, or accumulating in sumps and tanks, which increases cleaning and maintenance requirements.
- Scaling can be caused by ion concentrations increasing in the loop.
- Acidity and/or corrosion has been observed in some recirculated systems, which in one instance was attributed to pipe corrosion and failure.

The 2015 Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category allowed for purges from a closed-loop bottom ash handling system only to an FGD scrubber. However, such a purge may not be feasible if the purge volume required is higher than the FGD make-up demand (due to excess water or water quality control), especially if a plant has an evaporative FGD treatment technology that requires all distillate to be returned to the scrubber. Additionally, ash transport water could require storage (i.e., multiple surge tanks) during plant outages (i.e., scrubber is offline) if maintenance is required on the ash dewatering equipment. Further, purge water from a closed-loop system could have negative impacts on a FGD scrubber's gypsum crystallization and gypsum marketability. In some cases, additional treatment may be required for the transport water for it to be used in a FGD scrubber.

Table 1. Merrimack Cost Effectiveness for FGD Physical/Chemical and Evaporative Wastewater Treatment

	Removal (TWPE per year)	Capital Cost (Million dollars, in 2012 dollars*)	O&M Cost (Million dollars per year)	Total Annualized Cost (Million dollars per year)	Cost Effectiveness Ratio (Dollars per TWPE)	Capital Cost (Million 1981 dollars)	O&M Cost (Million 1981 dollars per year)	Total Annualized Cost (Million 1981 dollars per year)	Cost Effectiveness Ratio (1981 Dollars per TWPE)	Cost Effectiveness Ratio if Only O&M Costs (1981 Dollars per TWPE)
Physical/ Chemical	4,122	15	1.8	3.3	790	5.7	0.7	1.2	300	170
Incremental VCE and Crystallizer	480	31.2	2.4	5.3	11,060	11.9	0.9	2.0	4,208	1,889
Incremental Drum Dryer	298	2.4	0.2	0.5	1,553	0.9	0.09	0.2	588	306

O&M = operations and maintenance

*- Costs shown in 2012 dollars because that is year system installed.

Table 2. Merrimack Cost Effectiveness for Closed-Loop Bottom Ash Handling System

	Removal (TWPE per year)	Capital Cost (Million dollars in 2017 dollars)	O&M Cost (Million dollars per year)	Total Annualized Cost (Million dollars per year)	Cost Effectiveness Ratio (Dollars per TWPE)	Capital Cost (Million 1981 dollars)	O&M Cost (Million 1981 dollars per year)	Total Annualized Cost (Million 1981 dollars per year)	Cost Effectiveness Ratio (1981 Dollars per TWPE)
Closed-loop bottom ash	192	14.9	0.2	1.6	8,333	5.0	0.06	0.5	2,797

O&M costs estimated by EPRI; all other costs are from PSNH.

References

Eastern Research Group, Inc. (ERG. 2009. *Memorandum: Technology Option Loads Calculation Analysis for Steam Electric Detailed Study*. To: Public Record for the Effluent Guidelines Program Plan 2009/2010. From: TJ Finseth, ERG. EPA-HQ-OW-2008-0517.

Electric Power Research Institute (EPRI). 2013. EPRI Comments on Proposed Effluent Limitations Guidelines Rule. Docket ID EPA-HQ-OW-2009. September 20.

Guidance Document for Management of Bottom Ash Handling Water in Compliance with the 2015 Effluent Limitations Guidelines (ELGs). EPRI, 2016. 3002008345

U.S. Environmental Protection Agency (EPA). 2013. *Technical Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*. EPA-821-R-13-002. April 19.

Appendix A
FGD Wastewater Treatment Cost-Effectiveness Analysis

Introduction

This appendix provides details on how EPRI estimated cost-effectiveness for flue gas desulfurization (FGD) wastewater treatment. Physical/chemical and vapor compression evaporation (VCE) FGD wastewater treatment pollutant removals were estimated and the costs associated with each system were compared with their removal rates. Cost estimates are based on information provided by Public Service of New Hampshire (PSNH) Merrimack Station.

Pollutant Removals Calculation Methodology

Pollutant removals were defined as the estimated quantity of contaminants removed from wastewater. The estimated contaminants removed were calculated both as concentrations and toxic-weighted pound equivalents (TWPE). TWPE factors are used by the U.S. Environmental Protection Agency (EPA) to express the relative toxicity of pollutants. Calculations use the concentration of contaminants in the water, wastewater flow, and toxic weighting factors (TWF). Data from PSNH Merrimack sampling were used in the calculations.

Summary of Available Data

EPRI's evaluation used data from two sampling episodes at PSNH Merrimack. The wastewater treatment system influent was based on a 5-day sampling episode that ranged from late December 2011 through early January 2012 and an additional sample in July 2014. The physical/chemical treatment system effluent data were based on six data samples ranging from January 2012 through March 2012 and one sample in July 2014. Two sample points occurring on the same day were averaged first before averaging the remaining four data points. Non-detect data were treated as half of the method detection limit. Analytes that were not included as part of the plant PSNH sampling episodes were estimated with data based on the following documents:

- *Physical/Chemical Influent: Memorandum: Technology Option Loads Calculation Analysis for Steam Electric Detailed Study* (ERG, 2009)
- *Physical/Chemical Influent and Effluent: Technical Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (EPA, 2013)

The influent and effluent data were averaged respectively and multiplied by the average flow rate at Merrimack when plant is operating (44 gallons per minute) and TWF to calculate TWPE per year. The flow per year was based on PSNH's estimate of operating roughly 40 percent of the time. The available data are summarized in **Tables A-1, A-2, and A-3. Table A-4** summarizes the averaged influent and effluent values, and estimated pollutant removals by physical/chemical (pollutants in physical/chemical influent minus physical/chemical effluent), by VCE (removal of pollutants in physical/chemical effluent) systems and by the Drum Dryer systems (estimated elimination of crystallizer brine).

The Merrimack sample data used in the analysis represent water quality only as a few snapshots in time. Each stream sampled had a variety of dates and sample events. Because of this, the sample data used does not necessarily represent typical or average plant water quality.

Pollutant Removal Estimates

For clarity, the following terms are used:

- Physical/Chemical removal: The estimated amount of pollutants removed via physical/chemical treatment (i.e., physical/chemical influent minus physical/chemical effluent)
- VCE removal: The amount removed via VCE treatment (i.e. removal of all remaining pollutants in the physical/chemical treatment system effluent). It is noted that this is a conservatively high estimate of pollutant removal as PSNH is required to operate with a small discharge of wastewater (which is currently managed offsite). If this wastewater discharge was counted the cost-effectiveness would be an even higher $/TWPE value.
- Drum dryer removal: The estimated amount of pollutants removed in the crystallizer brine (i.e. removal of all pollutants contained in the crystallizer brine)

The pollutant removal calculation followed EPA's methodology outlined in the Technical Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category (EPA, 2013) pollutant removal calculations. However, since the calculation included plant-specific data, our estimate had three deviations from EPA's methodology as follows:

- Actual sampled plant influent/effluent data were used
- Physical/chemical removal was calculated using the influent to the physical/chemical treatment system
- VCE treatment system benefits were calculated starting with physical/chemical system effluent, and assuming all pollutants are eliminated (i.e. no pollution discharged from VCE)
- Drum dryer treatment system benefits were calculated starting with crystallizer brine, and assuming all pollutants are eliminated (i.e. no pollution discharged from the drum dryer)

A summary of the estimated benefit calculation for PSNH Merrimack is presented in **Table A5**.

Table A-1. Merrimack Station Physical/Chemical Influent Data and Average Concentrations (in milligrams per liter [mg/L])

Analyte	Sample Day 1 12/20/11 – 12/21/11	Sample Day 2 01/03/12 – 01/04/12	Sample Day 3 01/04/12 – 01/05/12	Sample Day 4 01/05/12 – 01/06/12	Sample Day 5 01/06/12 – 01/07/12	Sample 7/23/14	Average
Ammonia						1.9	1.9
Nitrate Nitrite as N						100	100
Chloride	9,100	10,000	10,000	10,000	11,000	14,000	10,683
Sulfate	2,200	3,200	2,800	3,200	3,100	1,200	2,617
Cyanide, Total							0.0117[b]
Aluminum	65.5	45.2	708	85.8	84.3		198
Antimony	0.0178	0.0128	0.0145	0.0152	0.0152		0.0151
Arsenic	0.224	0.206	0.232	0.221	0.233		0.223
Barium	0.579	0.582	0.657	0.407	0.301		0.505
Beryllium	0.00739	0.00978	0.0122	0.0112	0.0101		0.0101
Boron							208[a]
Cadmium	0.0159	0.0198	0.0208	0.0206	0.0201		0.019
Calcium							4,850[a]
Chromium	0.665	0.535	0.718	0.608	0.659		0.637
Chromium (VI)	0.088	0.207	1.35	1.91	0.0442		0.720
Cobalt							0.0875[a]
Copper	0.279	0.314	0.357	0.338	0.341		0.326
Iron	116	104	137	117	128		120
Lead	1.89	1.65	1.7	1.51	1.56		1.66
Magnesium	870	970	948	1010	968		953
Manganese	22.3	25.5	25.9	22.1	23.3		23.8
Mercury	0.183	0.288	0.303	0.239	0.277		0.258
Molybdenum							0.124[a]
Nickel	1.03	1.08	1.16	1.03	0.992		1.06
Selenium	2.93	2.71	2.86	2.52	2.68		2.74
Silver	0.000781	0.00015	0.00015	0.00015	0.00015		0.000276
Sodium							612[a]
Thallium	0.02	0.0128	0.014	0.0155	0.0178		0.016
Tin							0.0115[a]
Titanium							0.608[a]
Vanadium							0.344[a]
Zinc	5.1	3.75	4.56	4.11	3.91		4.29

[a] Data gap filled with Memorandum: Technology Option Loads Calculation Analysis for Steam Electric Detailed Study (ERG, 2009)

[b] There was no available data for cyanide in FGD influent. There is available data for cyanide in the physical/chemical treatment system effluent (Table A-2). Cyanide is not typically removed by physical/chemical treatment, therefore, the value for influent is set equal to the data available for physical/chemical treatment system effluent. Cyanide was analyzed in the 2014 sample, but was not detected. The detection limit is higher than the quantified values in 2012; therefore, the 2014 result is not included in these calculations.

Table A-2. Merrimack Station Physical/Chemical Effluent (VCE Influent) Data and Average Concentrations in mg/L

Analyte	Sample 1/5/12	Sample 1/5/12	Average of 1/5/12 samples	Sample 1/26/12	Sample 2/2/12	Sample 2/9/12	Sample 3/2/12	Sample 7/23/14	Average
Ammonia	0.92		0.92	1.2	1.1			2.7	1.48
Nitrate Nitrite as N	100		100	68	65			100	83.3
Chloride	11,000		11,000	9,500	9,300			13,000	10,700
Sulfate	1,200		1,200		1,200			1,400	1,267
Cyanide, Total	0.02		0.02	0.01	0.005				0.0117
Aluminum	0.0411	0.04	0.0406	0.04	0.218	0.1			0.100
Antimony	5.20E-04	4.08E-04	4.64E-04	7.58E-04	1.55E-03				9.24E-04
Arsenic	0.00498	0.00851	0.00675	0.00956	0.0121	0.00375	0.00812		0.00806
Barium	0.3	0.24	0.27	0.208	0.243				0.240
Beryllium	5.22E-04	6.00E-04	0.000561	0.0006	0.0015				8.87E-04
Boron	980	493	737			357			547
Cadmium	2.07E-04	2.00E-04	2.04E-04	5.87E-04	5.00E-04	5.00E-04	2.00E-04		3.98E-04
Calcium	5050	5010	5030						5030
Chromium	2.50E-04	0.001	6.25E-04	0.001	0.0025	0.0025	0.001		0.00153
Chromium (VI)									0.00209[a]
Cobalt						0.0025			0.0025
Copper	2.50E-04	0.001	6.25E-04	0.00261	0.00553	0.0025	0.001		0.00245
Iron	0.025	0.1	0.0625	0.1	0.25		0.1		0.128
Lead	1.00E-04	4.00E-04	2.50E-04	4.00E-04	0.001	0.001	4.00E-04		6.10E-04
Magnesium									769[a]
Manganese	0.293	0.28	0.287	0.349	0.631	1.73			0.749
Mercury	1.05E-05	1.05E-05	1.05E-05	1.22E-05	3.60E-05	2.09E-05	1.72E-05		1.94E-05
Molybdenum	0.14	0.134	0.137	0.373	0.195	0.11	0.419		0.247
Nickel	0.00803	0.00979	0.00891	0.00776	0.0025	0.0126	0.0291		0.0122
Selenium	0.074	0.0689	0.0715	0.104	0.121	0.0822	0.109		0.0975
Silver	5.00E-05	2.00E-04	1.25E-04	2.00E-04	5.00E-04	5.00E-04	2.00E-04		3.05E-04
Sodium	277	259	268						268
Thallium	0.00664	0.00556	0.0061	0.00565	0.00685				0.00620
Tin									0.1[b]
Titanium									0.01[b]
Vanadium						0.0025			0.0025
Zinc	5.00E-04	0.002	0.00125	0.002	0.005	0.005	0.002		0.00305

[a] Data gap filled with the average value of an earlier data set for the primary wastewater treatment system effluent data during plant startup (late-January 2011).

[b] Data gap filled with *Technical Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (EPA, 2013)

Table A-3. Merrimack Station Crystallizer Brine Data with Estimated Concentrations in mg/L

Analyte	CRX Liquor (Crystallizer Brine) Estimate [a]
Ammonia	0
Nitrate Nitrite as N	3,400
Chloride	260,000
Sulfate	500
Cyanide, Total	0.06
Aluminum	2
Antimony	0.03
Arsenic	0.4
Barium	3
Boron	1,000
Cadmium	0.05
Calcium	66,000
Chromium	0.3
Chromium (VI)	0.07
Cobalt	0.08
Copper	0.3
Iron	20
Lead	0.08
Magnesium	24,000
Manganese	1.0
Mercury	0.00004
Molybdenum	0.52
Nickel	3
Selenium	1.2
Silver	0.1
Sodium	2,800
Thallium	0.2
Tin	3
Titanium	0.3
Vanadium	0.08
Zinc	0.1

[a] Data gap filled with Physical/Chemical Effluent data average (Table A-2), and then cycled up by a factor of 34-fold to reflect the brine concentration taking place in the evaporator and crystallizer.

Table A-4. Merrimack Station Influent and Effluent Average Concentrations and Removals in mg/L * TWF

Analyte	TWF	FGD Wastewater (Phys/Chem Influent)	Phys/Chem Effluent (VCE Influent)	Phys/Chem Removal	VCE Removal	Dryer Removal
Ammonia	0.00111	0.00211	0.00164	0.00046	0.00164	0
Nitrate Nitrite as N	0.0032	0.320	0.266	0.0536	0.266	10.9
Chloride	2.43E-05	0.260	0.260	-	0.260	6.32
Sulfate	5.60E-06	0.0147	0.00709	0.00756	0.00709	0.0028
Cyanide, Total	1.12	0.0130	0.0130	-	0.0130	0.0670
Aluminum	0.0647	13	0.00645	12.8	0.00645	0.129
Antimony	0.0123	0.000185	1.13E-05	1.74E-04	1.13E-05	0.000343
Arsenic	3.47	0.774	0.0279	0.746	0.0279	1.39
Barium	0.00199	0.00101	0.000478	5.27E-04	0.000478	0.00498
Beryllium	1.06	0.0107	0.000937	0.00977	0.000937	0
Boron	0.00834	1.74	4.56	-	4.56	8.34
Cadmium	22.8	0.442	0.00906	0.433	0.00906	1.14
Calcium	0.000028	0.136	0.141	-	0.141	1.85
Chromium	0.0757	0.0482	0.000115	0.0481	0.000115	0.0189
Chromium (VI)	0.517	0.372	0.00108	0.371	0.00108	0.0367
Cobalt	0.114	0.0100	0.000286	0.00971	0.000286	0.00971
Copper	0.623	0.203	0.00153	0.202	0.00153	0.156
Iron	0.0056	0.674	0.000718	0.674	0.000718	0.112
Lead	2.24	3.72	0.00137	3.72	0.00137	0.179
Magnesium	0.000866	0.825	0.666	0.159	0.666	20.6
Manganese	0.102667	2.45	0.0769	2.37	0.0769	0.107
Mercury	110	28.4	0.00213	28.4	0.00213	0.00440
Molybdenum	0.201	0.0250	0.0497	-	0.0497	0.105
Nickel	0.109	0.115	0.00133	0.114	0.00133	0.379
Selenium	1.12	3.07	0.109	2.96	0.109	1.35
Silver	16.5	0.00455	0.00502	-	0.00502	1.65
Sodium	5.49E-06	0.00336	0.00147	0.00189	0.00147	0.0152
Thallium	2.85	0.0457	0.0177	0.0280	0.0177	0.602
Tin	0.301	0.00346	0.0301	-	0.0301	1.02
Titanium	0.0293	0.0178	0.000293	0.175	0.000293	0.00997
Vanadium	0.28	0.0963	7.00E-04	0.0956	7.00E-04	0.0238
Zinc	0.0469	0.201	0.000143	0.201	0.000143	0.00486
Total		**56.8**	**6.3**	**53.4**	**6.3**	**56.5**

"-" =Indicates where effluent were greater than influent values. These data were discarded.

Table A-5. Merrimack Station Treatment System Benefits

	Flow (gpy)	Removal Factor (mg/L * TWF)	Removal (TWPE per year)
Physical/Chemical	9,250,560	53.4	4,122
VCE	9,250,560	6.28	480
Drum Dryer	630,720	56.5	298

gpy = gallons per year

Cost Estimate

Cost data were obtained from PSNH Merrimack. Costs were annualized based on a 20-year plant life span at a 7 percent interest rate. **Table A-6** summarizes the annualized cost in current dollars and 1981 dollars. Capital and operating costs are provided by PSNH Merrimack for the physical/chemical treatment system and VCE and Crystallizer, they are based on actual costs for their installation at Merrimack. Capital and operating costs for the drum dryer system were estimated based on quotes from an equipment vendor, plus additional costs for the balance of plant.

This system cost reflects its construction as a component of the FGD Scrubber/Clean Air Project. The VCE costs likely would increase if built as a standalone system.

Table A-6. Merrimack Station Cost for Physical/Chemical and VCE Treatment Technologies

	Capital Cost [million dollars]	O&M Cost [million dollars per year]	Total Annualized [million dollars per year]	Capital Cost [1981 million dollars]	O&M Cost [1981 million dollars per year]	Total Annualized [1981 million dollars per year]
Physical/ Chemical [1]	15	1.8	3.3	5.7	0.7	1.2
VCE and Crystallizer [1]	31.2	2.4	5.3	11.9	0.9	2.0
Drum Dryer [2]	2.7	0.3	0.5	0.9	0.09	0.2

Notes:

1. Capital and operating costs are actual costs are provided by PSNH Merrimack for the physical/chemical treatment system and VCE and Crystallizer.
2. Capital and operating costs estimated by WSSI, in 2017 dollars (so is pro-rated to 2012 dollars in Table 1 of this memo).

Appendix B

Bottom Ash Sluice Water Treatment Cost-Effectiveness Analysis

Introduction

This appendix provides details on how EPRI estimated cost-effectiveness for a closed-loop bottom ash handling system. Cost estimates are based on information provided by PSNH Merrimack Station.

Pollutant Removals Calculation Methodology

Pollutant removals for bottom ash transport water were defined as the pollutants in bottom ash transport water minus the pollutants in the source water. The estimated contaminants removed were calculated both as concentrations and toxic-weighted pound equivalents (TWPE). TWPE factors are used by the U.S. Environmental Protection Agency (EPA) to express the relative toxicity of pollutants. Calculations use the concentration of contaminants in the water, wastewater flow, and toxic weighting factors (TWF). Data from PSNH Merrimack sampling were used in the calculations.

Summary of Available Data

EPRI's evaluation used data from two sampling episodes at PSNH Merrimack. The bottom ash transport water data were based on one sample taken in July 2013 and an additional sample taken in July 2017. These two data sets were averaged before subtracting out the source water pollutants. The source water data were based on a sample taken in July 2013 corresponding to the bottom ash sample. Analytes that were not included as part of the plant PSNH sampling episodes were estimated with data for source water and bottom ash water based on the following document:

- EPRI Comments on Proposed Effluent Limitations Guidelines Rule (EPRI, 2013)

The source water data was subtracted from the bottom ash transport water and multiplied by the average flow rate on days the plant is operating at Merrimack Station (4 million gallons per day) and TWF to calculate TWPE per year. The flow per year was based on PSNH's estimate of operating roughly 40 percent of the time. The available data are summarized in **Table B-1** and **Table B-2** summarizes bottom ash transport water minus the source water.

The pollutant removal calculation followed the methodology outlined in the *EPRI Comments on Proposed Effluent Guidelines Rule* (EPRI, 2013) pollutant removal calculations.

A summary of the estimated benefit calculation for PSNH Merrimack Station is presented in **Table B-3**.

Table B-1. Merrimack Station Source Water and Bottom Ash Transport Water Concentrations

Analyte	Source Water 07/22/2013 (mg/L)	Bottom Ash Transport Water 07/22/2013 (mg/L)	Bottom Ash Transport Water 07/19/2017 (mg/L)	Bottom Ash Transport Water Average (mg/L)
Aluminum	0.08	0.23	0.67	0.45
Antimony	0.0005	0.0005	0.0005	0.0005
Arsenic	0.0005	0.0005	0.002	0.00125
Barium	0.008	0.009	0.015	0.012
Beryllium	0.0005	0.0005	0.0005	0.0005
Boron	0.025	0.025	0.025	0.025
Cadmium	0.0005	0.0005	0.0005	0.0005
Calcium	4.2	4.6	4.4	4.5
Chromium	0.0005	0.0005	0.002	0.00125
Cobalt	0.0005	0.0005	0.0005	0.0005
Copper	0.03	0.001	0.005	0.003
Iron	0.42	0.66	1.1	0.88
Lead	0.004	0.0005	0.002	0.00125
Magnesium	0.68	0.73	0.75	0.74
Manganese	0.031	0.03	0.047	0.0385
Mercury	0.000002	3.3E-06	0.00005	2.67E-05
Molybdenum	0.0005	0.0005	0.001	0.00075
Nickel	0.0005	0.0005	0.002	0.00125
Selenium	0.0005	0.0005	0.0005	0.0005
Silver	0.0005	0.0005	0.0005	0.0005
Sodium	9	10	12	11
Thallium	0.0005	0.0005	0.0005	0.0005
Tin	0.005	0.005	0.0025	0.00375
Titanium	0.0025	0.01	0.032	0.021
Vanadium				
Zinc	0.013	0.0025	0.01	0.00625
Chloride				
Sulfate	4	9	8	8.5
Nitrate/Nitrite			0.25	0.25
Ammonia-N				
Fluoride				
Cyanide				
Hexavalent Chromium				

Table B-2. Merrimack Station Bottom Ash Transport Water Minus Source Water

		Bottom Ash Water Minus Source Water	
Analyte	**TWF**	**mg/L**	**mg/L * TWF**
Aluminum	0.0647	0.370	0.0239
Antimony	0.0123	-	-
Arsenic	3.47	0.000750	0.00260
Barium	0.00199	0.00400	7.96E-06
Beryllium	1.057	-	-
Boron	0.00834	-	-
Cadmium	22.8	-	-
Calcium	0.000028	0.300	8.40E-06
Chromium	0.0757	0.000750	5.68E-05
Cobalt	0.1143	-	-
Copper	0.623	-	-
Iron	0.0056	0.460	0.00258
Lead	2.24	-	-
Magnesium	0.000866	0.0600	5.19E-05
Manganese	0.103	0.00750	0.000770
Mercury	110	2.47E-05	0.00271
Molybdenum	0.201	0.000250	5.04E-05
Nickel	0.109	0.000750	8.17E-05
Selenium	1.12	-	-
Silver	16.5	-	-
Sodium	5.49E-06	2	1.1E-05
Thallium	2.85	-	-
Tin	0.301	-	-
Titanium	0.0293	0.0185	0.000542
Vanadium	0.28	0.0199[a]	0.005569
Zinc	0.0469	-	-
Chloride	2.43E-05	1.81[a]	4.39E-05
Sulfate	5.6E-06	4.5	2.52E-05
Nitrate/Nitrite	0.0032	6.25E-03[a]	2.00E-05
Ammonia-N	0.00111	0.00[a]	-
Fluoride	0.035	0.01018[a]	0.000356
Cyanide	1.12	NA[a]	0
Hexavalent Chromium	0.517	NA[a]	0
	Total		**0.0394**

[a] Gap filled with *EPRI Comments on Proposed Effluent Limitations Guidelines Rule*

- Represents no removal, as source water was equal to or greater than bottom ash water data.

Table B-3. Merrimack Station Bottom Ash Treatment System Benefits

	Flow (gpy)	Removal (mg/L * TWF)	Removal (TWPE per year)
Bottom Ash Transport Water Minus Source Water	584,000,000	0.0394	192

TWPE = Toxic Weight Pound Equivalent

Cost Estimate

Capital costs and operating costs were estimated by CH2M. CH2M's estimate was developed using equipment cost quotes, and then adding parametric factors such as piping, contractor profit and engineering. The equipment is primarily the remote submerged flight conveyor (SFC). PSNH has designed a system with one remote SFC. Therefore, the cost is lower than it would be for sites that choose to include redundant systems for reliability. Costs were annualized based on a 20-year plant life span at a 7 percent interest rate. **Table B-4** summarizes the annualized cost in current dollars and 1981 dollars.

Table B-4. Merrimack Station Cost for Closed-Loop Bottom Ash Handling System

	Capital Cost, [million dollars]	Operation & Maintenance, [million dollars per year]	Total Annualized, [million dollars per year]	Capital Cost, [1981 million dollars]	Operation & Maintenance, [1981 million dollars per year]	Total Annualized, [1981 million dollars per year]
Bottom Ash Sluice	14.9	0.2	1.6	5.0	0.06	0.5

Note: Capital costs and operating costs estimated assuming one remote submerged flight conveyor needed.

Attachment 6

The document identified as Attachment 6 is designated as "Confidential Business Information," in accordance with 40 C.F.R. Part 2 and, therefore, has been removed from the publicly filed version of these comments.