Public Service of New Hampshire

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A Northeast Utilities Company

October 8, 2010

Mr. John King
Office of Ecosystem Protection
United States Environmental Protection Agency
5 Post Office Square, Suite 100 (OEP06-3)
Boston, MA 02114

Re: Public Service Company of New Hampshire
Merrimack Station, Bow, New Hampshire
Response to Informal EPA Request for Supplemental Information about Planned
State-of-the-Art Flue Gas Desulfurization ("FGD") Wastewater Treatment System

Dear Mr. King:

PSNH is required by law (RSA 125-O:11-18) to construct and operate a state-of-the-art wet flue gas desulfurization system (the "FGD System") at Merrimack Station in Bow, New Hampshire, as soon as possible, to significantly reduce mercury and sulfur dioxide emissions. As an integral part of this FGD System, an equally state-of-the-art wastewater treatment system (the "FGD WWTS") has been specially designed to address the Station-specific pollutants that will be present, at Station-specific concentrations, in the wastewater discharged by the FGD System (the "FGD Wastewater"). EPA has recently followed up on PSNH's preliminary submissions regarding the design and operation of the FGD WWTS with an informal request for additional information. Based on technical analysis and design work by leading FGD wastewater treatment expert Siemens Water Technologies and international engineering firm URS Corporation, and in response to EPA's informal request, this correspondence: (1) describes the FGD WWTS' key components and processes, (2) discusses the technology options that PSNH evaluated for treating the FGD Wastewater, and (3) explains why, for Merrimack Station, the FGD WWTS constitutes the "best available technology economically achievable" ("BAT") for removing pollutants from the FGD Wastewater under the Clean Water Act ("CWA").

I. Background

Merrimack Station's two primary electric generating units, MK1 and MK2, combust coal to generate steam (which in turn drives turbine generators to produce electricity for sale to PSNH's customers). Currently, the flue gas from each of these two units passes through air pollution control equipment that includes selective catalytic reduction systems to control nitrogen oxides emissions and two electrostatic precipitators to control particulate matter emissions.

In 2006, the New Hampshire legislature enacted RSA 125-O:11-18, which requires PSNH to install and operate a wet FGD system at Merrimack Station to reduce mercury emissions as soon as possible but by no later than July 1, 2013. In response to this statutory mandate, PSNH has committed itself to the construction and operation of a technically advanced FGD System designed to reduce mercury emissions by no less than 80 percent and sulfur dioxide emissions by no less than 90 percent. Moreover, PSNH has committed to having the FGD System fully operational well in advance of the statutory deadline in accordance with the legislative determination that expeditious operation of the facility, and concomitant reduction in mercury and sulfur dioxide emissions, is in the public interest (RSA 125-O:11,I). With the FGD System up and running, Merrimack Station will be among the cleanest coal-fired electric generating plants in the United States.

The advanced wastewater treatment technologies designed by Siemens and URS for use at Merrimack Station combine proven physical-chemical processes with a state-of-the-art "polishing" subsystem for enhanced removal of metals (both technologies together comprise the FGD WWTS). Together, these technologies will reduce pollutant concentrations in the FGD Wastewater to the maximum extent reasonably achievable prior to its discharge to the Station's existing treatment pond and ultimately to the Merrimack River in accordance with applicable law. The result is a milestone in FGD wastewater treatment, with pollutant reductions to levels that are comparable to, or lower than, background levels.

Most notably, the FGD WWTS will reduce mercury levels in the FGD Wastewater greater than 99.9 percent. Indeed, applicable state water quality requirements for mercury will be exceeded. New Hampshire's assimilative capacity requirement for the Merrimack River for mercury could be satisfied by treating the FGD Wastewater using only the physical-chemical component of the FGD WWTS. Instead, PSNH is taking a pioneering approach, incorporating the enhanced metals removal subsystem into the FGD WWTS to ensure the achievement of "no net mass increase" in mercury discharges. As a result, only a nearly non-detectible concentration of mercury will be present in the treated FGD Wastewater upon discharge.[1]

II. <u>The FGD WWTS</u>

The FGD System is a wet limestone forced oxidation system (i.e., a "wet scrubber") that will direct the flue gas from MK1 and MK2 into an absorber unit for mixture with a sprayed slurry that is comprised of fresh slurry containing a limestone sorbent and recirculated slurry that has already mixed and reacted with incoming flue gas.[2] The contact between the flue gas and the slurry will effect a mass transfer of pollutants from the flue gas to the slurry, and will generate two by-products: (1) the cleansed scrubbed flue gas, which will be emitted through a new stack, and (2) additional reacted scrubber slurry, which contains supersaturated dissolved gypsum, dissolved chlorides, dissolved metals, suspended gypsum crystals, suspended fine solids and heavy metals.

A portion of the reacted scrubber slurry will be purged from the FGD System on a regular basis – typically when the percent gypsum crystals or chlorides concentration in the slurry reaches an

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[1] PSNH acknowledges that under the CWA, EPA is not required to consider a wastewater discharge's impact on receiving waters in determining whether a particular treatment technology is BAT for that discharge (although it also notes that even in the context of setting BAT-based effluent limits, EPA must heed the fact that "at some point extremely costly more refined treatment will have a de minimis effect on the receiving waters." *Ass'n of Pacific Fisheries v. EPA*, 615 F.2d 794, 818 (9th Cir. 1980); *see also American Petroleum Inst. v. EPA*, 787 F.2d 965, 972 (5th Cir. 1986) ("Indeed, EPA would disserve its mandate were it to tilt at windmills by imposing BAT limitations which removed de minimis amounts of polluting agents from our nation's waters, while imposing possibly disabling costs upon the regulated industry.")).

[2] The New Hampshire legislature expressly required PSNH to install "a wet flue gas desulphurization system" at Merrimack Station, on the grounds that the New Hampshire Department of Environmental Services "determined that the best known commercially available technology is a wet flue gas desulphurization system, hereafter 'scrubber technology,' as it best balances the procurement, installation, operation, and plant efficiency costs with the projected reductions in mercury and other pollutants from the flue gas streams of Merrimack Units 1 and 2." RSA 125-O:11,II. Therefore, PSNH did not consider installing a dry FGD system.

established limit – to maintain proper scrubber chemistry. The purged scrubber slurry will be directed to hydroclones to separate gypsum crystals from the slurry's liquid component. These separated gypsum crystals will be recirculated back to the FGD System (with a portion ultimately dewatered, recycled and sold for commercial applications such as wallboard manufacturing). The liquid component of the separated scrubber slurry – the FGD Wastewater – will be directed to the FGD WWTS for treatment.

The FGD Wastewater will contain suspended fine solids (including gypsum, unreacted limestone, fly ash and other inert materials) and dissolved chlorides, as well as supersaturated dissolved gypsum and dissolved metals. The FGD WWTS has been designed to treat the wastewater from Merrimack Station's FGD System in several stages (please refer to the diagram provided as Exhibit A to this correspondence).[3] Specifically:

- The FGD Wastewater will be transferred to an equalization tank to eliminate spikes in wastewater flow rates and pollutant concentrations.

- From the equalization tank, the FGD Wastewater will be transferred to one of two process trains, each containing two reaction tanks, to undergo several initial "conditioning" steps that will prepare it for clarification (i.e., the removal of precipitated solids by gravity settling).

- In the first reaction tank, hydrated lime will be added to elevate the pH level of the FGD Wastewater. In addition, a portion of the sludge developed in the downstream reactor-clarifier will be recycled to this reaction tank. This pH adjustment and sludge addition will promote both the desaturation of remaining dissolved gypsum and the precipitation of dissolved metals into insoluble metal hydroxides. In addition, organosulfide will be added to further precipitate dissolved metals into metal sulfides (metal sulfides generally have even lower solubilities than metal hydroxides).[4] The precipitated metal hydroxides and metal sulfides will be removed in the downstream clarification and filtration stages (their dissolved predecessors would not have been captured by those stages).

- In the second reaction tank, ferric chloride will be added to coagulate the suspended solids and metals precipitate in the FGD Wastewater, which will further promote the settling out of the metals precipitate during clarification. In addition, polymer will be added downstream of the second reaction tank to enhance the flocculation of fine suspended particles in the FGD Wastewater and thereby enhance their removal in the clarification and filtration stages.

- From the reaction tanks, the conditioned FGD Wastewater will be transferred to a solids-contact reactor-clarifier unit. The reactor component of this unit will mix the incoming FGD Wastewater with an internally re-circulating volume of clarifier sludge – dense floc and precipitate that were previously settled out of the FGD Wastewater by the unit's clarifier component – to promote particle growth and further improve the

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[3] The design basis for all FGD WWTS components is the maximum potential flow of FGD Wastewater to the FGD WWTS equalization tank, excluding internal recycle streams and chemical feed flow rates, based on full-time operation of the FGD System at maximum capacity. The FGD WWTS will process incoming FGD Wastewater on a continuous basis in order to maintain consistent water chemistry.

[4] Precipitation reduces the solubility of dissolved heavy metals in wastewater, enabling the settling and removal of the resulting metal hydroxide and metal sulfide precipitates (i.e., solids) through clarification and filtration.

removal of suspended solids. The chemically conditioned FGD Wastewater then will be directed up through the unit's clarifier (the "clarification zone"). As the wastewater slowly rises through the clarification zone, the precipitated solids will continuously settle out. At the top of the clarification zone, the treated FGD Wastewater will flow over the clarifier's circular weir (which controls even distribution of the water as it rises) and be discharged.[5]

- The clarified FGD Wastewater – which, compared to the FGD Wastewater originally separated from the FGD System scrubber slurry, will contain substantially reduced levels of suspended and dissolved solids and metals – will be neutralized with hydrochloric acid and passed through continuously backwashed gravity filters to remove additional suspended solids and metals precipitate.

- Finally, the FGD Wastewater will be directed through a state-of-the-art treatment subsystem – specially designed by Siemens for PSNH to address the FGD Wastewater generated by Merrimack Station's FGD System – that will "polish" the clarified FGD Wastewater to achieve additional removal of mercury and arsenic (as well as still further reduction in total suspended solids concentrations) over and above what prior treatment steps will already have removed. Using proven wastewater polishing techniques in a novel application to FGD wastewater, this subsystem will employ cartridge filters and two different types of targeted adsorbent media to provide this enhanced metals removal treatment.

  Specifically, in the first stage of this pioneering treatment subsystem, the FGD Wastewater will be directed through three sets of cartridge filters. Each of these sets of filters will consist of a fiber-reinforced plastic housing, 2 feet in diameter by 2-1/2 feet long, containing 22 filter spiral-wound cartridges. The first housing will contain 3-micron pore filters, the second 1-micron pore filters and the third 0.2-micron pore filters. The purpose of these filters is to remove very fine suspended solids still remaining in the wastewater (potentially including gypsum, limestone and metallic hydroxides and sulfides that were not captured upstream) so that they do not clog the adsorbent media.

  In the subsystem's second stage, the FGD Wastewater will pass though two sets of targeted adsorbent media that will enable Merrimack Station's FGD WWTS to achieve near-complete removal of mercury, arsenic and other heavy metals from the FGD Wastewater. These media, both proprietary to Siemens, are demonstrated technologies for reducing heavy metals concentrations in other industrial wastewaters and drinking water. The first – a Siemens SCU carbonaceous media – is carbon-based and will be deployed in the FGD WWTS to adsorb mercury; the second – Siemens GFH® media – is ferric hydroxide-based and will adsorb arsenic, chromium, selenium and other heavy metals. Deployed together as the FGD WWTS' last treatment step, these adsorbent media will remove dissolved and extremely fine particles of arsenic and mercury (ionic, elemental and in the form of hydroxide compounds and sulfide compounds) that none of

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5 Some of the FGD Wastewater/clarifier sludge mixture will be withdrawn from the bottom of the clarifier and pumped back to the first reaction tank to mix with newly incoming FGD Wastewater (as described above); the remaining portion will be withdrawn from the bottom of the clarifier and pumped to a holding tank for dewatering by filter presses. The drainage from these filter presses will be recirculated to the equalization tank and the resulting sludge filter cake will be disposed of off-site.

the other evaluated FGD wastewater treatment technologies can remove effectively, if at all.[6]

- The "polished" FGD Wastewater will be stored in effluent holding tanks and then sent to the Station's existing treatment pond, for ultimate discharge to the Merrimack River in accordance with applicable requirements.[7]

III. The FGD WWTS Constitutes BAT for Treating the FGD Wastewater

A. The Statutory BAT Factors

Under CWA § 301(b)(2), BAT-based effluent limitations represent the minimum level of treatment that can be attained using a technology that is technologically available and economically achievable – in other words, whose installation and operation is technically feasible and practicable, meets all legal requirements and is not cost-prohibitive – and that will result in reasonable progress toward the elimination of the discharge of toxic and non-conventional pollutants. Under CWA § 304(b)(2), EPA is required to consider the following factors in developing BAT limits: (1) the age of the equipment and facilities involved, (2) the manufacturing processes used, (3) the engineering aspects of the application of recommended control technologies, including process changes and in-plant controls, (4) non-water quality environmental impacts, including energy requirements, (5) cost and (6) such other factors as EPA deems appropriate. PSNH therefore evaluated the FGD wastewater treatment technologies identified below in light of these factors, to determine which, if any, may be BAT for treating the FGD Wastewater.

PSNH understands that EPA intends to establish BAT limits for Merrimack Station's FGD Wastewater discharge using its "best professional judgment" ("BPJ"), because it has not yet promulgated national technology-based effluent limitation guidelines for FGD wastewater discharges from steam electric generating facilities.[8] According to the NPDES regulations, in

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6 Once the media depletes its adsorption capacity, it will be removed by Siemens, which will also install replacement media. The exhausted media typically can be disposed of as non-hazardous waste.

7 A small amount of water from the existing treatment pond, including a small amount of the treated FGD Wastewater, will be recirculated back into the FGD System on a continuous basis.

8 *See* Memorandum from James A. Hanlon, Director, EPA Office of Wastewater Management to Water Division Directors, EPA Regions 1 – 10, entitled "National Pollutant Discharge Elimination System (NPDES) Permitting of Wastewater Discharges from Flue Gas Desulfurization (FGD) and Coal Combustion Residuals (CCR) Impoundments at Steam Electric Power Plants," dated June 7, 2010, Attachment A, at 1 ("This document addresses how to establish technology-based effluent limits for flue gas desulfurization (FGD) wastewater discharged from steam electric facilities in NPDES permits issued until such time a revised effluent guideline is promulgated.").

The issuance of BPJ-based permits "was to be only an interim measure pending the promulgation of guidelines, limitations, and standards mandated elsewhere in the Act." *See NRDC v. EPA*, 437 F.Supp.2d 1137, 1160 (C.D.Cal. 2006), quoting H.R.Rep. No. 92-911, at 126 (1972) (because it would be unreasonable to delay issuance of permits until implementation of standards is complete, EPA "may issue permits during this interim period with such conditions as [it] determines are necessary to carry out the provisions of this Act.") (emphasis supplied). However, the CWA does not expressly allow the use of BPJ-based permits on an ongoing basis, such as where EPA has failed to issue applicable regulations over a long period of time. *See id.* at 1160-1161 ("We know of no legal authority stating that the practice of issuing permits based on "best professional judgment" was to be ongoing") (citing *E.I. du Pont de Nemours & Co. v. Train*, 430 U.S. 112, 120, 97 S.Ct. 965, 51 L.Ed.2d 204 (1977), which stated that although § 402(a)(1) "authorizes the imposition of limitations in individual permits, the section itself does not mandate either the Administrator or the States to use permits as the method of prescribing effluent limitations").

developing such BPJ-based BAT limits, EPA must apply the statutory factors listed above, as well as consider both the "appropriate technology for the category of point sources of which the applicant is a member, based on all available information," and "any unique factors relating to the applicant."[9] PSNH questions the validity of EPA's use of BPJ to establish effluent limits for inclusion in NPDES permits. Nonetheless, and reserving its rights to challenge any aspect of EPA's NPDES permitting decision regarding the FGD WWTS, PSNH below summarizes its evaluation of the technologies it considered for treating the FGD Wastewater.

B. The Technologies Evaluated as Potential BAT for Treating the FGD Wastewater

PSNH undertook a conceptual evaluation of the following technologies with the assistance of industry experts to assess which, if any, may constitute BAT for treating the FGD Wastewater. In addition, New Hampshire Department of Environmental Services ("NHDES") technical staff provided invaluable guidance and input over the course of the past year.

1. Treatment by the Station's existing wastewater treatment system (the "Existing WWTS")
2. Discharge to a publicly owned treatment works ("POTW")
3. Settling ponds
4. Evaporation ponds
5. Off-site treatment and disposal
6. Flue gas injection
7. Fixation
8. Vapor-compression evaporation
9. Biological treatment

C. The Technological Availability of the Evaluated Technologies for Treating the FGD Wastewater

As outlined above, the CWA requires EPA to consider "the age of the equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques [and] process changes" in determining whether a particular treatment technology is technologically available.

1. Age of the Equipment and Facilities Involved

In evaluating whether a particular technology may be BAT for treating a discharge from an already existing facility, the "age of the equipment and facilit[y] involved" is relevant both to the feasibility of retrofitting the facility with the treatment technology being evaluated and to the cost of such a retrofit. Therefore, in its evaluation, PSNH took into account the fact that the Station has numerous large structures that are already in place, in use and intended to remain so (such

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[9] *See* 40 C.F.R. § 125.3(c)(2), (d)(3).

as the buildings housing the boilers and turbines), as well as other permanent site features (such as the proximity of the Merrimack River), and as a result has less flexibility in siting, designing and installing a new FGD wastewater treatment system than would an as yet unbuilt power plant. For each FGD wastewater treatment technology evaluated, PSNH assessed whether the technology could be BAT for treating the FGD Wastewater in part by determining whether it could be installed at Merrimack Station in light of existing Station infrastructure and land use, and the resultant lack of open space to accommodate new structures. Its conclusions with regard to this BAT factor are discussed in the next section, which addresses the technical feasibility (or infeasibility) of implementing each of the evaluated technologies at the Station.

2. Engineering Aspects of Implementing the Evaluated Technologies for Treating the FGD Wastewater / Process Changes

a) Treatment by the Existing WWTS

Merrimack Station has an existing on-site WWTS that it uses to treat the wastewater streams from its current operations before discharging them, via the Station's treatment pond and discharge canal, to the Merrimack River in accordance with applicable law. This WWTS consists primarily of three large, rectangular concrete settling basins with chemical feed systems and basic mixing capability (using compressed air), and the Station's treatment pond. Where necessary, wastewaters are first directed through a neutralizer (to adjust pH prior to treatment) or an oil/water separator, as appropriate.

PSNH evaluated using the existing WWTS to manage the FGD Wastewater and determined that it would not provide optimal treatment, especially compared to the significant reductions in FGD-related pollutant concentrations that the FGD WWTS is projected to achieve. The existing WWTS' limitations as a treatment system for the FGD Wastewater stem directly from the fact that the characteristics of the FGD Wastewater and the Station's other wastewaters, and thus their respective treatment requirements, are appreciably different.

The principal purpose of the Station's existing WWTS is to remove suspended solids from large batches of Station wastewater. However, the FGD-related pollutants in the FGD Wastewater will be present primarily as dissolved solids. Specifically, the FGD Wastewater will have higher concentrations of dissolved metals and chlorides than any of the Station's other wastewaters and will be supersaturated with dissolved gypsum, which the Station's other wastewaters are not. For this reason, effective treatment of the FGD Wastewater will require certain conditioning steps (described above) to precipitate and flocculate the dissolved metals and gypsum prior to clarification. These conditioning steps are most favorably performed as they will be in the FGD WWTS: in a continuous, not a batch, process using reaction tanks configured in a series, not settling basins. In short, to use the Station's existing WWTS to condition the FGD Wastewater prior to clarification, PSNH would need to undertake a major redesign and reconstruction of the existing WWTS' settling basins. While this is potentially feasible from a design and construction standpoint, even the existing WWTS' reconfigured design would not be optimally conducive to effective conditioning of the FGD Wastewater. Moreover, this option would leave the Station with reduced capacity of the system it presently uses to treat the waste streams it currently generates, which will continue to constitute the vast majority of its total wastewater even after the FGD WWTS commences operation.

In addition, the existing WWTS' settling basins are not suitable for the clarification process required to treat the FGD Wastewater. As noted above, settled FGD wastewater sludge must be continuously removed from an FGD wastewater treatment system's clarifier and recirculated within the system. Clarifiers with a center reaction well and sloped bottom allow for continuous sludge removal and recirculation and thus are generally the most advantageous for an effective

FGD wastewater treatment system. The Station's rectangular settling basins have neither center reaction wells nor sloped bottoms, which would make continuous FGD Wastewater sludge removal and recirculation difficult to the point of being impracticable.

Finally, while it might be technically possible to retrofit the existing WWTS' settling basins to provide some level of treatment for the FGD Wastewater, it would not be appropriate or effective from an operational perspective to manage the FGD Wastewater and all of the Station's other wastewaters together in the existing settling basins. The dilution of the FGD Wastewater that would result from mixing it with these other wastewater streams would require higher addition rates of the chemical reagents necessary to precipitate and enhance flocculation of the FGD Wastewater-specific pollutants prior to clarification. In addition, the full volume of the Station's non-FGD wastewater streams would unnecessarily undergo this pre-clarification conditioning, while the FGD Wastewater would unnecessarily be subjected to the various chemicals currently added to the basins to treat the existing wastewater streams, which could improperly interfere with the treatment of the metals specifically targeted by the FGD WWTS, mercury and arsenic.

b) Discharge to a POTW

Discharging the FGD Wastewater to the POTW closest to Merrimack Station – the Hall Street Wastewater Treatment Facility in Concord, New Hampshire – is technically infeasible because there currently is no physical connection between the Station and the POTW by which to convey the FGD Wastewater.[10] Moreover, the POTW is not designed to manage wastewater with the pollutant characterization of the FGD Wastewater. Unlike the FGD WWTS, it does not employ the equipment or treatment processes needed to reduce the FGD-related pollutants in the FGD Wastewater to concentrations achievable by modern FGD wastewater treatment systems.[11] In short, the FGD WWTS will provide superior treatment of the FGD Wastewater to what the Concord POTW is able to provide.

c) Settling Ponds

The use of on-site settling ponds dedicated solely to treating the FGD Wastewater is technically infeasible at Merrimack Station because there is not enough usable open space at the Station to construct a settling pond system of adequate dimensions to achieve proper treatment. To be effective, a settling pond must retain wastewater for a sufficient period of time to allow particulates to fall out of suspension before the wastewater is discharged. Specifically, a pond must be designed to have enough volume to store the solids that settle out without decreasing pond retention time, and enough open water area to allow effective settling. Merrimack Station does not have sufficient usable open space to construct ponds with sufficient open water area.

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[10] The POTW is more than five miles away from the Station. Thus, the physical distance alone resolves the question whether the capital costs for construction of such a connection would be "reasonable" under the CWA. *See BP Exploration & Oil, Inc. v. EPA*, 66 F.3d 784, 796 (6th Cir. 1995) *citing American Iron & Steel Inst. v. EPA*, 526 F.2d 1027, 1051 (1975), *modified in other part*, 560 F.2d 589 (3d Cir. 1977), *cert. denied*, 435 U.S. 914, 98 S.Ct. 1467, 55 L.Ed.2d 505 (1978) (when EPA sets BAT limits, it is governed by standard of reasonableness).

[11] The Concord POTW uses primary clarifiers for solids removal, biological treatment units for dissolved and suspended organics removal, and secondary clarifiers for the removal of solids produced during biological treatment. *See* http://www.epa.gov/ne/npdes/permits/attachments/nh0100901fs.pdf (Fact Sheet, NPDES Permit No. NH0100901, Hall Street Wastewater Treatment Facility, Concord, New Hampshire, p. 2).

In addition, settling ponds are designed to remove suspended particulates from wastewater by means of simple gravity separation, and do not include the process control features that are intrinsic to modern clarifiers, allowing operator control over treatment factors such as settling rate, removal and recirculation. As explained above in this letter's discussion of the existing WWTS' settling basins, even if it were technically feasible, use of settling ponds would not result in the best available treatment for the FGD Wastewater, which necessitates the conditioning and clarification processes described above to effectively remove dissolved metals and gypsum.

In sum, even though, as EPA has noted, power plants most commonly use settling ponds to manage FGD wastewater,[12] PSNH has committed itself to installing and operating the technologically advanced FGD WWTS, which will combine physical-chemical treatment and state-of-the-art enhanced metals removal to achieve near total reductions in the metals most predominantly present in the FGD Wastewater.

d) Evaporation Ponds

Using evaporation ponds at Merrimack Station to treat the FGD Wastewater is technically infeasible because the New Hampshire climate is not sufficiently warm and dry year-round to enable evaporation ponds at the Station to achieve an evaporation rate that would be equal to or greater than the flow of FGD Wastewater to the ponds. If PSNH were to rely solely on evaporation ponds to remove FGD-related pollutants from the FGD Wastewater, it would only be able to operate the FGD WWTS – and thus the FGD System – during the summer months. Not only would this be impracticable, but it also would bring PSNH into direct violation of the state law under which PSNH is building and will be operating the FGD System. Therefore, on-site evaporation ponds are not technologically available to treat the FGD Wastewater.

e) Off-Site Treatment and Disposal

PSNH considered the option of sending the FGD Wastewater off-site for treatment and disposal. However, this option was rejected because PSNH is not aware of any facility that is capable of achieving the substantial reductions in mercury, arsenic and other FGD-related pollutant concentrations that the FGD WWTS will, let alone any existing or planned independent FGD wastewater treatment or disposal facilities. (By "independent," PSNH means an FGD wastewater treatment and disposal facility that (1) is not owned or operated by PSNH and not located at Merrimack Station, and (2) is not owned or operated by another steam electric power generator and is not located at one of that generator's own power plants for the treatment and disposal of its own FGD wastewater.) In other words, there are no third-party vendors that provide these services.

Moreover, to PSNH's knowledge, power plants that operate FGD systems manage their own FGD wastewater, on-site, using one or more technologies. PSNH intends to manage the FGD Wastewater using a state-of-the-art FGD WWTS that, by combining demonstrated physical-chemical processes with a state-of-the-art enhanced metals removal process, constitutes BAT for the treatment of FGD Wastewater at Merrimack Station.

f) Flue Gas Injection

This treatment technology option would involve injecting part or all of the FGD Wastewater into the Station's flue gas upstream of the electrostatic precipitators ("ESPs") and relying on the hot

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12 *See Steam Electric Power Generating Point Source Category: Final Detailed Study Report* (EPA 821-R-09-008) (October 2009), p. 4-26.

flue gas to evaporate the liquid component of the FGD Wastewater and the ESPs to capture the remaining metals and chlorides. PSNH is not aware of any flue gas injection system currently in operation at any power plant in the U.S. to treat FGD wastewater. Further, after evaluating this option for use at Merrimack Station, PSNH has concluded that the lack of such systems is due to the numerous technical, operation and maintenance ("O&M") and potential worker safety issues they could pose. First, there is a reasonable risk that the highly corrosive dissolved chlorides remaining after the evaporation of the injected FGD wastewater's liquid component would not be fully captured by the ESPs, with the result that over time, they would concentrate in the FGD system's scrubber and other components, posing a serious risk of equipment corrosion and FGD system failure. This in turn would give rise to burdensome long-term O&M issues and costs that, while potentially manageable in theory, could in fact render operation of the flue gas injection system impracticable. In addition, metals that commingle and become concentrated with fly ash in the boilers and elsewhere could pose a potential health risk to employees.

In sum, PSNH has concluded that flue gas injection has not been either (1) sufficiently developed for safe large-scale commercial usage, or (2) sufficiently demonstrated, through long-term operation and monitoring, to be effective at a facility comparable to Merrimack Station, to be considered BAT for managing the FGD Wastewater.

g) Fixation

Fixation would involve the mixing of lime, fly ash and FGD Wastewater with the gypsum solids separated from the purged slurry to form a concrete-like substrate. Through the pozzolanic reactions that result, dissolved solids, metals and chlorides in the FGD Wastewater would be bound up in the concrete-like substrate, which would be disposed of by landfilling.

However, fixation generally is not used to manage the gypsum solids by-product generated by forced-oxidation FGD systems like the Station's FGD System, which are designed and operated to "recycle" these solids into wallboard-quality gypsum. Rather, fixation historically has been used to manage the unusable calcium sulfite by-product generated by inhibited oxidation FGD systems and the calcium sulfite/calcium sulfate by-product generated by natural oxidation FGD systems. In addition, the fixation process requires the use of pug mills to blend the lime, fly ash, separated slurry solids and FGD wastewater. Because pug mills have limited turndown capability and are designed to operate in batch mode rather than continuous full load, even if the Station wanted to manage the gypsum solids and FGD Wastewater by fixation, it would need to operate the FGD System to support the pug mill blending operation, rather than vice-versa. As a result, it is difficult to conclude that fixation would be BAT for the FGD Wastewater.

h) Vapor-Compression Evaporation

Power plants have used vapor-compression evaporator systems – typically consisting of brine concentrators in combination with forced-circulation crystallizers – to treat cooling tower blowdown since the 1970s. Nonetheless, FGD wastewater chemistry and cooling tower blowdown chemistry are very different, with the result that the power industry's design and operational experience with treating cooling tower blowdown using evaporation systems is not directly transferable to the use of evaporation systems to treat FGD wastewater. In fact, there are currently no power plants in the United States that are operating vapor-compression evaporator (i.e., brine concentrator and crystallizer) systems to treat FGD wastewater.

The treatment of non-FGD wastewater using a vapor-compression evaporator system is typically accomplished in three steps: (1) pre-concentration of the wastewater into a brine slurry using a brine concentrator, (2) evaporation of the remaining water in the brine slurry using a forced-circulation crystallizer (or a spray dryer), and (3) dewatering of the resulting sludge using a filter press or centrifuge. The first step, which also uses a mechanical vapor compressor to enable the vaporization and condensation of a portion of the wastewater's liquid component, concentrates the wastewater to a brine containing about 25% solids and produces distilled water as a by-product.[13] In the second step, the brine is fed to a forced-circulation crystallizer (also usually assisted by a mechanical vapor compressor), which produces a filtrate and a wastewater sludge containing approximately 70% solids. This sludge is dewatered to a salt cake (with low moisture content) by a filter press or centrifuge. While the recovered filtrate is returned to the crystallizer, the salt cake, which consists primarily of soluble salts, requires disposal in a classified landfill to ensure that the chemical species removed from the FGD wastewater do not dissolve and migrate to groundwater or surface water.[14]

In treating FGD wastewater with a vapor-compression evaporator system, there is a high potential for scaling and corrosion. In fact, using a crystallizer to treat FGD wastewater requires pretreatment, upstream of the brine concentrator, to "soften" the wastewater by removing calcium chloride and magnesium chloride salts that could result in a very high scaling potential within the brine concentrator and crystallizer. This softening process consumes large quantities of lime and soda ash and produces large quantities of sludge that must be dewatered, usually by filter press, for landfill disposal.

Vapor-compression evaporator systems have not yet been sufficiently demonstrated, through long-term operation and monitoring, to be effective at a facility comparable to Merrimack Station to be considered BAT for managing the FGD Wastewater. Until recently, RCC Ionics was the only supplier that had installed a vapor-compression evaporator system using a brine concentrator and crystallizer for FGD wastewater treatment in the United States; however, none of the five units that it has installed are currently operational. Aquatech had designed and manufactured vapor-compression evaporator system components for the Dallman Power Station in Springfield, Illinois, but this system was never installed. At present, another Aquatech vapor-compression evaporator system is currently in start-up in the United States, at Kansas City Power & Light's Iatan Station in Weston, Missouri; however, to date there has been no published information regarding its start-up or operation. Aquatech has also installed five vapor-compression evaporator systems at ENEL power plants in Italy, but not all of these systems are in operation, and performance data has not been published. It has been reported that these systems are experiencing corrosion; URS has asked for information and none has been provided.

Based on all of the above, PSNH has determined that compared to the FGD WWTS' combination of physical-chemical treatment (i.e., the conditioning and clarification steps described above) and state-of-the-art enhanced metals removal (i.e., the cartridge filtration and targeted adsorbent steps described above), a vapor-compression evaporator system would not be BAT for treating the FGD Wastewater.

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13 The vapor-compression evaporation process is often referred to as "zero liquid discharge" ("ZLD") because it is designed to produce this distillate stream, which can be reused. However, as EPA has noted, "[i]f the distillate is used for other plant operations that generate a discharge stream (e.g., used as boiler make-up and ultimately discharged as boiler blowdown), then the FGD process/wastewater treatment system is not achieving true zero liquid discharge. Therefore, the operation of the vapor-compression evaporation system itself does not guarantee that the FGD process/wastewater treatment system achieves zero discharge." *See* Steam Electric Power Generating Point Source Category: Final Detailed Study Report (EPA 821-R-09-008) (October 2009), p. 4-35.

14 This second step can use a spray dryer instead of a crystallizer. Spray dryers typically discharge evaporated moisture to the atmosphere rather than recovering it. While this may be "zero liquid discharge," it is not truly "zero discharge" to the environment.

i) Biological Treatment

Biological treatment of wastewater refers to various technologies that use microorganisms to target the removal of specific pollutants, including continuous suspended growth activated sludge, sequential batch reactor activated sludge, and the use of specialized microbes in a fixed film or suspended growth system. Target pollutants in a FGD wastewater stream could include chemical oxygen demand ("COD"), biological oxygen demand ("BOD"), general organic matter, nitrogen compounds or metals. However:

- Treatment of FGD wastewater for BOD and/or COD is less and less an issue for plants generating FGD wastewater, because most new FGD scrubber system designs – including the design of the Station's FGD System – do not rely on organic acid additives (e.g., adipic acid) to attain the required SO2 removal efficiency.
- A biological treatment system designed to remove nitrogen from FGD wastewater has only recently been started-up at one power plant. This plant has installed the nitrogen treatment system because it discharges to waters leading to the Chesapeake Bay, which has been designated as water quality-impaired by excessive nutrients.
- Biological treatment systems designed to remove selenium from FGD wastewater have been in operation at several North Carolina power plants that discharge to receiving waters identified as having comparatively high ambient in-stream concentrations of selenium, so that reduced levels of selenium in plant effluent are needed to meet applicable water quality criteria.

None of these biological treatment systems has been operating for a sufficiently long period of time to demonstrate (1) the suitability of the construction materials used in these systems over time, (2) the nature and extent of maintenance and/or component replacement required during routine operation and during outages,[15] and (3) the specific fate of pollutants the concentrations of which appear to have been reduced by such systems (for example, where a biological treatment system appears to be removing mercury, confirmation is required as to whether mercury is being captured by the system's microbes or simply absorbed by the activated carbon bed in which the microbes are suspended). Moreover, these systems have not been demonstrated to be effective at a facility sufficiently comparable to Merrimack Station to be considered BAT for managing FGD wastewater with the site-specific characteristics of the FGD Wastewater.

Based on the above, PSNH determined that following the FGD WWTS' physical-chemical treatment stages (i.e., the conditioning and clarification steps described above) and enhanced metals removal stage (i.e., the cartridge filtration and targeted adsorbent steps described above) with biological treatment for nitrogen and/or selenium removal would not constitute BAT for the FGD Wastewater. As described above, the biological treatment systems designed to remove nitrogen and selenium have been installed only recently and only at power plants that needed to implement these technologies to meet applicable water quality criteria. PSNH has designed and is implementing the installation of a FGD WWTS that both will exceed all of the necessary objectives for meeting applicable water quality standards and will reduce metals concentrations in the FGD Wastewater to lower levels than has been achieved by other power plant FGD wastewater treatment systems.

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[15] For example, one of the power plants with a selenium removal system has experienced considerable difficulty in obtaining the correct flow rates for periodic backflushing of the system's microbes.

D. Non-Water Quality-Related Environmental Impacts (Including Energy Impacts) of Implementing the Evaluated Technologies for Treating the FGD Wastewater

While EPA is not required to consider water quality impacts in setting BAT-based effluent limits, it is required to consider environmental impacts that are not water quality-related, as well as energy impacts.[16] In fact, EPA may determine that a particular treatment technology is technologically available and economically achievable but cannot be BAT because of unacceptably high non-water quality environmental or energy impacts.[17]

Several of the FGD wastewater treatment technologies that PSNH evaluated to determine whether they would be BAT for treating the FGD Wastewater would have potentially significant non-water quality environmental and energy impacts. For example, using fixation would result in a tremendous increase in the volume of solid waste generated by the Station. While landfilling is the most likely (and potentially the only permissible) means of disposing of this cementitious material, landfill capacity in New England is limited; in addition, landfills' long-term risk of failing to contain the wastes they have received must be taken into account, along with the potential resulting adverse impacts to groundwater and other media. In addition, with any off-site disposal option, a substantial increase in trucking traffic would have environmental and potential public safety impacts. Moreover, fixation would require siting, construction and operation of a pug mill mixing plant, which would not only increase energy costs (including power replacement costs) but also generate its own air emissions (primarily particulates) and wastewater discharge (such as pugmill mixer wash water).

Similarly, if a vapor-compression evaporation system were used to treat the FGD Wastewater, the salt cake generated by this process would similarly require disposal in a controlled landfill to ensure that the pollutants removed from the FGD Wastewater were segregated and prevented (at least in the short term) from migrating to groundwater or surface water. Moreover, the pretreatment process to which FGD wastewater must be subjected so that it may be treated in a crystallizer produces large quantities of sludge that are typically landfilled after dewatering, posing the same concerns. In addition, the use of a vapor-compression evaporation system at the Station to treat the FGD Wastewater would have potentially significant energy impacts, because the vapor compressors used by brine concentrators and crystallizers use substantial amounts of energy – and considerably more than any of the other FGD wastewater treatment technologies that PSNH evaluated.[18]

PSNH determined that the FGD WWTS constitutes BAT for treating the FGD Wastewater because it most effectively and efficiently removes pollutants from the FGD Wastewater while both minimizing the generation of other pollution (such as air emissions requiring capture or solid wastes requiring disposal) and avoiding the costs (including the environmental costs) of consuming more electricity.

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16 *See* CWA § 304(b)(2).

17 *See, e.g., BP Exploration & Oil, Inc. v. EPA*, 66 F.3d 784, 796 (6th Cir. 1995) (in establishing BAT-based effluent limits for produced waters discharged by offshore oil and gas extraction facilities, EPA properly determined that while reinjection was technologically feasible, combination of "negative impact reinjection would have on air emissions," high cost, and resulting loss of production was valid basis for rejecting it as BAT).

18 *See* Treatment Technology Summary for Critical Pollutants of Concern in Power Plant Wastewaters (EPRI, January 2007), p. 4-3 ("with evaporation, even with mechanical or thermal vapor recompression (MVR or TVR) or other energy saving processes, the overall energy consumption is significantly higher as compared to the other [FGD wastewater treatment] technologies discussed").

E. The Economic Achievability of Implementing the Evaluated Technologies for Treating the FGD Wastewater

The state-of-the-art combination of FGD wastewater treatment technologies that will achieve the most effective treatment of the FGD Wastewater (that is, the FGD WWTS) is among the more costly technology options evaluated. PSNH has nonetheless determined – in reliance on expert technical assessments and the considerable expertise and advice of NHDES, with knowledge of industry experience, and in consideration of the site-specific constraints and requirements of Merrimack Station and its FGD System – that this technology combination constitutes BAT for the FGD Wastewater. Certainly some of the evaluated technologies are less costly than the FGD WWTS, but they will not achieve the same cutting-edge pollutant reductions that the FGD WWTS will, and in some cases will simply pass pollutants to other environmental media.

On the other hand, several of the technologies evaluated may be prohibitively costly and thus not economically achievable for Merrimack Station.[19] PSNH has not provided an economic achievability analysis in this summary of its BAT analysis for the FGD Wastewater since none of the technology alternatives reviewed would perform as well in the site-specific conditions as the combination of technologies PSNH has selected for the FGD Wastewater. However, we reserve the right to supplement this correspondence with additional information and analysis demonstrating that the cost of installing one or more of the evaluated technologies at Merrimack Station is cost-prohibitive to the point of not being "economically achievable" or "reasonable" under CWA § 301(b)(2).[20]

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19 In particular, the costs associated with the installation and operation of vapor- compression evaporator equipment are high compared to the costs of the other FGD wastewater treatment technologies that PSNH evaluated. With regard to capital costs, brine concentrators, evaporators and crystallizers are constructed from expensive metals and metal alloys, such as titanium, to help prevent scaling and plugging of equipment internals. Equally significant, with regard to operating costs, the vapor compressors used by evaporators and crystallizers are high power users, requiring 70 to 100 kW-hr per 1000 gallons of feed, or approximately 600 hp for 100 gpm of feed.

20 *See, e.g., Ass'n of Pacific Fisheries v. EPA*, 615 F.2d 794, 818 (9th Cir. 1980) (when court reviews EPA's BAT determination for a specific point source category or individual discharger, it must determine whether EPA "considered the cost of technology, along with other statutory factors, *and whether its conclusion is reasonable*") (emphasis supplied).

We are enthusiastic about the FGD wastewater treatment technology selection we have made for the Merrimack Station scrubber project – we believe that this technology will provide optimal treatment, ensuring that we will operate well within applicable water quality standards. We look forward to discussing this technology in greater detail with EPA. In the meantime, please call me or Allan Palmer (603-634-2439) if you need additional information or have any questions.

Very truly yours,

William H. Smagula

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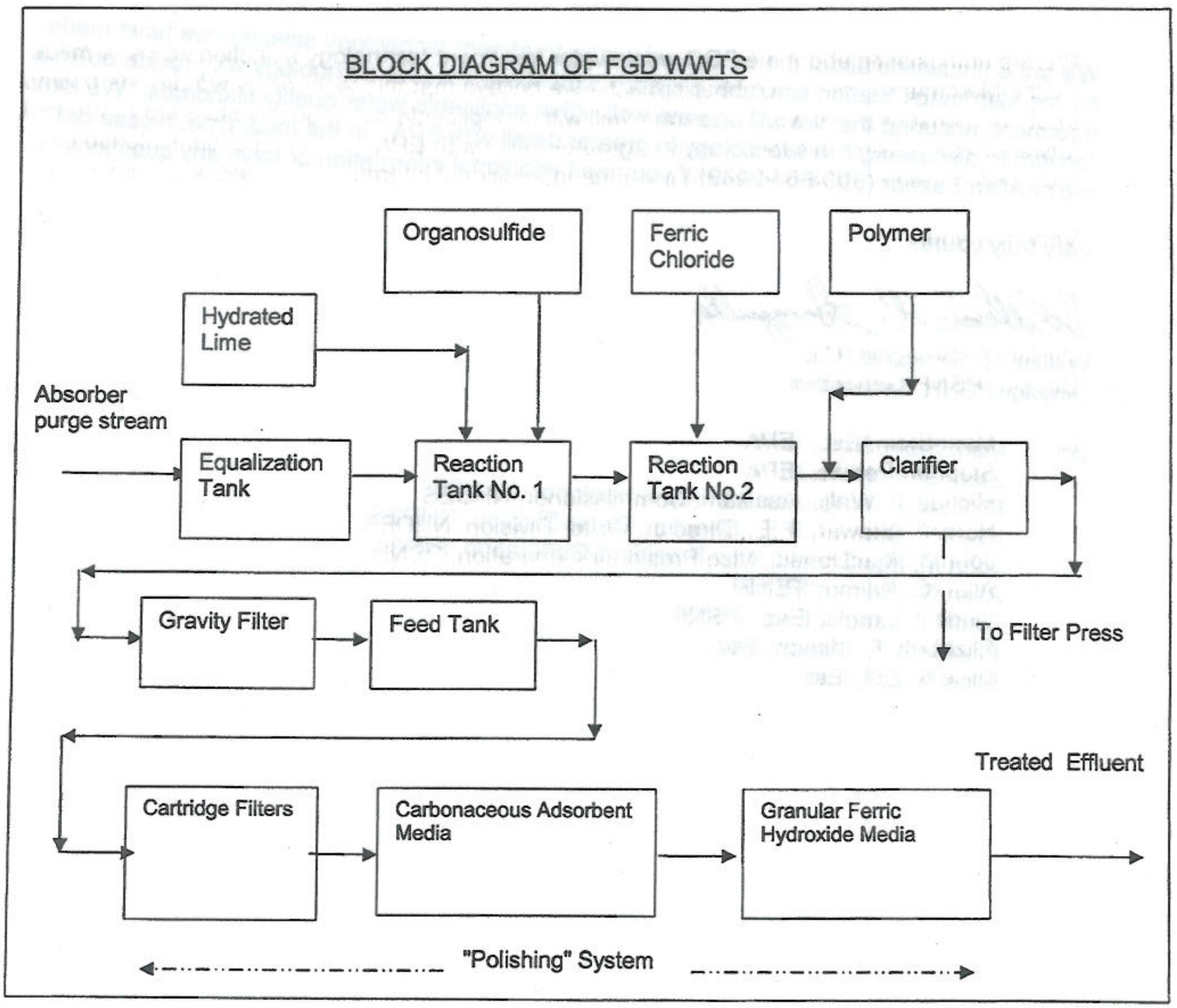
Exhibit A


BLOCK DIAGRAM OF FGD WWTS
Organosulfide
Ferric Chloride
Polymer
Hydrated Lime
Absorber purge stream
Equalization Tank
Reaction Tank No. 1
Reaction Tank No.2
Clarifier
To Filter Press
Gravity Filter
Feed Tank
Treated Effluent
Cartridge Filters
Carbonaceous Adsorbent Media
Granular Ferric Hydroxide Media
"Polishing" System