Public Service of New Hampshire

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The Northeast Utilities System

December 8, 2010

BY OVERNIGHT DELIVERY

Mr. Stephen Perkins
Office of Ecosystem Protection
U.S. Environmental Protection Agency
5 Post Office Square
Boston, MA 02109-3912

Re: Public Service Company of New Hampshire
Merrimack Station, Bow, New Hampshire, NPDES Permit No. NH0001465
Response to Information Request about Planned State-of-the-Art Flue Gas Desulfurization Wastewater Treatment System

Dear Mr. Perkins:

Public Service Company of New Hampshire ("PSNH") hereby responds to Question No. 4(e) of the United States Environmental Protection Agency's ("EPA's") October 29, 2010 information request under CWA §308 regarding the planned state-of-the-art wet flue gas desulfurization ("FGD") system and FGD wastewater treatment system at PSNH's Merrimack Station in Bow, New Hampshire (the "§308 Letter"). We appreciate that, at PSNH's request, EPA extended the due date for PSNH's submission of its response to Question No. 4(e) to December 8, 2010.

PSNH's Response to Question No. 4(e) of EPA's Information Request

4. Please provide additional explanation - beyond that already provided in PSNH's October 8, 2010 Submission - of why, in light of engineering considerations and PSNH's pertinent detailed evaluations, the following technologies were not considered preferable as part of the FGD WWTS at Merrimack Station:

e. Vapor-compression evaporation system as an addition to the chemical/physical treatment already planned for Merrimack Station.

For purposes of this supplemental response to the §308 Letter, the term "vapor-compression evaporation" means that process of thermal dewatering that is accomplished through the use of a falling film evaporator (also called a brine concentrator for certain applications, including FGD wastewater treatment) and a crystallizer.[1] Although the term "vapor-compression" is used, the

[1] In addition, for purposes of this supplemental response, (1) "FGD System" means the planned state-of-the-art wet flue gas desulfurization ("FGD") system at Merrimack Station; (2) "FGD WWTS" means the wastewater treatment system, described in PSNH's October 8, 2010 letter to EPA, that has been specially designed to address the Merrimack Station-specific pollutants expected to be present, at Station-specific concentrations, in the wastewater produced by the FGD System; (3) "FGD Wastewater" means the wastewater produced by the FGD System; and (4) "Clean Air Project" means PSNH's design and construction of the FGD System and FGD WWTS .

energy source for the evaporator/brine concentrator and/or crystallizer can be provided either by an electric motor- or steam turbine-driven vapor-compressor or by indirect steam heat exchange (e.g., using a shell and tube heat exchanger).[2]

In the initial design stage of the Clean Air Project, PSNH undertook a conceptual evaluation of a wide range of technology options, including vapor-compression evaporation, to identify proven, state-of-the-art technology for treating FGD Wastewater. This assessment included technical research and presentations by representatives from several engineering firms and equipment suppliers with the highest experience in treating FGD wastewater. Based on this initial evaluation, PSNH selected the physical-chemical treatment process as the most proven treatment technology for FGD Wastewater in use today. As described in our October 8, 2010 letter, a number of other technologies were considered but were not identified as the "best available technology economically achievable" ("BAT") for removing pollutants from the FGD Wastewater at Merrimack Station under the CWA. A few options, including variations of concentration/evaporation, were eliminated as BAT based upon extremely limited real world applications designed to address narrow site-specific needs, some of which should be considered experimental in nature.

Question No. 4(e) of the §308 Letter asks PSNH to explain why using a "[v]apor-compression evaporation system as an addition to the chemical/physical treatment already planned for Merrimack Station" is not "preferable as part of the FGD WWTS at Merrimack Station."[3] To the extent EPA is asking why PSNH is proposing to follow the physical-chemical stages of the FGD Wastewater treatment process with the recently designed enhanced metals removal subsystem described in our October 8, 2010 letter, as opposed to a vapor-compression evaporation subsystem, PSNH reiterates that based on the Merrimack Station-specific pollutants that are expected to be present, at Station-specific concentrations, in the FGD Wastewater, the FGD WWTS' combination of proven physical-chemical treatment and state-of-the-art enhanced metals removal will provide optimal treatment compared to the other FGD wastewater treatment technologies that PSNH evaluated.

Any new or reevaluation of the site-specific technological feasibility of installing and operating a vapor-compression evaporation subsystem to further treat the FGD Wastewater – as an add-on either to the FGD WWTS as currently proposed, or only to the original FGD WWTS' physical-

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2 Using a vapor-compressor enables the reuse of some of the energy that is present in the vapor already produced in the evaporator/brine concentrator and crystallizer. As a result, the amount of energy required to power the evaporator/brine concentrator and crystallizer, although still significant, is considerably less than it would be if the incoming liquid were to be evaporated using only an influent heat exchanger followed by energy input to achieve the evaporation. Operation with indirect heating by steam is not as thermodynamically efficient as the use of vapor-compression.

3 PSNH respectfully notes that under the CWA in general, and in the context of a BAT analysis under the CWA in particular, the meaning of the term "preferable" is unclear. Reserving its rights, PSNH responds to Question No. 4(e) herein.

chemical treatment process – would need to address the following considerations, at a minimum:[4]

- Identification of vapor-compression evaporation subsystem processes and/or components that are technically feasible on a site-specific basis as well as reasonable in light of the CWA's goals.

  - Pretreatment

    - PSNH would need to evaluate, among other factors, whether "pretreatment" of the FGD Wastewater (which would already have been treated through the FGD WWTS' physical-chemical process and, depending on the evaluated configuration of the FGD WWTS, its enhanced metals recovery subsystem):

      - Is required (the need for softening depends on an FGD wastewater's concentrations of calcium, magnesium, and chloride, and on the vapor-compression evaporation system's equipment configuration).
      - Would consist of softening, ultrafiltration and/or use of anti-scalants.
      - Would be required to attain a meaningful reverse osmosis recovery rate. (Evaluation considerations regarding reverse osmosis are addressed below)
      - Would be required to enable an evaporator/brine concentrator to use vapor-compression.
      - Would control expected scaling and corrosion.

    - Because softening produces potentially large volumes of sludge with no beneficial reuse (due to its use of large volumes of lime and/or soda ash as reagents), PSNH would need to evaluate the availability and cost of softening sludge disposal options.

  - Reverse Osmosis.

    - PSNH would need to evaluate, among other factors:

      - Whether reverse osmosis could be used effectively to reduce the volume of flow to be evaporated (through pre-concentration), which could allow use of a smaller evaporator/brine concentrator and/or crystallizer, or potentially only a crystallizer, and therefore require less energy to operate.

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4 It is very important that these design considerations be based on operational experience, as operational experience is a primary tool of engineering design. As discussed in more detail below, to PSNH's knowledge, no coal-fired power plant in the United States has any operational experience using crystallizers or reverse osmosis to treat FGD wastewater. Kansas City Power & Light's Iatan Station in Weston, Missouri provides a limited operational experience base for the use of falling film evaporators to treat FGD wastewater, but with a very different fuel (Powder River Basin coal, not the Eastern Bituminous coal that Merrimack Station uses).

- Whether the reject rate of certain elements would be lower than desired (e.g., less than 99%) and could result in increasing concentrations if returned to the FGD System.

- Concentration and Evaporation Stages.

  - PSNH would need to evaluate, among other factors, what combination of concentration and evaporation system components would be technically feasible on a site-specific basis and reasonable in light of the CWA's goals. For example:

    - An evaporator/brine concentrator followed by a crystallizer or spray dryer.
    - An evaporator/brine concentrator only.
    - A crystallizer or spray dryer only.
    - Reverse osmosis followed by an evaporator/brine concentrator and a crystallizer or spray dryer.
    - Reverse osmosis followed by a crystallizer or spray dryer only.

- Identification of equipment and construction materials.

  - PSNH would need to closely evaluate all materials used in construction and the equipment due to the highly corrosive nature of the FGD wastewater. Merrimack Station burns predominately Eastern Bituminous coal which typically contains higher concentrations of chlorides than other fuel sources such as Powder River Basin coal and can result in a more corrosive wastewater.

- Site layout / system component location.

  - Considerations would include that Merrimack Station has numerous large structures that are already in place, in use and intended to remain so (such as the buildings housing the boilers and turbines), as well as other permanent site features (such as the proximity of the Merrimack River and cooling canal), and as a result has little flexibility in siting and installing a vapor-compression evaporation system (in addition to the FGD WWTS' physical-chemical treatment process infrastructure and, depending on the evaluated configuration of the FGD WWTS, its enhanced metals recovery subsystem).

- Energy source (vapor-compression and/or steam)

  - With regard to the use of vapor-compression, considerations would include that vapor-compressor effectiveness depends in part on the concentrations of dissolved solids in the wastewater to be treated (because higher dissolved solids concentrations result in a higher boiling point and pressure). PSNH would need to evaluate, among other factors, the suitability of using electric motor-driven vapor-compression relative to the wastewater dissolved solids composition.

- With regard to the use of steam for evaporation energy, considerations would include the need to use either an auxiliary boiler or extraction steam from the power plant. Additional considerations would include that steam pressure and temperature requirements depend in part on the concentrations of dissolved solids in the wastewater to be treated. PSNH would need to evaluate, among other factors, whether extraction steam would be available and, if so, what impacts using extraction steam would have on the power plant heat cycle.

- Capital costs (including the costs of vapor-compression evaporation system design, procurement, installation and startup activities).

- Energy costs.

  - Considerations would include the fact that the amount of energy required to concentrate and evaporate the FGD Wastewater would be very large compared to the amount of energy required to operate the FGD WWTS physical-chemical treatment subsystem.

  - Additional considerations would include that the higher chloride concentrations in FGD wastewater from power plants operating on Eastern Bituminous coal elevate the boiling point of FGD wastewater to be treated through vapor-compression evaporation and, correspondingly, the required temperature and pressure of the compressed vapor. This makes operation with a vapor-compression cycle less efficient and more costly due to the increased power needs.

- Operation and maintenance costs (including costs for personnel support and for the service, repair and replacement of system components).

  - Considerations would include the fact that FGD wastewater from power plants operating on Eastern Bituminous coal typically contains high concentrations of dissolved chlorides. In a vapor-compression evaporation system, these chlorides become more highly concentrated through each stage of evaporation, thereby potentially contributing to increased scaling and plugging (as well as corrosion of the system's key components). Additional maintenance associated with these potential issues could result in higher use of chemicals and cleaning waste products.

- Additional treatment chemical consumption and costs.

  - Large volumes of soda ash are required by concentration-evaporation systems as well as anti-scalants, polymers and cleaning agents.

- Disposal options and associated costs for solid wastes that the Station does not currently generate, and that would be generated by a vapor-compression evaporation system (potentially including brine concentrate mixed with fly ash, concentrated crystallizer-generated salt cake and/or softening sludge).

- Considerations would include whether disposal could be accomplished by mixing the concentrated FGD Wastewater with fly ash, lime and gypsum to produce a pozzolonic (cementitious) material that would then be landfilled. PSNH would need to evaluate, among other factors:
  - The quantity of required fly ash versus the amount of available fly ash based on multiple coals and Station operating conditions.
  - The required ratios of FGD Wastewater, fly ash, lime and gypsum required to ensure production of a structurally stable material that is suitable for landfilling.
- Because Merrimack Station does not have sufficient space to develop a large, secure on-site landfill, PSNH would need to truck the additional solid wastes generated by operation of a vapor-compression evaporation at the Station to an off-site treatment and/or disposal facility. PSNH would need to evaluate several interrelated factors, including among others the nature and quantity of the solid wastes to be trucked off-site. (For example, mixing the concentrated FGD Wastewater with fly ash, lime and gypsum would require disposal of much larger quantities of solid waste (compared to the concentrated crystallizer-generated salt cake) and could result in loss of beneficial use of fly ash.)

- Impacts (other than costs) of the significant increase in the volume of solid wastes generated by the Station due to operation of a vapor-compression evaporation system.

- Impacts (including costs) on PSNH's current and potential beneficial reuse of Station combustion byproducts (including fly ash).

- Impacts of increased truck traffic associated with the off-site disposal of the solid wastes generated by a vapor-compression evaporation system.

- Scheduling (for bidding and awarding system contracts, delivery, construction and startup).

At present, there is only one FGD wastewater thermal dewatering system in operation in the United States, at Kansas City Power & Light's ("KCP&L's") Iatan Station in Weston, Missouri. The Iatan system, furnished by Aquatech, uses a clarifier for solids settling, followed by two 50% capacity falling film evaporators to achieve initial concentration of the FGD wastewater. The distillate from the evaporators is recovered for reuse. The brine concentrate is not further dewatered in a crystallizer stage, but is instead combined with fly ash, using a pug mill, and landfilled on-site. In fact, Iatan Station has a 140-acre landfill on-site that is permitted to dispose of more than 2000 tons of fly ash and gypsum per day.

There are several differences between Iatan Station and Merrimack Station that PSNH would need to address, that is identify technological solutions and then evaluate, if it were to look at the Iatan system as a potential model for a partial thermal dewatering system to treat the FGD Wastewater. First, as noted above, Iatan has its own on-site landfill, which it uses for disposal of the large quantities of a brine concentrate/fly ash solid waste mixture generated by its FGD wastewater thermal dewatering system. Merrimack Station does not, and likely will not, have an on-site landfill that is capable of disposing vast amounts of vapor-compression evaporation system-generated ash-based solid wastes. Second, because the Iatan thermal dewatering system does not use a crystallizer or spray dryer in a second evaporation stage, it will not provide an optimal opportunity for identifying and evaluating the potential operational and maintenance difficulties that could be experienced by a thermal dewatering system operating at Merrimack Station, which could include a crystallizer and reverse osmosis in addition to an evaporator/brine concentrator. Third, Iatan Station's generating units use Powder River Basin coal as their primary fuel source, while, as noted above, Merrimack Station uses Eastern Bituminous coal. This limits the ability of PSNH and EPA to use operating information from the Iatan system to assess the potential operational and maintenance difficulties that could result from concentrating FGD wastewater to a higher total dissolved solids level.

We look forward to continued discussions with EPA about the FGD WWTS. 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

William H. Smagula, P.E.
Director – Generation

Enclosures
cc: David Webster, EPA
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