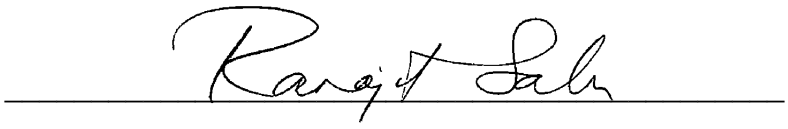
STATE OF NEW HAMPSHIRE
PUBLIC UTILITIES COMMISSION

Docket No. DE 11-250

PUBLIC SERVICE COMPANY OF NEW HAMPSHIRE

Investigation of Merrimack Station Scrubber Project and Cost Recovery

EXPERT TESTIMONY
OF
DR. RANAJIT (RON) SAHU



ON BEHALF OF THE SIERRA CLUB

DECMBER 20, 2013

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ATTACHMENTS

I. BACKGROUND AND EXPERIENCE

I, Ranajit Sahu have over twenty three years of experience in the fields of environmental, mechanical, and chemical engineering including: program and project management services; design and specification of pollution control equipment; soils and groundwater remediation; combustion engineering evaluations; energy studies; multimedia environmental regulatory compliance (involving statutes and regulations such as the Federal CAA and its Amendments, Clean Water Act, TSCA, RCRA, CERCLA, SARA, OSHA, NEPA as well as various related state statutes); transportation air quality impact analysis; multimedia compliance audits; multimedia permitting (including air quality NSR/PSD permitting, Title V permitting, NPDES permitting for industrial and storm water discharges, RCRA permitting, etc.), multimedia/multi-pathway human health risk assessments for toxics; air dispersion modeling; and regulatory strategy development and support including negotiation of consent agreements and orders.

I have a B.S., M.S., and Ph.D., in Mechanical Engineering, the first from the Indian Institute of Technology (Kharagpur, India) and the latter two from the California Institute of Technology (Caltech) in Pasadena, California. My research specialization was in the combustion of coal and, among other things, understanding air pollution aspects of coal combustion in power plants.

I have over twenty one years of project management experience and have successfully managed and executed numerous projects in this time period. This includes basic and applied research projects, design projects, regulatory compliance projects, permitting projects, energy studies, risk assessment projects, and projects involving the communication of environmental data and information to the public.

I have provided consulting services to numerous private sector, public sector and public interest group clients. My major clients over the past twenty one years include various steel mills, petroleum refineries, cement companies, aerospace companies, power generation facilities, lawn and garden equipment manufacturers, spa manufacturers, chemical distribution facilities, and various entities in the public sector including EPA, the states of New York, New Jersey, New Mexico, the US Dept. of Justice, California

DTSC, various municipalities, etc.). I have performed projects in 48 US states, numerous local jurisdictions and internationally.

In addition to consulting, I have taught numerous courses in several Southern California universities including UCLA (air pollution), UC Riverside (air pollution, process hazard analysis), and Loyola Marymount University (air pollution, risk assessment, hazardous waste management) for the past seventeen years. In this time period I have also taught at Caltech, my alma mater, at USC (air pollution) and at Cal State Fullerton (transportation and air quality).

I have provided and continue to provide expert witness services in a number of environmental areas discussed above in both state and Federal courts as well as before administrative bodies.

Additional details regarding my background and experience can be found in my resume provided in Attachment A and in the list of publications and presentations provided in Attachment B. Attachment C contains a list of my previous expert testimony.

II. SUMMARY OF TESTIMONY

My testimony addresses the questions of what forthcoming environmental compliance costs or risks a prudent utility operating multiple coal-fired generating units in New England would have or should have considered in the summer of 2008 time frame.

Specifically, this report looks at:

1) Air quality regulations reasonably foreseeable in 2008, and the attendant risks and costs a prudent utility would have considered in that time frame;

2) Water quality regulations--including cooling-water regulations—reasonably foreseeable in 2008, and the attendant risks and costs a prudent utility would have considered in that time frame; and,

3) Climate-related regulations reasonably foreseeable in 2008, and the attendant risks and costs a prudent utility would have considered in that time frame.

In addition, this report notes that Public Service Company of New Hampshire (PSNH) did not consider these risks and costs in the summer of 2008, and thus did not incorporate them into its decision to go forward with its Scrubber Project.

III. DISCUSSION AND OPINIONS

It is my understanding that this proceeding addresses whether the costs of Public Service Company of New Hampshire's (PSNH) flue gas desulfurization system installation (the Scrubber Project[1]) were prudently incurred consistent with the requirements of RSA 125-O:11 *et seq.* and are therefore eligible for recovery through default services rates pursuant to RSA 125-O:18, and whether the resulting rates are just and reasonable pursuant to RSA 378:5 and 8.

It is also my understanding, during the summer of 2008, PSNH became alerted to the fact that the Scrubber Project costs were significantly higher than the previously anticipated $250 million cost.. Therefore, prudence should have dictated that prior to making the decision to incur the significantly increased costs via continued implementation of the Scrubber Project, that any entity, including PSNH, had an obligation to determine if it made sense to proceed with the project.[2] The prudency of proceeding would in part of course rely on an assessment of potential future risks and costs, including those flowing from potential future environmental requirements.

It is clear from the record that PSNH either: (a) had a rather narrow view of financial scenario planning; or (b) had a vested interest in sinking a large amount of new capital (via the Scrubber Project) into an otherwise aging coal plant, thereby prolonging its already long life; or (c) both of the above. In my testimony, I will not explore (b) and (c) further but focus on (a).

[1] Although it is not the main purpose of this testimony, I cannot help but note that the Scrubber Project, as conceived, was highly unusual. Scrubbers are not normally installed to reduce mercury emissions with SO_2 reduction being a co-benefit. Typically, it is the other way about – i.e., wet scrubbers are designed primarily for SO_2 removal, with a co-benefit of mercury reduction. The whole decision is perplexing because other focused mercury reduction technologies were available in the mid-2000s and could have achieved system-wide mercury reductions at far lower capital costs. In fact, mercury reduction could have been effected at each plant, Merrimack and Schiller, at lower cost than that incurred in the Scrubber Project. And, doing so on a plant-by-plant basis might have automatically enabled compliance with other Federal rules such as the MATS rule, which is based on reductions at each unit/plant.

[2] I am aware that it is PSNH's current argument that it had no choice but to proceed with the project on the theory that it was a legal mandate from the legislature.

One might argue that the raison-d'être of prudent (financial) planning, particularly at a point in time prior to making (or recommitting to) significant (financial) decisions, is to pause and properly consider the consequences of proceeding as such. This is the essence of good planning. It does not mean that one always gets it right. Futures do not always play out according to plan.

But, crucially, it does not mean that, simply because the future is not known with precision, it cannot (or should not) be included in the planning process. Yet, it appears that in the case of PSNH it is this latter, narrow view of planning that was the norm. Having reviewed the record, it is my opinion that PSNH, in the summer of 2008, did not properly (or at all) consider the ramifications of proceeding with the Scrubber Project, in light of known and anticipated additional environmental costs associated with running at least the two coal plants in its system in the years ahead. Again, just because the future with regards to these future environmental costs was not crystal clear and fully fleshed out does not mean that proper and prudent planning could not have properly been able to give them proper consideration.

Chief among these expected future environmental costs were several air and water quality requirements that would impact coal plants, like Merrimack's two units and also the coal units at Schiller. Although there were several such rules in the offing (or already on the books) depending on the planning horizon, at least the following were commonly known to impact coal plants like Merrimack and Schiller located in New Hampshire:

- New and Updated National Ambient Air Quality Standards (NAAQS) for various pollutants including various forms of particulate matter such as $PM_{2.5}$,[3] SO_2,[4] and ozone (which would affect precursor emissions like NO_x), all of which are emitted by power plants. Since NAAQS are reviewed periodically (typically every 5 years) by EPA, any prudent operator of coal-fired power plants which emit several NAAQS pollutants (and precursors) in significant quantities definitely should always consider developments in NAAQS. In 2008, EPA was in the midst of implementing the $PM_{2.5}$ NAAQS and the ozone NAAQS and was in

[3] http://www.epa.gov/ttn/naaqs/pm/pm25_index.html.

the assessment stage of the SO_2 NAAQS revision, which ultimately resulted in a new 1-hour SO_2 NAAQS. I found no evidence that the implications of any of these NAAQS on the operations at Merrimack were considered by PSNH. Yet, a proper consideration of the implications of these rules by a prudent utility operating facilities such as Merrimack and Schiller might have pointed to the need for significant upgrades of existing control systems or even the replacement of specific controls (such as replacing the existing cold-side electrostatic precipitators for particulate matter control at Merrimack with more effective controls for $PM_{2.5}$ such as bag houses in order to meet the $PM_{2.5}$ NAAQS). Costs of these upgrades and new controls typically are in the tens of millions of dollars in capital costs and generally also increase operating costs via the need for additional manpower, utilities, consumables, and auxiliary power;

- Regional Haze rules requiring Best Available Retrofit Technology (BART) for Merrimack Unit 2 and likely Reasonable Further Progress requirements for the other coal units were also well known. While PSNH was actively engaged in the impact assessment of BART requirements on MK2, it is not clear if there was any assessment of the impact of the haze rule, as a whole, on MK1 or Schiller. Again, reduction of emission rates for NO_x, SO_2, and/or PM for reducing haze and visibility impacts could necessitate upgrades of controls that could require capital investments of millions of dollars and increases in operating costs as well;

- By 2008, it was also clear that there were significant developments on the regulatory front relating to greenhouse gases, which are emitted in extremely large quantities by coal-fired units. For example, the semi-annual regulatory agenda issued in Spring 2008 by the EPA had a broad agenda item on this topic. EPA noted that:

> [T]his notice will solicit public input as EPA considers the specific effects of climate change and potential regulation of greenhouse gas emissions from stationary and mobile sources under the Clean Air Act. As EPA has considered how best to respond to the Supreme Court's decision in Massachusetts v, EPA, as well as how to respond to

[4] http://www.epa.gov/ttn/naaqs/standards/so2/s_so2_cr_rea.html.

> petitions and comments received in rulemakings asking EPA to regulate greenhouse gas emissions from mobile and stationary sources, it has become clear that implementing the Supreme Court's decision could affect many sources beyond cars and trucks. In this advance notice, EPA will present and request comment on the best available science including specific and quantifiable effects of greenhouse gases relevant to making an endangerment finding and the implications of this finding with regard to the regulation of both mobile and stationary sources. This notice will also seek comment, relevant data, and questions about the implications of the possible regulation of stationary and mobile sources, particularly covering the various petitions, lawsuits and court deadlines before the Agency. These include the Agency response to the Massachusetts v. EPA decision, several mobile source petitions (on-road, non-road, marine and aviation), and several stationary source rulemakings (petroleum refineries, Portland cement, and **power plant** and industrial boilers). Finally, the notice will also raise potential issues in the New Source Review program, including greenhouse gas thresholds and whether permitting authorities might need to define best available control technologies." (emphasis added)[5]

I note that regulation of greenhouse gases for power plants, is, in fact, coming to pass. On September 20, 2013, the U.S. EPA announced its first steps under President Obama's Climate Action Plan to reduce carbon pollution from power plants.[6]

- Finally, by 2008 it was also clear that EPA would need to develop a comprehensive air toxics rule (which eventually was promulgated as the Mercury and Air Toxics (MATS) Rule), as opposed to just focusing on mercury. Well-before PSNH was grappling with the cost escalation of the Scrubber Project, on February 8, 2008, the D.C. Circuit vacated EPA's rule removing power plants from the Clean Air Act list of sources of hazardous air pollutants. At the same time, the Court vacated the Clean Air Mercury Rule.[7] Thus, the fact that air toxics rules were likely to be proposed for power plants was definitely something a prudent utility would have been aware of.[8] In addition, it was also clear that any such rule would apply at individual power plants (since EPA has issued many

[5] See RIN 2060-AP12, Title: Greenhouse Gases Under the Clean Air Act, EPA Semi-Annual Regulatory Agenda, Spring 2008. Available at http://resources.regulations.gov/public/custom/jsp/navigation/main.jsp.
[6] http://www.epa.gov/climatechange/EPAactivities/regulatory-initiatives.html.
[7] http://www.epa.gov/mats/actions.html.
[8] In fact, such rules were proposed on March 16, 2011 and finalized on February 16, 2012. See http://www.epa.gov/mats/actions.html.

such air toxics rules for other types of sources,[9] all of which apply at individual plants or processes within plants), with no allowance for "averaging" across geographically separate and completely different facilities (such as, say, the Merrimack and Schiller plants). Thus, reducing mercury, one of the main air toxics slated for reduction from power plants via this rule, needs to occur at each plant, and a prudent utility would have anticipated this in the summer of 2008. Given this, the lack of PSNH's planning is stunning. It now has a $422 million investment for mercury reduction for its entire system but this does nothing to reduce mercury emissions at Schiller. PSNH will need to comply with the MATS requirements at Schiller, without the benefit of "averaging" of reductions that might have occurred at Merrimack. This will require additional investments at Schiller. I note that PSNH, having been caught flat-footed on this, is now requesting additional time to comply with the MATS rule at Schiller, claiming it is finding it difficult to hire vendors, contractors, and technology providers.[10] Proper planning would be obviated this mess.

- In addition to these air quality rules, it is my opinion that a prudent operator of coal-fired power plants, and especially PSNH, would have been well aware by 2008 or earlier that EPA would be proposing regulations to address the broad area of cooling water for power plants, including regulations to reduce injury and death of fish and other aquatic life caused by cooling water intake structures existing at power plants, and might well require power plants to avoid such injury to require closed-loop cooling systems such as cooling towers.[11] After all, EPA was working on this rule since before 2004 and arguably substantially prior to that. More importantly and relevant to PSNH, EPA Region 1, the regulator and permit issuer for this Clean Water Act National Pollutant Discharge Elimination System (NPDES) permit, was actively engaged in the 2002-2007 time frame in a permitting decision related to reducing impacts to aquatic life for at least one

[9] http://www.epa.gov/ttn/atw/mactfnlalph.html.
[10] See letter dated October 21, 2013 from PSNH to the NHDES requesting an extension of time to meet MATS compliance at Schiller. Among other reasons for this request, it notes the challenge of finding vendors.
[11] http://water.epa.gov/lawsregs/lawsguidance/cwa/316b/phase2/index.cfm.

power plant facility (the Brayton Point plant in MA) by requiring a closed cycle cooling system for that plant.[12] There is no reason for a prudent operator to have ignored such actions on a fellow utility in the same EPA region - which is what PSNH did by viewing in the summer of 2008 time frame the necessity to construct new cooling water structures as "unlikely."[13]

In fact, EPA ultimately did issue a draft NPDES permit for Merrimack station that would require closed-cycle cooling at the facility.[14] As a result, PSNH will likely have to install cooling towers at Merrimack, with capital costs of tens of millions of dollars if not higher and increased operating costs as well due to the need for additional manpower, consumables for anti-fouling agents, etc.

Keeping in mind that the above is not an exhaustive list, it is nonetheless clear that given some of the potentially substantial costs that might attach to these upcoming regulations, that a prudent operator should have considered the possibility of how such rules might impact the viability of already aging coal plants such as Merrimack or Schiller before charging on to invest more capital such as via the Scrubber Project at Merrimack. Indeed, a prudent utility would have considered how such forthcoming regulatory compliance costs would impact its service rates, and what impact that would have on its customer pool.

Yet, I have seen no evidence that PSNH properly considered any of the above potential (and now real) regulatory impacts in its decision to proceed with the Scrubber Project, its cost escalation notwithstanding. As a result of its imprudent decision to implement the Scrubber Project, PSNH faces the situation that its already over-capitalized coal plants face further large future regulatory costs, making them likely unviable for future generation.

[12] See http://www.epa.gov/region1/braytonpoint/.
[13] Deposition of Gary Long at 118:23-24 (September 16, 2013), available at http://www.puc.state.nh.us/regulatory/CASEFILE/2011/11-250/TRANSCRIPTS-OFFICIAL%20EXHIBITS-CLERKS%20REPORT/11-250%202013-10-11%20TRANSCRIPT%20OF%20DEPOSITION-G%20LONG%20HELD%20ON%2009-16-13.PDF.
[14] See http://www.epa.gov/region1/npdes/merrimackstation/.

Of course, properly accounting for these and other upcoming environmental rules and the attendant significant compliance costs (which, as I note above, have already come to pass in several instances) in the summer of 2008 could well have led PSNH to conclude that its aging coal plants might simply not be viable due to the large capital and operating costs needed to bring them into compliance. That is still the case today. PSNH is faced with tens of millions of dollars in compliance costs to meet the draft NPDES permit by EPA which requires cooling towers at Merrimack. It needs unknown but significant additional investment at Schiller to meet the MATS rule. It does not have a strategy to deal with the various NAAQS.[15] And, it faces additional millions of dollars in compliance costs to deal with green house gas emissions reductions that are likely in the future. Clearly this will make the currently costly Merrimack and Schiller units even less viable as power producers in the future.[16] A prudent utility would have recognized this reality in the summer of 2008; PSNH, by failing to engage in prudent planning and evaluation of likely forthcoming environmental compliance costs and risks, irresponsibly incurred the hundreds of millions of dollars now sunk into the Merrimack Scrubber Project.

[15] See letter dated October 21, 2013 from PSNH to the NHDES requesting an extension of time to meet MATS compliance at Schiller.

[16] See a recent report from the PUC that also reaches the obvious conclusion that the Merrimack and Schiller plants, facing increased regulatory compliance costs and a dwindling rate base, are not viable in the future. Report available at http://www.puc.state.nh.us/regulatory/Docketbk/2013/13-020/LETTERS-MEMOS-TARIFFS/13-020%202013-06-07%20STAFF%20REPORT%20ON%20INVESTIGATION%20INTO%20MARKET%20CONDITIONS.PDF.