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NH PUBLIC UTILITIES COMMISSION

September 12, 2012

Debra A. Howland
Executive Director
New Hampshire Public Utilities Commission
21 South Fruit Street Suite 10
Concord, New Hampshire 03301

Re: Docket No. DE 11-250
Public Service Company of New Hampshire
Investigation of PSNH Installation and Cost Recovery of Scrubber Technology at Merrimack Station
Final Report of Jacobs Consultancy

Dear Ms. Howland:

In 2010, the Commission contracted with Jacobs Consultancy, Inc. to provide a variety of consulting services and, pursuant to the contract, Staff engaged Jacobs in the review the installation of wet flue gas desulphurization (Scrubber) technology at Merrimack Station by Public Service Company of New Hampshire (PSNH). Staff previously filed Jacobs' preliminary due diligence report and three quarterly reports in this docket on January 20, 2012.

Please find enclosed a REDACTED copy of the final Jacobs report regarding PSNH's installation of the Scrubber at Merrimack Station. Staff redacted certain information from the report pursuant to Order No. 25,332 (February 6, 2012). A confidential version of the document will be separately filed with the Commission.

I certify that a copy of this letter and the enclosed material will be provided to all parties on the service list.

Sincerely,

Suzanne Amidon
Staff Attorney

Service List

JACOBS Consultancy

REDACTED

New Hampshire Clean Air Project
Final Report

Prepared For
New Hampshire Public Utilities Commission

September 10, 2012

JACOBS Consultancy

REDACTED

New Hampshire Clean Air Project
Final Report

Prepared For

New Hampshire Public Utilities Commission

For Jacobs Consultancy

Frank DiPalma

Frank DiPalma

September 10, 2012

This report was prepared based in part on information not within the control of the consultant; Jacobs Consultancy Inc. Jacobs Consultancy has not made an analysis, verified, or rendered an independent judgment of the validity of the information provided by others. While it is believed that the information contained herein will be reliable under the conditions and subject to the limitations set forth herein, Jacobs Consultancy does not guarantee the accuracy thereof. Use of this report or any information contained therein shall constitute a release and contract to defend and indemnify Jacobs Consultancy from and against any liability (including but not limited to liability for special, indirect or consequential damages) in connection with such use. Such release from and indemnification against liability shall apply in contract, tort (including negligence of such party, whether active, passive, joint or concurrent), strict liability or other theory of legal liability, provided, however, such release limitation and indemnity provisions shall be effective to, and only to, the maximum extent, scope, or amount allowed by law.

This document, and the opinions, analysis, evaluations, or recommendations contained herein are for the sole use and benefit of the contracting parties. There are no intended third party beneficiaries, and Jacobs Consultancy shall have no liability whatsoever to third parties for any defect, deficiency, error, omission in any statement contained in or in any way related to this document or the services provided.

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1 Executive Summary

1.1 Background

The New Hampshire Public Utilities Commission (Commission) retained Jacobs Consultancy Inc. (Jacobs) to monitor the progress of the New Hampshire Clean Air Project at Merrimack Power Station. Public Service of New Hampshire (PSNH) was installing a wet scrubber at its Merrimack Power Station to comply with state environmental requirements.

In 2002, the State of New Hampshire passed the New Hampshire Clean Power Act to address four pollutant emissions, sulfur dioxide (SO_2), nitrogen oxide (NOx), mercury (Hg), and carbon dioxide (CO_2). In 2005, Senate Bill - 128 was introduced requiring mercury emissions be reduced at the Merrimack Power Station plant to 24 pounds per year through a technology identified as activated carbon injection. In 2006, The New Hampshire Clean Power Act was amended to require reduced mercury emissions by 80 percent using wet flue gas desulphurization technology at the Merrimack Power Station no later than July 1, 2013.

Following passage of the Clean Power Act, PSNH began working with engineering firms to determine appropriate technologies to meet the regulatory requirements; eventually settling on wet flue gas desulphurization (FGD). In order to determine preliminary costs, specifications were prepared for the required major equipment and work areas. In addition to the wet FGD system, other supporting systems or “islands”, as they came to be known, were materials handling for receiving and delivery of the limestone and handling the gypsum byproduct, a chimney for discharge of the scrubbed flue gas to the atmosphere, and effluent treatment to process the blow-down water from the FGD process. Through a competitive bidding process, Siemens Environmental Systems and Services was selected to supply the FGD system. The selection was based on both price and mercury removal warranties.

The New Hampshire Clean Air Project was planned for completion in 2012 at an original estimated cost of $457 million (M). This estimate was subsequently revised downwards to $422M.

1.2 Scope and Approach

Jacobs’ Scope of Work was threefold: first, to complete a due diligence review on the completed portion of the project; second, to monitor the project through completion; and third, produce a final report summarizing the project completion. This report is the final summary report and includes knowledge gained from the previous Due Diligence and Quarterly reports, as well as a concluding assessment of the projects safety, program management, performance, costs and ongoing power plant operation.

Jacobs Consultancy completed its review using a four-stage process:

1) **Project Initiation** – involved the initial conference call/meetings with the Commission and PSNH to provide a thorough understanding of the Commission's expectations and an orientation to the PSNH Clean Air Project.
2) **Investigation, Data Gathering, and Fact-Finding** – a detailed review to opine if the appropriate controls, systems, and processes were in place and if PSNH properly executed its plans. This process included collecting data and metrics, conducting interviews with PSNH personnel, and identifying current key processes, policies, practices, and procedures. Because of pending litigation against PSNH, extensive delays associated with document confidentiality were encountered in obtaining and securing data through the discovery process. In addition, the amount of discovery reviewed was extensive amounting to almost 3,000 pages.
3) **Analysis –** made use of both quantitative and qualitative assessment techniques. Quantitative assessments were based on the information gathered through our review of documents and qualitative assessments were based on the information gathered during interviews.
4) **Reporting –** includes periodic project updates and status reports in addition to the Draft and Final reports. These reports contain the results of our review, expressed as findings, conclusions, and, if warranted, recommendations to the Commission.

1.3 Assessments and Conclusions

In the various sections of this report, we address 22 specific topics offering background, analysis and our overall assessment. In this section of the Executive Summary, we present an overview of our key assessments and conclusions.

Large Project Review Process - PSNH procurement, risk review, approval, and contracting strategy processes are well developed for projects of this size. In addition to numerous Northeast Utilities' internal assessments, risk mitigation factors considerations and approvals, PSNH sought to seek the most appropriate contracting strategy, conducted an FGD installation cost comparison, and worked to understand market conditions and their impact on large construction projects.

Cost Estimates - Large projects typically go through a series of project estimate stages, depending on the level of information and cost estimate parameters available. As projects move from conceptual design through detailed engineering design and pre-construction design to construction, estimates become better defined and refined. PSNH's process for developing the project estimate chain follows this sequence with the initial conceptual estimate, the detailed Clean Air Project estimate, and the current estimate. The initial estimate of $250M, developed by Sargent and Lundy, based on existing FGD designs and installations, did not contain any specific mercury or sulfur dioxide guarantees, PSNH costs, or site-specific needs. The Clean Air Project estimate of $457M developed with the support of the Program Manager, URS Corporation (URS) contained a detailed estimate and actual proposal price, including mercury and sulfur dioxide guarantees, all PSNH costs including AFUDC, as well as specific-site needs. Jacobs was able to reconcile the 2006 conceptual estimate and the 2008 detailed Clean Air Project estimates by taking into account the factors cited above, as well as the impact due to the extensive inflationary pressure on both materials and contractor labor during that time period. Since the Clean Air Project estimate in 2008, there have been several budget reductions and additions, and as a result, the current estimate for the project is now $422M.

Project Schedule - While the statutory obligation required a completion date of the mandated Clean Air Project is mid 2013, the detailed project schedule, published in June 2008, projected an in-service date of mid 2012. When Jacobs reviewed the schedule and verified actual construction, it was evident the completion date shown in the schedule was reasonable and attainable.

Project Management Approach - Along with providing its own internal oversight, PSNH made use of two leading engineering firms to help manage the project. URS was employed as Program Manager and R.W. Beck as Independent Engineer. As the Program Manager, URS performed the engineering, procurement, and construction management role; and as Independent Engineer, R.W. Beck provided an independent third-party oversight of the engineering, procurement, and construction functions. PSNH's oversight role, as clearly defined in its Clean Air Project Manual, consists of three essential elements: 1) project manager contract management, 2) project schedule control, and 3) project cost control. These established safeguards for project overview and control helped to ensure that the Clean Air Project was controlled and managed effectively.

Construction Approach - Selecting the island approach made the coordination efforts to some extent more streamlined. Each of the island contractors was responsible for all aspects within their scope. In addition to the four major island contracts, URS handled the Balance of Plant (BOP) construction coordination issues. Since URS performed the design and procurement for these systems, in addition to coordinating their construction and the four island contractors, the coordination of the entire site construction interfaced well.

Safety - Safety on all construction projects is paramount. On any project ensuring a safe work environment is challenging; the larger a project becomes and the more spread out the workforce is the more difficult it becomes. Safety performance was initially below what would be expected from a high quality project team. However, after the implementation of a safety recovery plan, the project experienced a reduction in its recordable incident rate achieving acceptable levels of safety.

Program Manager - PSNH has a relatively small staff and was aware that a project as large as the Clean Air Project at Merrimack would need a sizeable number of personnel. Therefore they decided to engage an experienced firm to serve as the Program Manager for the project. After a thorough evaluation, they engaged URS, a very experienced firm in the power plant design and construction field. URS was deemed most qualified for the project management role and for providing the balance of plant engineering services. URS profit compensation was in the upper range for providing program management services to regulated industries.

Project Performance - PSNH was proactive in getting the project underway as soon as possible, and through good ongoing management by PSNH and URS, the project was completed a year ahead of schedule. A key factor in this performance was PSNH's anticipation that there might be sizeable delays, either due to weather or due to interveners, resulting in development of a more than adequate schedule that was put into place from the beginning. PSNH reduced the budget by $35M, for a final estimate of $422M, due to higher productivity and lower commodity costs, which held change orders for the project to six percent of the final project estimate. URS set up an excellent commissioning team and process early and involved all parties, resulting in a smooth commissioning process. Units were tied-in and operational, 22 months earlier than mandated, and 10 months ahead of PSNH's schedule.

Project Scope Changes - During the course of the Clean Air Project, nine project scope changes totaling $42.7M were encountered. These changes included a limestone truck unloading system and scales, corrosion protection of the FGD vessel, acoustic study changes, and improved wastewater treatment systems. The improved wastewater treatment system consisted of an enhanced wastewater treatment system and a secondary wastewater treatment system. These systems effectively reduce the liquids effluent to zero, resulting in nothing being discharged into the river and reduces the solid effluent to a minimum that can be disposed of in existing licensed landfills.

1.4 Overall Opinion

The New Hampshire Clean Air Project at Merrimack Power Station was a well-defined and documented effort. The PSNH team did a thorough analysis of the technical requirements prior to initiating the project, availing themselves of various industry specialists to strengthen their findings. PSNH followed rigid corporate procedures to ensure compliance with both regulatory and prudent business requirements. The selection process for a Program Manager was a thorough and fruitful procedure followed by an equally thorough process for selecting equipment suppliers and contractors.

Given the size and complexity of the Merrimack Clean Air Project, the construction approach functioned as planned. The various contractors have worked well together, eventually achieving a better than average safety record. Throughout the project, PSNH exercised good oversight by properly controlling cost and schedule, as evidenced by the project being completed under budget and ahead of schedule.

The installation of the secondary wastewater treatment system was expensive, but it eliminated the potential litigation delays that probably would have accompanied a public involvement in the revision of the plant NPDES permit. The secondary wastewater treatment system reduces the liquids effluent to zero, resulting in nothing being discharged into the river and reduces the solid effluent to a minimum amount that can be disposed of in existing licensed landfills.

Most importantly, based on early testing, the wet flue gas desulphurization system is expected to perform at or above the guaranteed mercury and sulphur removal performance levels, potentially exceeding the state mandated requirements.

2 Background

This section discusses Jacobs Consultancy's Scope of Work and our methodic four-stage process. In addition, we address the New Hampshire Clean Power Act and the technology PSNH had to utilize in an effort to control the mercury content and sulfur emissions of the coal burned at the Merrimack Power Station.

2.1 Jacobs' Role

The New Hampshire Public Utilities Commission (Commission) on January 26, 2010, contracted Jacobs Consultancy to monitor the progress of the Public Service of New Hampshire Clean Air Project at Merrimack Power Station. Public Service of New Hampshire (PSNH) is installing a wet scrubber at its Merrimack Power Station to comply with state environmental requirements. The New Hampshire Clean Air Project was planned for completion in 2012 at an original cost of $457 million (M). Jacobs Consultancy's Scope of Work was threefold:

1) Due diligence on completed portions of the project.

   The Due Diligence Report, completed in June 2011, addressed portions of the New Hampshire Clean Air Project already completed. The report covered items such as technology selected, accuracy of estimate, cost and schedule with major deviations noted and detailed, and PSNH project controls.

2) Monitoring of the ongoing portion of the project.

   Quarterly reports coupled with site visits were focused on monitoring the progress of the New Hampshire Clean Air Project. These quarterly reports track the progress of the scrubber project noting deviations from budget and schedule and highlighting major accomplishments. In total three quarterly reports were completed.

3) Summarization of project completion.

   This report is the summarization of the New Hampshire Clean Air Project and includes knowledge gained from the previous Due Diligence and Quarterly reports, as well an assessment of the project's safety, program management, performance, costs and ongoing power plant operation.

2.2 Jacobs' Approach

Jacobs Consultancy employed a workflow process to accomplish the investigation in an efficient and concurrent approach that uncovers key issues concerning the Clean Air Project. Our team conducted its review using a process that consisted of four principal stages: 1) Project Initiation, 2) Investigation, Data Gathering, and Fact-finding, 3) Analysis, and 4) Reporting.

Project Initiation Stage

This stage involved the initial conference call/meetings with the Commission and PSNH and provided us with a thorough understanding of the Commission's expectations as well as introductions, logistics, and Clean Air Project orientation at PSNH.

Investigation, Data Gathering, and Fact-Finding Stage

Based on the detailed work plan and schedule as mutually determined in the Project Initiation Stage, we began the detailed review of PSNH to opine if essentials such as the appropriate project controls, systems, and processes were in place, and if PSNH properly executed its plans relative to the scrubber installation. This process included:

- Collecting data and metrics, including pre-filed testimony. The amount of data collected and reviewed was extensive and amounted to almost 3,000 pages.
- Conducting interviews with PSNH personnel.
- Identifying current key processes, policies, practices, and procedures for the functional areas.
- Providing ongoing communications and project status as mutually determined with the Commission.

Because of pending litigation against PSNH, we encountered extensive delays associated with document confidentiality, which negatively affected the timeliness in obtaining and securing data through the discovery process.

Analysis Stage

Our analysis made use of quantitative and qualitative assessment techniques:

- **Quantitative Assessments -** based on the information gathered through our review of documents.
- **Qualitative Assessments -** based on the information gathered during interviews with knowledgeable individuals and the professional experience of our consulting team.

Reporting Stage

This process consisted of periodic project updates and status reports in addition to the Draft and Final reports. The status reports include a summary of completed activities, observations and findings, project issues, and project budget status in the format approved by the Commission.

Following the completion of the analysis stage, we reported our results in terms of findings, conclusions, and if warranted, recommendations to the Commission.

- **Findings**—represent facts supporting strengths, weaknesses, opportunities, and threats that can be directly tied to documents, interviews, or observations.
- **Conclusions**—summarize the findings and may suggest necessary improvement actions.
- **Recommendations**—relevant improvement actions based on conclusions reached and our experience.

2.3 Report Organization

The Executive Summary provides an overview of our report's key findings and conclusions.

The body of our report is divided into nine sections, generally along functional lines. Each section contains an overall assessment, background, and analysis of specific topics. Overall assessments are narrative statements of conclusion that provide a summary of our general perception of the function or topic.

In the various sections, we address 22 specific topics. For each specific topic, we present our analysis in the form of findings and conclusions as appropriate.

3 What the Law Required PSNH To Do

In July 2002, the state of New Hampshire passed the New Hampshire Clean Power Act (NHCPA), also known as the Multiple Pollutant Reduction Program; RSA 125-O. NHCPA addressed four pollutant emissions: sulfur dioxide (SO_2), nitrogen oxide (NOx), mercury (Hg), and carbon dioxide (CO_2). This Act, as amended in June 2006, specifically required PSNH to reduce mercury emissions by 80 percent using wet flue gas desulphurization (FGD) technology. The Act also limited the SO_2 credits available to PSNH.

3.1 Technology Employed

PSNH had to reduce 80 percent of the aggregated mercury content of the coal burned at the Merrimack Units 1 and 2 and Schiller Units 4, 5, and 6, and as a collateral benefit, expected a 90 percent reduction in sulfur emissions. To accomplish these objectives, the law required the best-known commercially available technology, a wet flue gas desulphurization (FGD) system installed at the plant no later than July 1, 2013. The NHCPA also mandated a reduction in the sulfur dioxide (SO_2) credits available to Merrimack Station to comply with Federal Acid Rain requirements.

For several years before House Bill 1673 passed in May 2006, the subject of mercury removal had been an ongoing issue at the PSNH facilities. In January 2005, Senate Bill - 128 was introduced, requiring mercury emissions be reduced at the Merrimack plant to 24 pounds per year. Senate Bill - 128 identified Activated Carbon Injection as the technology employed to achieve this level of mercury removal.

While Activated Carbon Injection technology had long been utilized in the Waste-to-Energy industry to remove mercury, it was unknown if it would remove mercury to the level being proposed by Senate Bill - 128. During the summer of 2005, the units at Merrimack underwent testing using a well-developed and extensive test protocol. The results showed that Activated Carbon Injection would not meet the stringent requirements proposed by Senate Bill 128[1].

Since Activated Carbon Injection failed to show promise of meeting the mercury removal mandate, and the fact that House Bill - 1673 stipulated that the technology be wet FGD, PSNH began working with several engineering firms to determine the potential of the FGD technology meeting the requirement and to determine preliminary costs[2]. Specifications were prepared for

[1] DR 025 Janus Report Part 1
[2] The decision to utilize wet FGD technology is further discussed in Section 4.1 - Initial Conceptual Estimate.

the major equipment that would be required, the FGD system being the primary one. The other associated equipment system work areas or "islands", as they became known, were essentially supporting systems for the FGD. The islands identified were: materials handling for receiving and delivery of the limestone and handling gypsum byproduct, a chimney for discharge of the scrubbed flue gas to the atmosphere, and effluent treatment to process the blow-down water from the FGD process. The work area islands are further described in Section 4.2. The technologies selected for these ancillary systems are commonly utilized processes and the type of technology to employ was not an issue; the only unproven technology for the intended purpose was the FGD system itself. While wet FGD systems have been in operation for decades for sulfur removal, the Merrimack Plant FGD requirement was the first for a power plant in the United States to mandate mercury removal as a function and require a guarantee for the percent removed.

PSNH and URS Corporation (URS), the Program Manager, prepared a comprehensive specification for the process and issued it for bid from reputable FGD system suppliers. PSNH received bids from three of the most respected names in the FGD industry. These firms offered similar equipment in their proposals consisting of the type commonly used for sulfur removal with enhancements to reduce the mercury emitted. Only one of the bidders, Siemens Environmental Systems and Services (SESS), was willing to guarantee the mandated mercury removal percentage. In addition, SESS had the lowest evaluated cost and the highest overall evaluation[3], and consequently was selected by PSNH. Jacobs believes PSNH did a commendable job evaluating the technology and the supplier, and initiated the practical enhancements needed to ensure success for the system. Furthermore, Jacobs believes PSNH chose the proper technology for the Merrimack installation. This opinion is based on SESS' guarantee and the preliminary test results from an independent lab, which indicated a 96-98 percent removal of both sulfur and mercury. However it will only be after more thorough testing and evaluation, that the technology will be proven to be effective.

3.2 Findings

- New Hampshire law requires a reduction of 80 percent in mercury from coal fired power generation facilities of PSNH.
- In 2005, PSNH tested ACI technology for mercury reduction with unsatisfactory results.
- New Hampshire Department of Environmental Services determined that wet flue gas desulphurization is the best-known commercially available technology for mercury reduction.
- New Hampshire law requires the installation and operation of scrubber technology by July 1, 2013 at the Merrimack Power Station.

[3] DR 025 Janus Report Part 2.

- Three viable wet FGD proposals were received; however, only one of the bidders, Siemens Environmental Systems and Services, was willing to guarantee the mandated mercury removal percentage.
- PSNH did a commendable job evaluating the technology and the supplier and initiated the practical enhancements needed to ensure success for the FDG system.

3.3 Conclusions

PSNH did a thorough investigation of similar FGD installations and was able to confirm the technology decision mandated by the legislation. Through the competitive bidding process, only one supplier, Siemens Environmental Systems and Services – the supplier eventually selected, was willing to guarantee the level of mercury removal. To date the selected technology is exceeding expectations.

4 Large Project Review and Contracting Strategy

In this section, we discuss Northeast Utilities (NU)/PSNH procurement, risk review, approval, and contracting strategy process. We also comment on the contracting strategy study performed by R.W. Beck and its findings and conclusions. Further, we comment on the study performed by Power Advocate, Inc. related to market conditions associated with capital construction projects and retrofit scrubber projects.

4.1 Large Procurement Process

The Clean Air Project, at a cost of $457M, clearly qualifies as a large project and was therefore subject to NU's Large Project Review Process. The NU Large Project Review Process involves several review committees that must signoff before Purchasing will release any request for proposal (RFP). This process is a well developed and suitable for reviewing large projects. The following describes the threshold and process for large project procurement:

All NU project procurements, that exceed $5M for a project, are subject to the Large Procurement Process and review by their Risk Management Council[4]. The objectives of Large Procurement Process[5] are to conduct risk analysis, ensure prudence/due diligence, provide lowest total cost and manage "What If" scenarios. To meet these objectives the process encompasses:

Contract Risk Mitigation

- Identify project risk
- Develop risk mitigation strategy for RFP development and contract negotiations
- Corporate acknowledgement of risk

Ensure Prudence/Due Diligence

- Documentation of detailed evaluations and negotiations
- Documentation of Risk Management Council concurrence
- Provide for lowest total cost of ownership

[4] DR JC-023 NU Purchasing Policy Manual
[5] DR JC-023 ERMC Large Project Process

Cost/Benefit of Risk Mitigation

- Provide for clear understanding of roles and responsibilities of core project team and support departments.
- Manage "What If" scenarios from a cost, execution, and legal perspective.

NU's Large Procurement Process allows for a structured and consistent approach to contracting for projects. It standardizes the signoff and approval process and reporting requirements. It also establishes the participation of the core team, risk management, and executive risk oversight. Since the procurement exceeds $25M, an Executive Risk Management Council review was also required.

Prior to the approval of any purchase order valued at $10M or more, associated with existing projects, the Director of Purchasing will confirm the Risk and Capital Committee has reviewed the purchase order and the NU Chief Executive Officer (CEO) has approved the expenditure.

Risk and Capital Committee and Executive Risk Management Council [6]

The Risk and Capital Committee of Northeast Utilities, together with its subsidiaries, has the responsibility for ensuring NU is prudently managing its principal enterprise-wide risks.

Specifically the Risk and Capital Committee will:

- Provide oversight for the development and implementation of Enterprise Risk Management (ERM) and the NU Risk Management Policy (Risk Policy).
- Provide oversight for the risk assessments prepared in accordance with the Risk Policy.
- Review and assess the risks associated with strategic projects and/or proposals and policy and investment decisions that expose NU to material financial, strategic, operational, or reputation risk.
- Review key risk topics that could materially affect the Company.
- Review the NU business and functional area risk and financial assessments of capital projects undertaken in accordance with the Risk and Capital Committee Project Approval Policy and Procedures and make recommendations to the Company's CEO for approval, if required.

[6] DR-JC-023 Risk and Capital Committee Charter

Starting in December 2007, the project team presented quarterly reviews of the Clean Air Project at the Merrimack Power Station to the Risk and Capital Committee. These presentations include a status of the project to date and a review of the financial cost. Each quarterly review details the accomplished items in each of the preceding quarters. The quarterly reviews also included a list of risk events, horizons, likelihood of occurrence, expected cost exposure, and mitigation plans.

4.2 Contracting Strategies [7]

During 2006, PSNH retained R.W. Beck to provide contract strategy consulting engineering services associated with implementation of the Merrimack Project. In order to develop the contract strategy, R.W. Beck took into account:

- Realities of the current market for scrubber projects.
- Influence of the current market conditions on contracting options.

Using the R.W. Beck draft study results, NU Contracting and PSNH project leadership reviewed four different contracting options and issued request for qualifications (RFQ) to selected contractors and FGD vendors. Subsequently, NU Contracting and PSNH made a decision to have the FGD original equipment manufacturers (OEM) complete the same RFQ as the potential Engineer/Procure/Construct (EPC) or Engineering/Procurement/Construction Management (EPCM) firms that were under consideration for work in the other areas not directly related to the FGD. From the RFQ results, it was clear OEMs, as a group, were not interested in increasing their scope of work beyond their specific system or "Scrubber Island[8]."

The four options PSNH Contracting considered were:

- **Turnkey EPC Contract – Fixed Price Proposal** [9]

  None of the respondents were executing any competitively bid scrubber retrofit projects. Only one qualified turnkey contractor[10] indicated a willingness to provide a proposal on a fixed price basis, and that contractor confirmed that fixed price would likely be the most expensive contracting option for PSNH.

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[7] DR JC-034 Contract Strategy Report
[8] See section 7.1.1 for Island definition and description.
[9] Fixed Price – means that the stated price is fixed for some portion of the work or piece(s) of equipment or materials throughout the term of the agreement, subject to adjustment based on change orders.
[10] Turnkey EPC contract: A single EPC contractor that provides a complete project "wrap" including other subcontracts, i.e., scrubber island, material handling, stack, construction labor etc.

- **Turnkey EPC Contract – Fixed Price After "Open Book"** [11]

  Only one qualified turnkey contractor was currently executing scrubber retrofit projects on a Fixed Price After Open Book, turnkey contract basis; and only that contractor indicated a willingness to provide a proposal for the project on this basis.

- **Alliance EPC Contract – Contractor and PSNH Share the Risk** [12]

  In an Alliance Contract approach, risks are shared between the contractor and the owner. Two qualified contractors were executing other projects on this basis. Both these contractors indicated a willingness to perform the project using this contracting approach.

- **EPCM Contract** [13]

  Since a significant amount of detailed engineering and design are complete before awarding major construction subcontracts, the EPCM contract approach generally allows for most competitive subcontracts bids. The EPCM Contract approach had been executed in a number of scrubber retrofit projects, and all the qualified respondents indicated a willingness to perform the project using this contracting approach, although two of them were less interested under this type of contract because of the significantly lower profit potential compared with other contract types.

R.W. Beck recommended the EPCM contract was the best approach for the Merrimack Project. This approach addressed PSNH's objectives as follows:

- Cost risks are limited:
  - Fixed price supply and erect contracts for the scrubber island and the stack.
  - Fixed price design and material supply contracts for the material handling systems and the wastewater treatment. In addition, it may be possible to supply these systems on a supply and erect basis.
  - Detailed engineering and design up to 80 percent complete before awarding major construction subcontracts. This is a critical advantage of the EPCM approach. The EPCM approach allows bid packages for the construction subcontracts to be complete and obtain the most competitive bids from local and

[11] Open Book is a method of procurement that allows each party to have access to the project cost information allowing all non-final pricing to be developed as costs are known.
[12] An Alliance Contract is a relationship between two or more parties to pursue a set of agreed upon goals or to meet a critical business need while remaining independent organizations.
[13] Engineering, Procurement, Construction Management is a contract where the contractor is responsible for the design, procurement, construction and management phases of a project. Typically, the contractor is reimbursed for all costs (direct and indirect) it incurs to perform the work, plus a fee (profit).

regional contractors. The EPCM approach also allows the contractor and the owner to design a construction-contracting plan that will support the project's need for well-trained and highly skilled labor, while also supporting the project's need for a predictable schedule without the possibility of labor disruptions.
  - Allows for an award fee or other incentives to the contractor when appropriate.

- Enables performance and delivery guarantees and liquidated damages with the major equipment suppliers.
- Separate owner's engineer provides project oversight, compensating for PSNH's limited staff.
- Project change orders can be addressed quickly and at minimum cost.

4.3 Power Advocate Study [14]

PSNH hired Power Advocate, Inc. in July 2008 to conduct a thorough review of the market conditions associated with capital construction projects and retrofit scrubber projects. The study, updated in March 2009, specifically sought to:

- Assist in a review of URS Corporation's (URS) cost estimate to determine its reasonability by accurately comparing the cost of this project with other wet scrubber projects through a normalization of the dollars per kilowatt cost.
- Consider the project's risk mitigation strategy in conjunction with the overall cost control technique in order to develop a comprehensive project cost management assessment.
- Take into account the considerable opportunities for PSNH to capitalize on current favorable market conditions with the un-awarded project subcontracts.

The report evaluated the unique site-specific factors, including engineering, Balance of Plant[15] (BOP), Flue Gas Desulphurization (FGD), Material Handling considerations, and how these factors affect the overall project cost.

By analyzing the unique or project-specific attributes and applying adjustments for site-specific and unique factors, Power Advocate was able to normalize the scope of Merrimack's project with other wet scrubber projects. This approach allowed for "apples to apples" comparison. The figure below shows the factors considered as a potential impact to the cost of the project.

[14] DR JC-031 Power Advocate Report
[15] Balance of Plant is the sum of all equipment for safe operation as well as the technical coordination of all concerned parts of a power plant.

Figure 1 - Site Specific Analysis Components

Site Specific Component	Significant Impact?
Mercury Scrubber	Yes
Asymmetrical Units to Single Absorber	Yes
Station Site Constraints	Yes
All-Subcontract Construction Basis	Yes
Foundations	No
Limited Highway Access	No
Pressurized Cyclone Boiler	Yes

Each of the factors with significant impact potential was normalized based on the following logic:

Mercury Scrubber

Merrimack's Project is designed specifically for Hg removal with an added benefit of further reducing SO_2 emissions. Most wet FGD scrubbers in use today and under construction are designed primarily for SO_2 capture. The design differences for this type of approach include additional Hg oxidation controls/consideration, increased surface area of absorber bed and increased contact time with flue gas to allow for full reaction. This scrubber technology conforms to the reduction of mercury emissions requirements mandated by the passing of House Bill 1673-FN in May 2006.

Asymmetrical Units Combining into a Single Scrubber

This is the largest design difference between Merrimack Station's absorber and the majority of similar sized systems in the industry. Since Unit 2 has over twice the power of Unit 1, the flows and capacities of the duct and induced draft system are very different. In addition, there are design aspects of balancing unequal flows into the same duct channel setting this project apart from many others.

Station Site Constraints

Merrimack Station is located on the Merrimack River in central New Hampshire. The eastern edge of the main plant is bounded by the river and there are several railroad spurs cutting north to south across the station's footprint. In addition, the material handling design extends from the coal yard to the north, down the east side of the power block to the absorber building to the southeast. This would require construction of components for the material handling and other systems to occur directly above a rail spur.

All-Subcontract Construction Basis

The Clean Air Project was constructed without any direct labor hired from the EPCM firm. All aspects of the project were completed in Contract Packages utilizing a General President's Project Maintenance Agreement (GPPMA),[16] or National Maintenance Agreement (NMA)[17] primarily with local union personnel. This approach simplifies management for PSNH, but increases the likelihood of markups associated with multiple layers of subcontractors. However, PSNH felt and Jacobs agrees this approach provided higher accountability on contracts, stronger product guarantees, and better warranties; all of which help mitigate the extra cost risks.

Pressurized Cyclone Boiler

Both coal combustion units at Merrimack Station are of the pressurized cyclone type. This type of combustor can produce higher temperatures and flows than similar pulverized coal combustors. Due to these operating characteristics, further engineering is required to ensure proper long-term operation.

Each of these factors contributes to the uniqueness of the project when compared to a more standard wet FGD system. When these attributes are summarized and used to levelize the per-kilowatt cost, the Power Advocate Study concluded that the Merrimack Station's Clean Air Project costs are reasonably in line with other projects of similar size and scope.

4.4 Findings

- NU/PSNH has a well-developed process for Large Project Review.
- All project procurements over $5M are subject to the NU/PSNH large procurement process.
- Both the Risk Management Council and the Executive Risk Management Council reviewed the Merrimack Station's Clean Air Project.
- PSNH contracted R.W. Beck to identify and recommend contracting strategies.
- R.W. Beck recommended the EPCM contracting approach.
- PSNH contracted Power Advocate Inc. to assist in a review of URS' cost estimate to determine its reasonability.

[16] The General President's Project Maintenance Agreement is designed to provide skilled, highly trained craft people to contractors who perform continuing supplemental maintenance work at industrial sites throughout the United States, using a nationally negotiated collective bargaining agreement designed to provide many cost saving provisions to the owner community.

[17] The NMAPC administers the National Maintenance Agreement (NMA), which is a collective bargaining agreement utilized by over 3,500 industrial contractors employing the members of 14 participating building trades international unions throughout the United States.

- Power Advocate Inc. found the cost to be in line with other scrubber projects after normalization.

4.5 Conclusions

The process for approval and monitoring of the Merrimack Station's Clean Air Project is well developed and contains checks and balances to ensure that all risk and mitigation factors are considered. PSNH was prudent to contract for support in developing their contract strategy and reviewing cost estimates from URS, the program manager.

5 Cost Estimates

In our experience, utilities typically go through a series of project estimate stages depending on the level of information available and cost estimate parameters. As projects move from conceptual design through detailed engineering design and pre-construction design to construction, estimates become better defined and refined. Cost estimates will change in response to changes in the design concept, changes in scope, more detailed material cost estimates and build sequence modifications that can affect the total cost, in some cases appreciably. In this section, we discuss PSNH's process for developing the project estimate chain over time and review, in particular, the initial conceptual estimate, the detailed Clean Air Project estimate, and close with an estimate comparison along with a discussion of estimate change-agent impacts.

5.1 Initial Conceptual Estimate [18]

In 2004, PSNH contracted with Burns and McDonnell for a feasibility study, which identified three possible alternatives for addressing future air-quality requirements at Merrimack Station. In 2005, PSNH continued to pursue mercury control options as part of the ongoing compliance with New Hampshire's four-pollutant bill, RSA 125-O, also known as NHCPA. Specific to mercury emissions, based on initial testing of activated carbon injection, it was clear that this technology would not provide sufficient mercury control to satisfy the goals of NH legislators and other stakeholders. Encouraged by early indications from some scrubber manufacturers of possible mercury capture capability, PSNH proceeded to acquire experienced engineering assistance.

Based upon the feasibility study, a specification for engineering services was prepared consistent with all indications that New Hampshire would require significant mercury capture. The specification not only addressed mercury emission capture, but also the request to assess an overall multi-pollutant strategy recognizing New Hampshire's four-pollutant requirements. The following summarization is from Section III of PSNH's specification, which deals with the broad review of multi-pollutant control strategies at Merrimack Station. Specifically, in Section III, the first item requests optimizing a scrubber for sulfur emissions reduction. The second item requested determining the mercury capture associated with a scrubber, including guarantees, and determined other controls required to provide the additional, incremental mercury capture above the scrubber to a total capture of 90 and 95 percent. At the time of this specification, information suggested conventional wet scrubbers were achieving a capture rate in the range of 70 - 85 percent mercury, under certain conditions[19].

[18] DR 025 Janus Report Part I
[19] DR 037 Mercury Reduction

Once the Burns and McDonnell Feasibility Study and Specification for Engineering Services were completed, PSNH contracted Sargent and Lundy (S&L) in 2005 to develop an early conceptual estimate for a FGD at Merrimack Station to satisfy legislative and stakeholders' discussions. The first costs provided by S&L relied on past installations of FGDs and certain Merrimack Station conditions. During the first conceptual pricing of a scrubber system, PSNH found FGD suppliers were open to discussions but still unwilling to provide mercury reduction guarantees and equipment pricing with associated guarantees. S&L's cost estimate was developed working in an expedited time line and with no vendor guarantees in writing. Based on the available information, S&L issued an initial conceptual estimate of $250M for the installation of an FGD system at Merrimack Station. The estimate contained one very significant caveat, "No specific mercury guarantee was included in S&L pricing since it was not available at this time from suppliers[20]."

5.2 Clean Air Project Estimate Contracts

Contracting Strategy [21]

As previously discussed in Section 3 - Large Project Review Process and Contracting Strategy, PSNH management desired high accountability on contracts, strong performance guarantees and product warranties, and greater price certainty through risk transfer to the suppliers of goods and services. Consequently, they determined the best available industry expertise and insight were necessary in order to decide the appropriate contracting strategy for the Merrimack project.

On July 25, 2006, PSNH issued the "Specification for Contract Strategy Consulting for a Wet Flue Gas Desulphurization Project" and, in September 2006, contracted with R.W. Beck to provide contracting strategy consulting services. R.W. Beck was asked to identify options and recommend the contracting strategy and the final structure for project oversight by PSNH. As previously described in Section 3.1 - Contracting Strategies, R.W. Beck recommended the EPCM contract is the best approach for the project.

The results of R.W. Beck's analysis were presented to NU's Risk Management and Executive Risk Management Committees, and PSNH management sought authorization to issue an RFP for Program Management Services and an RFP for the Scrubber Island EPC contractor.

[20] DR 037 Mercury Reduction
[21] DR 034 Contract Strategy Report

Program Manager Bid [22]

During late April 2007, bidding documents for the Project Program Manager continued to be developed. Request for Proposal RFX 00147-2007, "Clean Air Project, Merrimack Station Program Management", was issued on May 16, 2007.

PSNH assembled an internal cross-functional team to evaluate the bids. The evaluation team consisted of the Merrimack Station Plant Manager, the Merrimack Clean Air Project Manager, and Project Engineer, as well as representatives from Purchasing, NU, and PSNH Legal.

On July 2, 2007, bids were received from the following four contractors:[23]

- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- Washington Group International — (later URS) [24]

Contract Award

On September 21, 2007, PSNH entered into a contract with Washington Group International (later URS). The Northeast Utilities Risk and Capital Committee reviewed and approved the Project Program Manager selection and recommended increasing the initial funding to $10M and commitment authority to $45M. PSNH approved and released the purchase order on September 27, 2007.

In early May of 2008, URS submitted the revised Target Price Project Cost Estimate to PSNH.

An overview of URS final estimate is shown below:

[22] DR 025 Janus Report Part I
[23] Jacobs requested, but because of potential conflict of interests, was not provided with any of the program manager proposals.
[24] Washington Group International was acquired by URS Corporation in late 2007.

Figure 2 - Target Price Project Cost Estimate

PSNH/URS Item Description	PSNH/URS June 2008 Estimate (Millions $)
Program Manager	39.3
FGD Island	100.0
Chimney Island	13.1
WWT Island	15.0
Materials Handling Island	44.8
URS Engineered Equipment	26.1
URS Balance of Plant	61.0
URS Escalation	23.0
URS Growth and Contingency	19.1
Contingency	10.0
TOTAL	**351.4**

This estimate includes the work and associated costs managed by URS, but exclude NU/PSNH's costs. These costs include:

- Work scope retained by NU/PSNH.
- Owner's costs including NU labor, indirect costs, project financing costs, insurance, etc.

The estimates for the NU/PSNH cost were:

Figure 3 - Owner's Cost

PSNH Item Description	PSNH Estimate (Millions $)
Electric Power Supply	15
E-Warehouse	1
Office/Training Building	1.5
NU Labor	7
Indirect Costs	8
AFUDC	56
Insurance (OCIP and Builders Risk)	12
Miscellaneous	5

Total	**105.5**

The combined estimate for the total cost of the Merrimack project was $457M[25].

In June 2008, the project schedule confirmed an in-service date of mid 2012 based upon key island proposals. Early completion was encouraged by the NHCPA.

As previously described in Section 3.2 - Power Advocate Study, PSNH engaged Power Advocate to assist the Clean Air Project Team review of the revised cost estimate. The Power Advocate Study concluded that the Merrimack Project Cost Estimate was in the range of comparable FGD projects considering its scope and complexity and other site-specific factors.

The Clean Air Project at Merrimack Power Station was presented to NU corporate management for capital project review and approval at an estimated cost of $457M. Management recommended approval of the project by the NU Chairman and CEO and final approval of NU Board of Trustees was required. PSNH Senior Management obtained NU corporate management approval of an advanced in-service date for the project of mid 2012. On July 14, 2008, NU Board of Trustees approved the $457M for Merrimack Clean Air Project Estimate.

Clean Air Project Component Description [26]

The system work areas or islands include the Scrubber Island, the Material Handling Island, the Chimney, and the Wastewater Treatment System. URS' Program Manager's responsibilities included the design and oversight of the construction of the foundations based on criteria provided by the systems suppliers. Other significant Merrimack project contracts managed by URS related to construction work, major material/equipment purchases, and major services contracts. Preliminary site surveys and investigations were procured and managed by PSNH. The permanent FGD substation and the 115 kV switchyard expansions were also directly managed by PSNH/NU with close coordination with the PSNH Clean Air Project Team, URS, and the affected contractors. PSNH determined this approach was advantageous since PSNH and NU Transmission and PSNH Energy Delivery had greater expertise.

The various system work areas or islands are depicted in the rendering below:

[25] DR 010 Increase between the estimates of URS
[26] DR 025 Janus Report Part II

Figure 4 - Plant Site Rendition [27]

A brief description of each island follows:

Scrubber Island

The Scrubber (FGD) Island includes the limestone preparation, absorber, and gypsum-dewatering systems with all auxiliary support equipment from the day silo inlet, absorber vessel outlet breeching to the chimney, recycle pumps, oxidation air blowers, process tanks, dewatering equipment and an electrical distribution room. All interconnecting piping systems, electrical system downstream of switchgear and motor control centers, and buildings are part of the complete system.

[27] DR-56 2012 CAP Schematic.jpg

Material Handling Island

The Material Handling Island includes the limestone rail and truck unloading, reclaim, transfer conveyors/towers, bents, gypsum conveyors, and stack-out systems and building along with all auxiliary support equipment/systems. All dust suppression, water, air, electrical system downstream of switchgear and motor control center buildings are part of the complete system.

Chimney

The Chimney Island includes the complete chimney outer shell and fiberglass liner (flue) from the absorber outlet (breeching inlet) and all appurtenances such as aircraft lighting, lighting protection, elevator and elevator platforms, and electrical supply.

Wastewater Treatment System

The Wastewater Treatment System Island includes all treatment equipment and systems to comply with the discharge limits established by the New Hampshire Department of Environmental Services and the United States Environmental Protection Agency requirements. The existing treatment pond was used as the source of make-up water for the scrubber, which provides for the use of 100 percent reused or recycled water for the FGD system. All interconnecting piping systems, electrical system downstream of switchgear and motor control centers, and buildings are part of the complete system.

In order to accomplish the large variety of work required to complete the Clean Air Project, PSNH and its Program Manager had to prepare 16 RFPs and award 17 major contracts. Section 9 – Appendix, item 9.5, is a summary of the major contracts that have been awarded in connection with the equipment and physical work required for the Clean Air Project.

5.3 Estimate Comparison

In this section, we will analyze the differences between the initial conceptual estimate and the final URS estimate to determine if the variances are within expected tolerances. When comparing estimates, we must be aware that an estimate is "an approximate judgment or calculation, as of the value, amount, time, size, or weight of something[28]." It is important we understand the basis for each estimate and changes from one estimate to the next.

The original 2005 study done by S&L was conceptual based on current industry standards at the time and did not contain any guarantees for mercury. The S&L estimate was basically generic and not site specific. The S&L estimate also excluded Allowance for Funds Used During

[28] As defined by Dictionary.com

Construction (AFUDC), and cost of removal and relocation of existing facilities was included only for the known scope[29].

Other S&L assumptions were:[30]

- Single duct from MK-1 and MK-2 (365 tons including support steel).
- Fourteen thousand (14,000) square feet gypsum storage building.
- Hooded conveyors system.
- Basis for Railroad car unloader was bottom dump.
- Basis for silo discharge was basic hopper arrangement.

The URS 2007 estimate was based on a more detailed study using site-specific needs and included guarantees and project specific AFUDC. It also built upon S&L assumptions and determined that several enhancements were needed:

- Designed separate ducts for MK-1 and MK-2 (1935 tons including support steel).
- Nearly doubling the size of the gypsum storage building to 26,600 square feet.
- Totally enclosed conveyor galleries.
- Basis for railroad car unloader was rotary dump.
- Basis for silo discharge was rotary plow dischargers due to winter conditions.
- Included a limestone emergency silo fill-bucket elevator and receiving hopper.
- Larger absorber tank.
- Additional tray level.

To determine if the increase in the project between the conceptual and final estimate is reasonable, Jacobs made a side-by-side comparison looking at major work effort, owner's cost, escalation, contingency, and AFUDC as shown in the table below[31].

[29] DR 009 S&L estimate of 2006
[30] DR 026 Estimate Comparisons
[31] DR 026 Estimate Comparisons

Figure 5 - Estimate Cost Comparison

Item	PSNH/URS Item Description	PSNH/URS June 2008 Estimate (Millions $)	PSNH/S&L 2006 Estimate (Millions $)
1	Program Manager	39.3	18.1
2	FGD Island	100.0	75.0
3	Chimney Island	13.1	13.1
4	WWT Island	15.0	11.0
5	Materials Handling Island	44.8	21.8
6	URS Engineered Equipment	26.1	9.5
7	URS Balance of Plant	61.0	38.3
8	URS Escalation	23.0	0.0
9	URS Growth and Contingency	19.1	11.6
10	Electrical power Supply	14.9	6.3
11	New Yellow Building	1.5	0.0
12	E-Warehouse	1.0	0.0
13	NU Labor	6.7	35.2
14	NU Costs 1	15.4	0
15	NU Costs (Miscellaneous) 1	4.1	0
17	NU Indirect Costs 1	5.5	0
18	AFUDC 1	56.5	0
16	Contingency	10.0	10.0
	TOTAL	**457.0**	**250.0**
	1 included in 13		

Because of the two-year time difference between estimates, a number of project related costs experienced significant escalation. Jacobs Engineering Estimating Group estimated that during this time period, prices for certain materials and commodities escalated 45 to 60 percent. This extraordinary increase was reflected in the price of certain types of equipment and overall, the impact of this price escalation on the entire project is estimated to be an increase of 20 percent. When we apply this 20 percent factor to the S&L estimate, the cost variance between the estimates is reduced from 82 to 52 percent.

Figure 6 - Normalized Estimate Cost Comparison

Item	PSNH/URS Item Description	PSNH/URS June 2008 Estimate (Millions $)	PSNH/S&L 2006 Estimate (Millions $)
1	Program Manager	39.3	21.7
2	FGD Island	100.0	90.0
3	Chimney Island	13.1	15.7
4	WWT Island	15.0	13.2
5	Materials Handling Island	44.8	26.2
6	URS Engineered Equipment	26.1	11.4
7	URS Balance of Plant	61.0	46.0
8	URS Escalation	23.0	0.0
9	URS Growth and Contingency	19.1	13.9
10	Electrical power Supply	14.9	7.6
11	New Yellow Building	1.5	0.0
12	E-Warehouse	1.0	0.0
13	NU Labor	6.7	42.2
14	NU Costs 1	15.4	0.0
15	NU Costs (Miscellaneous) 1	4.1	0.0
17	NU Indirect Costs 1	5.5	0.0
18	AFUDC 1	56.5	0.0
16	Contingency	10.0	12.0
	TOTAL	**457.0**	**300**
	1 included in 13		

When PSNH retained work of $106M is added to the S&L estimate, the cost variance between the estimates is reduced to 13 percent. While we cannot determine a specific monetary value for the additional non-NU/PSNH items like the mercury level guarantee, which was included in URS estimate, it is easy to envision their value would approach the remaining 13 percent cost variance figure[32].

In October 2010, PSNH revised the project estimate to $430M due to productivity gains that reduced escalation reserves by $16M and contingency by $11M. In January 2011, the budget was further reduced by an additional $8M down to $422M. This reduction reduced reserves by $8M. When these reductions are factored into the URS estimate, the cost variance is reduced

[32] DR 010 Increase between the estimates of URS

to 1 percent. Several contract additions were made to cover secondary water treatment, cathodic protection and enhance treatment for the primary water treatment without changing the final estimate of $430M[33].

5.4 Findings

- Sargent and Lundy was contracted to develop a conceptual estimate based on existing FGD designs and installations.
- The Sargent and Lundy 2006 estimate of $250M did not contain any specific mercury guarantee and was not site-specific.
- AFUDC and other NU/PSNH costs were not included in S&L 2006 estimate.
- The Sargent and Lundy and URS estimates can be reconciled by taking into account such factors as: inflation, site-specific requirements, NU/PSNH work, AFUDC, and additional non-NU/PSNH items like the mercury level guarantee.
- In May 2008, URS Final Clean Air Project Estimate of $457M was submitted to PSNH.
- Both the Power Advocate Study and Jacobs Consultancy have been able to reconcile the differences between the $457M and $250M project cost estimates.
- During the course of the project, PSNH has been able to recognize savings due to higher productivity and lower commodity costs, revising the Clean Air Project estimate to $430M.
- To some extent, the $27M cost differential reflects both PSNH and URS' ability to control project costs effectively.

5.5 Conclusions

The process that PSNH followed in developing the estimates for the Clean Air Project started with the feasibility study, followed by development of engineering specifications, which combined became the basis for development a preliminary estimate. This estimate was followed by a detailed Clean Air Project Estimate, which included a number of items excluded from the initial estimate. Based on the various adjustments to the initial estimate, Jacobs Consultancy has been able to reconcile the S&L estimate within 1 percent of the actual projected costs.

[33] DR 040 CAP Cost Summary Jan-April 2011

6 PSNH Approach to Project Management

Utilities' often contract out the management of large capital-intensive projects. For the Merrimack Project, PSNH made use of two leading engineering firms to manage the project, with strong internal oversight. In this section, we examine the roles played by URS, as program manager, and R.W. Beck, as independent oversight engineering, for the project as well as to discuss PSNH's internal project controls.

6.1 URS' Role

Emissions from the PSNH plants, including Merrimack, have been the subject of multiple discussions for years, with a collaborative agreement reached among several entities in November 2001. With all of the scrutiny and interest in this subject, PSNH, over the span of several years, took an intelligent path, that being engaging respected, competent engineering firms in the quest for the right project for Merrimack. They engaged Burns & McDonnell and Sargent & Lundy in their early studies. These firms are very experienced in power plant engineering and in wet scrubber technology. The two firms were most helpful in establishing a path forward for the Merrimack plant.

In May 2007, a Request for Proposal for a Program Manager was issued for the Clean Air Project at Merrimack Station. Proposals were received from four firms, all well experienced in projects of this type and size. The firms were:

- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- Washington Group (later becomes URS[34])
- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**

After a thorough evaluation on September 24, 2007,[35] URS was awarded the contract to manage the Merrimack Project. URS, as the Program Manager (PM), was to function in an Engineering, Procurement, and Construction Management (EPCM) role. Accordingly, they are

[34] In 2007 The Washington Group was acquired by URS Corporation
[35] DR 025 Janus Report Part 1

responsible to PSNH management to ensure that all aspects of the project proceed as the owners' management team has mandated. As the PM, URS performs the following functions:

- Engineering:
  - Develop design criteria and basis
  - Prepare specifications for equipment and construction services
  - Prepare general drawings for the project
  - Assist in evaluation of proposals
- Procurement
  - Prepare bid documents for major equipment packages
  - Prepare bid packages for Balance of Plant (BOP) equipment
  - Prepare bid packages for BOP construction services
  - Coordinate evaluation of bids
  - Lead vendor presentation meetings
  - Issue purchase orders and award contracts
- Construction Management
  - Assist in evaluation of bids
  - Provide day-to-day supervision of all onsite contractors
  - Monitor progress of contractors against schedules and budgets
  - Oversee the project safety program
  - Prepare periodic project progress reports
  - Coordinate commissioning and start-up
  - Coordinate demobilization of the project site

To fulfill the role as Program Manager, URS established a typical project organization for this type project. They assigned a project manager whose initial functions centered on managing the home office engineering disciplines as the project scope was developed. The project manager is assigned personnel as needed in the various disciplines, including support functions as the needs arose. As the design progressed and the construction activities on the project began in earnest, the project manager's role was focused more in the field. To assist in managing the construction activities, a construction manager, who reports to the project manager, was assigned to handle the day-to-day construction activities. Reporting to the construction manager are various superintendents who provide the intimate coordination and monitoring required for a well-run project.

URS has done a good job ensuring the project meets PSHN's expectations, the project schedule, and budget. One noted exception was in the area of safety, where performance initially was not as expected. We will discuss safety in detail in Section 7 - Construction.

6.2 R.W. Beck's Role [36]

PSNH released a RFP for an Independent Engineering Service contract in September 2009, and R.W. Beck was selected as the vendor. The vendor's contract provided an independent third-party oversight of the engineering, procurement, and construction of the Clean Air Project. The specific services provided by the independent engineering group were:

To conduct on a monthly basis:

- Review of the final design for general compliance with contract guarantees.
- Review the progress of design for compliance with milestone schedule.
- Review the progress of the procurement specifications and procurement contracts.
- Review reports for general suitability regarding start-up and performance.
- Review proposed work plans and quality control procedures.
- Conduct monthly onsite visits for observation of the work in progress.
- Consulting with project participants in advance of scheduled major inspections' tests or start of important work phases.
- Review the activities of the project to ensure that appropriate due diligence was performed, appropriate alternatives were considered, and decisions and actions were prudent.
- Review change orders to construction contracts.
- Provide independent assessment of:
    - Performance guarantees specified in the contracts
    - Initial operation of the project
    - Substantial completion of the project

[36] DR JC-035 RW Beck oversight role

    - Completion of the construction contracts

- Prepare monthly Independent Engineer's Report. The report includes, but is not limited to:
    - Introduction
    - Summary of monthly review
        - Execution of the work plan
        - Review the actual / projected costs of the project and compare them to the Target Budget. Review the actual / projected schedule of the project and compare them to the Target Schedule.
    - Recommendations / Conclusions
- R.W. Beck will perform the following tasks during the startup and testing phase of the project
    - Review performance-testing procedures
    - Witness selected performance tests
    - Review contractor's test reports
- Verify project completion
    - Monitor successful completion of key open issues
    - Conduct final site visit to verify punch list items have been completed
- Provide follow-up services and regulatory support as needed

6.3 Project Controls [37]

The approach to project control is documented in the PSNH Clean Air Project Manual and consists of the following three distinct areas:

- Program Manager Contract Management
- Project Schedule Reporting
- Project Cost Reporting

Program Manager Contract Management [38]

[37] DR 001 Project Manual
[38] DR 013 Description of the project controls and software used to manage the project

Contract management is accomplished though the use of change notices and change orders and processed as outlined in Section 10.6 of the URS Project Execution Plan and Attachment K of the PXP, PEP-314 Change Control[39].

Change Orders must be approved by PSNH and URS management and are processed in accordance with Article 6 of the Contract. Major changes in the scope of work, the division of responsibility, the project schedule, or circumstances addressed in the Contract can necessitate change orders. These changes may be, but not limited to:

- Design basis or design concept changes.
- Site conditions beyond those presented in the Project Design Manual and existing site, survey reports.
- PSNH permit obligations.

Client authorization and approval of Contract Change Orders must be obtained prior to implementation and written authorization to proceed is required for client-initiated or client-requested changes regardless of contract type.

Change Order Control was implemented by use of a system of Work Change Requests and amendments to the Contract.

Work Change Requests are a required process needed before any scope change or any contractor can implement cost change. This requires a full scope, cost, and justification presentation by URS to PSNH for approval prior to any such work proceeding.

Project Schedule Reporting

URS developed and maintains the integrated Project Schedule in accordance with the requirements of Article 1.4 of Appendix I to the Agreement and has submitted periodic updates as described below.

The Project Schedule is a Critical Path Method (CPM) precedence diagram using Primavera Project Planner software produced by Primavera Systems and includes PSNH obligations and deliverables' receipt as milestone activities. URS provides PSNH information regarding project work operations, sequence of the work, breakdown of the work into individual activities with estimated durations, labor and material estimates, and weekly or monthly schedule updates as

[39] DR 001 Project Execution Plan Part II

required.

The Project Schedule status is reviewed weekly and is updated monthly throughout the project, unless otherwise requested by PSNH, except during unit outages when updates are required on a daily basis. The Planning Unit for the Project Schedule activities is one day, except during outages when the planning unit is one hour.

All schedules are subject to PSNH's review and approval, but do not reduce or affect URS' responsibility for completing the work under its contract in accordance with applicable schedule requirements.

Project Cost Reporting

The project costs are reported and controlled at various levels against the PSNH project Code of Accounts. A Clean Air Project resource analyst maintains the Project Cost Summary and the monthly actual costs are recorded early the following month. The project manager reviews the actual costs, compares them to the projected costs and revises future cost projections as necessary.

URS is responsible for developing and maintaining a project cost monitoring and control program. This monitoring is by island and URS provides PSNH a monthly list of contractors' personnel charging time to the project including hours charged.

Material and engineered equipment costs are reported in the Monthly Progress Report. The cost reporting identifies the budget, commitments, actual, and forecast costs. Subcontract costs are also reported in the Monthly Progress Report.

6.4 Findings

- URS is the Program Manager responsible for Engineering, Procurement, and Construction Management of the project.
- PSNH contracted R.W. Beck to give an independent engineering overview of the project.
- PSNH has a documented approach to Project Control as defined in the Clean Air Project Manual.
- Project Control Process consists of three essential elements:

  1) Project manager contract management
  2) Project schedule control
  3) Project cost control

- Project costs are reported and reviewed on a monthly basis.

6.5 Conclusions

PSNH established safeguards for projects overview and controls to ensure that the Clean Air Project is controlled and managed effectively. These safeguards rely on outside engineering expertise and a well-structure process, which monitors change orders, scheduling, and costs.

7 Current Status

7.1 Construction Approach

Even with the series of contract safeguards previously described in Section 6.3 - Project Controls, actual construction is not necessarily assured to proceed smoothly. There are critical elements ranging from how the project is divided, to the interaction among independently constructed portions of the project. In this case, there were four islands to help ensure the overall project designs and concepts are upheld. In addition, given the physical congestion present in such a work site, safety assurance is critical. In this section, we address the decision to undertake the work in four islands, how contractor and project manager coordination was handled, and how safety performance was monitored, and shortfalls mitigated. In addition, we discuss the program manager's role, the projects performance and costs, and conclude this section with a description of the commissioning process.

7.1.1 Four Islands

Several construction approaches can be implemented in a project similar to the Merrimack Station Project. Whether one is managing the project themselves or has engaged a PM, as is the case for the Merrimack Project, the alternatives relative to approach the construction remain essentially the same. Here are three possible alternatives:

- In the first approach, the engineer prepares the detailed design for the project, determines the processes to be used, performs all of the calculations required, prepares the detailed drawings and specifications for the equipment, and provides engineering oversight and assistance during construction, commissioning, and start-up. The equipment and system suppliers provide design information, such as process requirements and support information. The engineer uses this information in preparing the detailed design drawings. In this approach, the procurement process is detailed as the PM's procurement group individually addresses every part of the project. Once the equipment and systems are selected, the PM must obtain contractors for the total project, which may require multiple contractors, to address the specialty equipment type and systems prevalent in a large, complex system such as a scrubber.
- In the second approach, the engineer prepares less design; in essence, the engineer describes the project arrangement and process criteria. Either the suppliers prepare the design, procure the equipment for their systems, and can construct their equipment, known as Supply and Erect, or the PM can handle the construction similar to the first approach. The engineer will perform a less detailed design relative to the major equipment and systems since the suppliers are preparing some designs for their scope. The supplier commonly supplies the commodity items, such as structural steel, piping,

and electrical cable for the systems within its scope. The PM must provide engineering, procurement, and construction management for the remaining items for the system. They will be responsible for foundation, buildings, controls, and electrical supply to the supplier terminal points throughout the site. The engineering, procurement, and construction management effort is less than the first approach, but nonetheless a substantial undertaking, which requires a sizeable project team.

- The third approach is to divide the project into major systems and procure the systems on a lump-sum turnkey basis. The supplier for a major system is responsible for the total design, procurement, and construction management for its scope. The suppliers are responsible for what is within their boundaries. By shifting these responsibilities to the suppliers, this minimizes the number of personnel required by the PM for engineering, procurement, and construction management. However, this approach requires that the PM have highly competent, experienced personnel assigned to the project to monitor and direct the suppliers for compliance with the project specifications and requirements.

With the assistance of R.W. Beck, PSNH chose the third approach for the Merrimack Project[40]. PSNH decided the project would be broken into four major islands for implementation: Scrubber Island, the Materials Handling Island, the Chimney Island, and the Wastewater Treatment Island. The advantage of this approach is it provides a high level of cost certainty to a project. This aspect, combined with the incentive contract awarded to URS, gave PSNH comfort the project would be completed for the projected budget estimate or at a reduced amount. One disadvantage to this selected approach is the owner can lose a degree of control over desired details for their project if these are not clearly described in the bidding documents for the islands. This becomes a responsibility of the PM once the owner has identified these requirements and has presented them to the PM. In Jacobs' opinion, PSNH clearly described the details of the project to URS.

In the approach chosen for the Merrimack Clean Air Project, there is a balance of plant design and interconnection issues that need to be managed. URS, as PM, was expected to handle these issues, and in Jacobs' opinion, URS has done an acceptable job in this area.

7.1.2 Coordination

Selecting the island approach makes the coordination efforts to some extent more streamlined. Each of the island contractors is responsible for all aspects within its scope. PSNH and URS did an excellent job in defining the scopes for the island contractors; and URS fulfilled their responsibilities to manage the various island contractors. In addition to the four major island

[40] DR 034 Contract Strategy Report

contracts, URS handled the Balance of Plant (BOP) construction coordination issues. Since URS performed the design and procurement for these systems, in addition to coordinating their construction and the four islands, the coordination of the entire site construction interfaced well. Large projects the size and complexity of the Merrimack Project requires significant attention to coordination, which is a prime responsibility of the PM. Further, when a project such as this is being performed in an operating plant with a very congested site throughout the year, coordination of the various construction activities becomes paramount. Initially in the project, PSNH chose to assign and involve personnel with intimate plant knowledge in the project. Due to the close involvement of PSNH, in this aspect, the PM capabilities of URS, and the selection of competent contractors, the coordination of this challenging project was well managed.

7.2 Safety

Safety on all construction projects is paramount. On any project, ensuring a safe work environment is challenging; the larger the project and the more spread out the workforce is the more challenging safety becomes. When a project is in an existing plant, where operations must continue alongside the new systems being built, safety issues are further compounded. The Merrimack Clean Air Project has all the above-mentioned factors; in addition to being a complicated project, the plant is located in the North where the winters can be severe. In addition to the human factor, an unsafe work environment can contribute to lower productivity and ultimately a more expensive project. Considering all of the above factors, the project became a unique challenge from a safety standpoint and demanded that those responsible for safety be extremely diligent in performing their daily task.

For projects where there is a PM engaged, as in this case, the main thrust of the safety program is typically assigned to them. While the owner, PSNH, has a role, it is essentially to pass the corporate expectations to the PM and require them to be the entity responsible for the function of the safety program. This approach is appropriate, because for a safety program to function well, it must be promulgated, monitored, and closely supervised. The PM has the responsibility of constant contact and supervision of the sub-contractors in order to observe opportunities and enforce safety procedures. It is incumbent on the PM to assign the proper number of professionally trained safety personnel to ensure the entire workforce is working safely. It should also be noted a safety program that will work in a small greenfield project will definitely not work for a large, congested project such as the Merrimack Project. In addition, beyond the PM's responsibility to ensure environmental and worker safety, it is also their responsibility to ensure safe worker performance, and in extreme cases, to mitigate safety issues through the replacement of an offending sub-contractor.

However, it does not appear that safety performance effort initially was successful at the Merrimack Project. Once a significant number of construction personnel were working at the

Merrimack Station there was a disturbing number of recordable incidents. While the difficult weather circumstances cited above may have contributed to the initial high Recordable Incident Rate (RIR),[41] the incident rate continued to rise as the weather improved. Consequently, it appeared that the safety related incidents were not due to just bad weather. We eventually reached the conclusion that the management of the various sub-contractors did not have a full commitment to safety.

In addition to the human factor, an unsafe work environment can contribute to lower productivity, ultimately resulting in a more expensive project. From Jacobs' review of project costs, we have no reason to believe that the safety experience at the beginning of the project resulted in any increase costs of the total project.

Senior management cannot mandate safety. An effective safety program can be planned and promulgated in written documents and corporate procedures, but the only successful method to affect the safety plan is to present the plan on a daily basis to the workers, in their language, their culture, and by their immediate supervisor in a face-to-face environment. Initially, this was not done with respect to the Merrimack Project. Eventually PSNH and URS recognized the poor safety performance, and in August of 2010,[42] they took steps to address the situation by conducting an overall review of safety on the project and implementing a "Recovery Plan" that included the following:

Monthly all hands meetings: Meetings were scheduled on the first Monday of each month where all contractors onsite discussed safety activity/initiatives, reviewed upcoming significant work schedules, and had question and answer sessions.

Focused weekly safety inspections of each contractor and their subcontractors: At the beginning of this endeavor, the inspections were weekly and have been increased to twice weekly. URS Management, PSNH representatives, management of the various contractors, and a few of their craft employees attend the inspections.

URS developed a Supervisor/Foreman Safety Training Program: This was delivered to many onsite Supervisors and Foreman at an offsite location. The Program covered topics such

[41] Recordable incidents include all work related deaths, illnesses, and injuries which result in a loss of consciousness, restriction of work or motion, permanent transfer to another job within the company, or that require some type of medical treatment or first-aid. Recordable Incident Rate (or Incident Rate) is calculated by multiplying the number of recordable cases by 200,000, and then dividing that number by the number of labor hours at the company.
[42] PSNH Final Response 05_18_11.

as pre-job briefings, hazard identification and control, as well as fall protection, trenching, steel erecting, etc.

Safety Steering Committee was developed: This committee is made up of representatives from URS, PSNH, large island contractors, and other contractors. It is led by URS, and its goal is to review safety statistics, establish goals, and discuss upcoming work.

URS and PSNH Management met with each Island Contractor, including members of their corporate leadership, and requested they develop a Recovery Plan of their own: The Plan included enhanced safety communications, safety incentives for their workers, as well as a renewed commitment, and responsibility for safety from their teams.

Once the Recovery Plans were implemented, the Project achieved a goal of close to four months without having a recordable injury/illness. The twice-weekly safety inspections and monthly all hands meeting were continuously held, and the monthly steering committee remained effective throughout the entire project. The results of this emphasis manifested itself in the fact that there were no lost time accidents on the project, for which the entire project team should be commended.

The Clean Air Project used the Bureau of Labor Statistics, U.S. Department of Labor, which collects Injury and Illness Data from OSHA 300 Logs for all industries and classifies each using the North American Industry Classification System (NAICS). These are also the statistics used by OSHA, the project Insurance Carriers, and all sub-contractors on site.

In 2009, the Construction Industry had an OSHA Recordable Injury Rate (RIR) of 4.3 and a Days Away, Restricted Duty or Job Transfer (DART) rate of 2.3. At the end of March 2012, the Clean Air Project had a RIR of 3.6 and a DART of 0.00. The RIR of the Project is 16.3 percent lower than the Industry Average, as shown in the chart below, and the Project's DART rate is exceptional.

Figure 7 - Project Recordable Incident Rate

7.3 Program Manager

PSNH has a relatively small staff that is aware that a project as large as the Clean Air Project at Merrimack would need a sizeable number of personnel. Therefore, they decided to engage an experienced firm to serve as the Program Manager for the project. After a thorough evaluation, they engaged The Washington Group, a very experienced firm in the power plant design and construction field. Not long after PSNH contracted with The Washington Group, another large engineering and design firm, called URS, acquired the firm. It was under the URS name that the majority of the project work was performed.

URS had an experienced team that became available from a similar project and they were able to bring this expertise quickly to the Merrimack Project. Being a large company, URS has multiple personnel with like capabilities, so when it became obvious that a certain person was not a good match for the PSNH project, URS changed the person quickly. This is an admirable approach as it mitigates the affect a person who is not a good fit can have on a project team and fosters a positive overall project morale.

URS did a good job matching the staff assigned to the tasks to be accomplished. Whenever additional personnel were required, such as in the case of safety personnel, they quickly provided them. In matching the staff to the tasks, as of April 11, 2012, when a review meeting was held at the site, there was one URS person in their home office and three personnel at the site assigned to the project. This is a fitting number of staff, as the project is 99 percent+ complete and not in need of much construction attention by the Program Manager. The remaining tasks are essentially a few punch list items and completion of the Secondary Wastewater Treatment System. URS is, as has been the case throughout the project, meeting the needs properly.

Fees for URS project management, not including any performance bonuses, total $43.6M, which is approximately 9.5 percent of the original total project estimate. In Jacobs' experience, we have found project management and balance of plant engineering fees for non-regulated industries typically are in a range of 6 to 8 percent of a project's budget. In regulated industries, the range for these fees tends to be somewhat higher. Thus, it appears URS was compensated for its program management services at the upper range of the projects budget.

7.4 Project Performance and Changes

7.4.1 Schedule

When Jacobs was first engaged in this undertaking, a project schedule for the Merrimack Clean Air Project was presented[43]. The schedule was very detailed incorporating input from all of the entities that make up the total project. The schedule provided details of all information about the project from design through construction and commissioning.

While the completion of the Clean Air Project mandated by House Bill -1673 was mid 2013, the detailed schedule, which was completed in June 2008, confirmed an in-service date of mid 2012. When Jacobs' personnel reviewed the schedule and then toured the site to see the state of the construction, it was evident the completion date shown in the schedule was reasonable and realistic.

In the time period that Jacobs' personnel have been regularly monitoring the project, the schedule has been updated to reflect actual progress. The revised schedule is equally as detailed as the initial one.

Based on funds spent, the Clean Air Project is approximately 99 percent complete. All major systems have been constructed; and performance tuning on equipment and systems are scheduled to continue through the remainder of 2012. In the project conception stage, PSNH conducted studies to optimize the physical layout of the scrubber maximizing space and developed an efficient process to deliver materials to the project team. PSNH was able to

[43] DR 002 MER Detailed Schedule

advance the schedule by having the substructure foundation installed during the fall so steel work could be erected during the winter period. During the span of the project, the weather was mild and favorable and the contractors performed high quality and quantity of work during construction.

PSNH contracted URS to manage the project's main four islands and develop with PSNH staff an aggressive fully integrated project schedule based on unit tie-in dates. The schedule contained risk factors and was not padded for critical path items. If problems arose during construction, the project team worked with vendors to correct the situation. The URS contract contained a compensation program with a fee and an incentive element for meeting key project deliverables including schedule dates. This program also contained a penalty element putting both their fee and incentive at risk for missing key deliverables. Large contractors had to meet their contractual schedule completion dates, many having liquidated damages as penalties. The very detailed schedule helped PSNH ask questions of the contractors so they could remove some of the float, but left room to recover in the schedule if there was any problem. They were able to tie-in both units in the fall outages of 2011 because of no major issues on either unit; if major issues had arisen, the tie-in would had occurred at a later date, such as in the spring outage of 2012. The units were tied-in 22 months earlier than the date set by the legislation and 10 months ahead of PSNH original schedule.

To ensure the operational efficiency of the scrubber, PSNH integrated the station operations, maintenance, and other personnel in the process at an early date. Station personnel were involved in the review of equipment and buildings drawing and specifications. Numerous visits were made to other plants with scrubbers so plant personnel could gain firsthand knowledge of possible equipment issues and operational challenges.

PSNH started extensive training of plant personnel over a year in advance of initial operations and developed a training program outline that ensured a systematic approach to quality training. Every contractor had contractual obligations to the train plant personnel and training was coordinated by URS. All training had a similar structure that included a summary, specific training modules, dialog and post training test to ensure that employees had grasped the transfer of knowledge. Training was conducted in the classroom and in the field for operation and chemical personnel and in the classroom for maintenance.

7.4.2 Cost

PSNH originally estimated the Clean Air Project at $457M. This estimate is further discussed in Section 5 - Cost Estimates. During our October 2010 Due Diligence review it was stated that the project estimate was revised to $430M. The reduction was due to higher productivity than estimated, lower than anticipated commodity costs, and favorable weather conditions during the major construction period in 2008 through 2010. The combination of these factors resulted in a reduction in escalation reserves of $16M and in contingency of $11M. The escalation reserves were established to capture any savings from the bidding process. Several contract additions were made to cover secondary water treatment, cathodic protection, and enhance treatment for the primary water treatment without changing the final estimate of $430M[44]. Please refer to item 9.4 in Section 9 - Appendix for details regarding the cost of these additional systems[45].

In October 2011, PSNH further reduced reserves by $8M and revised the project estimate to $422M. The final estimate includes all additional systems, work, and studies identified after the project started.

Costs in any project of this magnitude are subject to scope changes and change orders. The following two sub-sections describe the various project scope changes that resulted in an expansion or reduction in the overall project costs; and the numerous change orders issued for both additions and subtractions to contracts and for new systems.

7.4.3 Project Scope Changes [46]

During the course of the Clean Air Project, nine project scope changes totaling $42.7M were encountered. These changes included a limestone truck unloader and scales, corrosion protection of the FGD vessel, acoustic study changes, and an enhanced wastewater treatment system. Figure 8 shows the additional work and associated cost related to project scope changes.

[44] DR 040 CAP Cost Summary Jan-April 2011
[45] DR 025 Janus Report Part I
[46] Project scope changes consists of the work that needs to be accomplished to deliver a project with the specified features and functions

Figure 8 – Project Scope Changes[47]

SCOPE CHANGES TO FINAL BUDGET PLAN 06/18/08
Additions associated with new information or newly defined obligations

	Item	Reason	Cost($M)
1	Limestone Truck Unloading	Flexibiltiy to obtain delivery and cost competiveness	4.0
2	Corrosion Protection of FGD Vessel - Potential Adjustment Protection System (PAPS)	Technical issue discovered by the industry post initial engineering design - corrosion protection with A2205 alloy	1.9
3	Accoustical Study changes including - Gypsum Building Expansion, Booster Fan Enclosure, and other accoustical treatment installations	Town of Bow - new requirement	5.6
4	Truck Scales	Reduces cost of fees from third party scalers	0.3
5	EMARS (enhanced mercury and arsenic system)	DES - water division - new permitting requirement	3.5
6	SWWT (including first effect, second effect, acid pump injection system)	EPA's decision to include this new, highly treated FGD discharge in the lenghty MK Station NPDES renewal process - see discussion re waste water discharge	32.6
7	Soda Ash softening process	Pre treatment to the SWWTS	3.8
8	Service Water Pumphouse Relocation	Permitting constraints	3.2
	Omissions from Final Budget Plan 06/18/08		
1	New rail unloading for limestone	More cost effective to modify existing coal car unloader system	-12.2
	Total Estimated Scope Change Cost		42.7

The costs identified above reflect the Change Log value for additions 1,2,3,5,7,8 and item 1 of the omissions.
Items 4 and 6 reflect the work order value. May-12

The majority of the scope changes for the Clean Air Project were a result of either cost saving, permitting or technical issues found after the initial engineering was completed. A discussion of each project scope change item follows:

Limestone Truck Unloading and Scales (addition items 1, 4, and omission item 1) - PSNH determined that due to the limited site, it was more cost effective to retrofit the existing unloading system than to build a new one for limestone unloading. To ensure they would have flexibility in the delivery of limestone and obtain cost competiveness, PSNH decided to build a limestone truck unloading system. Truck scales were installed at the same time to reduce third party charges for weighting trucks.

[47] DR-046 Scope changes to 6/18/08 final budget

Corrosion Protection of FGD Vessel (addition item 2) - At the time of the scrubber design, the industry accepted type 2205 stainless steel as a suitable and cost effective material to use on the scrubber tank. Near the end of construction, PSNH learned type 2205 stainless steel was experiencing unexpected corrosion and contracted with Sargent & Lundy to evaluate and recommend actions to reduce corrosion in the scrubber tanks. Sargent & Lundy recommended installation of a Potential Adjustment Protection (PAP) System[48] to protect against corrosion of degraded weld heat affected zones and design inherent crevices.

Acoustic Study Changes (addition items 3 and 8) - Throughout the Clean Air Project PSNH worked with the Town of Bow to obtain the necessary permits and waivers needed for construction activities. During the process, several scope changes were made to accommodate changes requested by the Town of Bow. These changes included:

1) Gypsum Building Expansion
2) Booster Fan Enclosure
3) Other acoustical treatment installations
4) Service Water Pump house Relocation

In Jacobs' opinion, all of the above changes in scope where appropriate and necessary.

Wastewater Treatment Systems

The remaining scope changes are wastewater treatment system related. Due to their complexity and magnitude, we will first provide an overview of wastewater treatment systems, followed by a description of the work PSNH completed, then a brief review of EPA's position, and finally Jacobs' opinion.

Overview of Wastewater Treatment Systems[49]

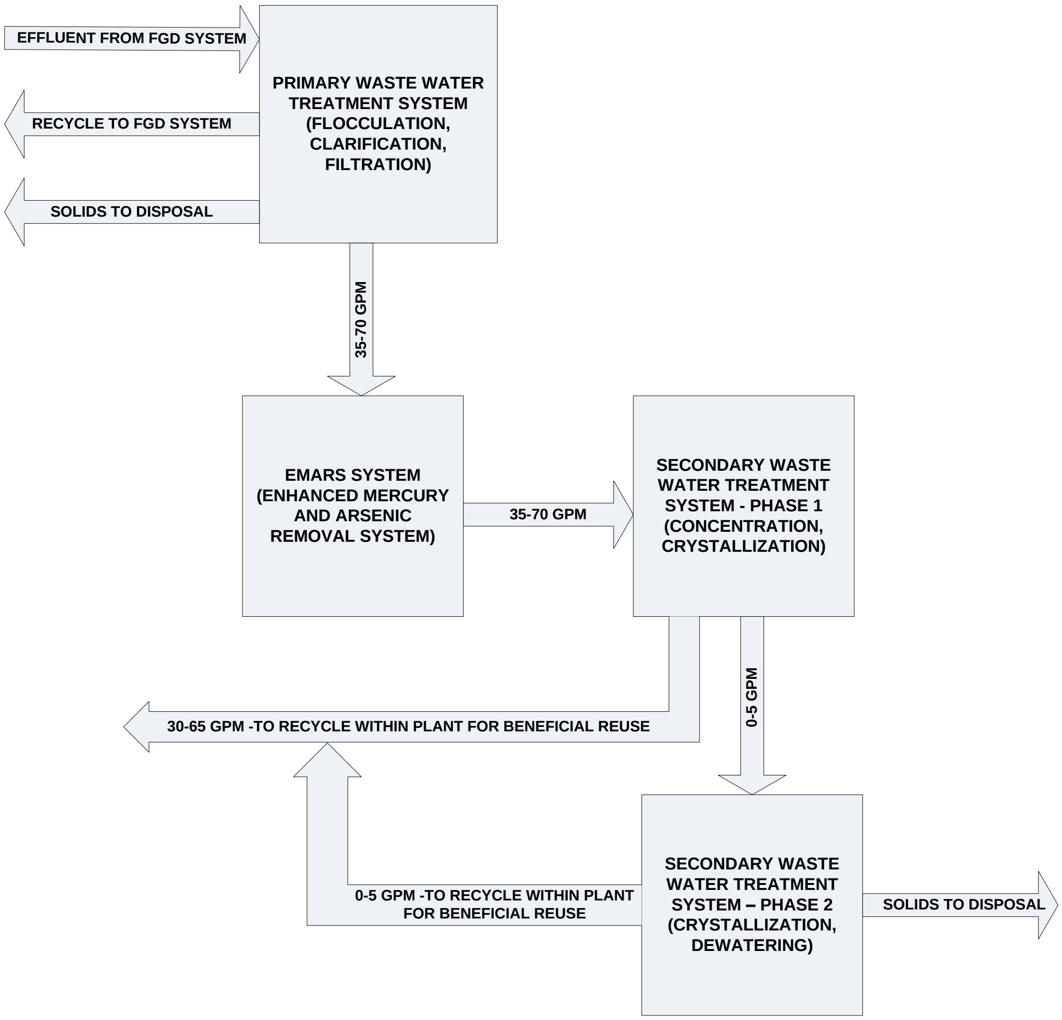
Scrubber systems, like the one installed at PSNH Merrimack plant, require a relatively small amount of the water circulating through the absorber vessel be blown down (removed from the cycle) to maintain appropriate chemistry in the system. The Merrimack system had a wastewater treatment system in its original configuration, as do all similar scrubbers. At the Merrimack plant, this initial wastewater treatment configuration became known as the primary wastewater treatment system.

[48] PAP systems upgrade the corrosion resistance of passive metals making their corrosion resistance comparable to higher grade alloys.
[49] DR-57 cap wwt picture edit 8 30 12.pptx

Referring to Figure 9, effluent from the FGD system is initially treated in the primary wastewater system where chemicals are added to enhance flocculation[50] and then passed through a clarification and filtration stage. The liquid from dewatering filter presses are returned to the process and the solids are removed for disposal offsite. From the original primary wastewater system, the effluent is passed through the added enhanced mercury and arsenic removal system (EMARS), which consists of fine filtration equipment. During this process, minute amounts of mercury and arsenic are removed by capture on the filter media. The filter media is periodically removed for offsite disposal. The next step in the effluent treatment is the secondary wastewater treatment system. The system consists of two phases. In Phase 1, the effluent is concentrated and crystallized, with the bulk of the water being discharged as clean liquid for reuse in the station and the concentrated effluent fed into Phase 2. The remaining 0-5 gpm going to Phase 2 is further crystallized and dewatered. The effluent leaving this stage is clean water for reuse in the station and solids will be disposed offsite.

[50] Flocculation can be described as clustering of individual dispersed droplets, whereby the droplets do not lose their identity.

Figure 9 - Wastewater Treatment Systems



Description of the Wastewater System Work Completed

PSNH worked with the New Hampshire Department of Environmental Services (NHDES) to structure conditions for discharge of the treatment system effluent along with the other plant discharges. This resulted in the addition of enhanced wastewater treatment system and eventually a secondary wastewater treatment system.

Enhanced Wastewater Treatment System (addition item 5) - In order to meet the NHDES imposed emission limits on water discharge PSNH installed an enhanced wastewater treatment system (EMARS) for $3.5M. This system provides for polishing treatment of mercury and arsenic downstream of the primary wastewater treatment system.

Secondary Wastewater Treatment System (addition items 6 and 7) - PSNH elected to install a secondary wastewater treatment system for $36.4M. This system is designed to received the effluent from the EMARS waste treatment system and further reduce it. Phase 1 of the secondary wastewater treatment system reduces the volume of water to 0-5 gpm through concentration and crystallization and the effluent can be recycled into the process. In Phase 2, which involves an additional crystallizer step and dewatering, the liquid effluent is reduced to zero, resulting in nothing being discharged into the river. The output of this secondary wastewater system also reduces the solid effluent to an amount that can be disposed of in a licensed landfill.

Additional details concerning the Enhanced Wastewater Treatment System, Potential Adjustment Protection System, and the Secondary Wastewater System contracts, which resulted from project scope changes, is contained in Section 9.5 - Contract Additions.

EPA's Position

The EPA's position was that the only way the discharge from EMARS could be accommodated was by adding it to the plant's NPDES permit, which had been in revision by the EPA for 14 years. PSNH believed adding the discharge to the NPDES permit would be an extremely long process, possibly taking many years, due to the statutory requirements regarding public involvement. PSNH[51] also believed there would be litigation challenges by one or more of the environmental groups that could prevent the start up of the scrubber and render the Merrimack Power Plant useless for years.

Consequently, to avoid further potential litigation and possibly years of delay in placing the unit into operation, PSNH elected to install the secondary wastewater treatment system. As previously mentioned the output of this secondary system reduces the liquids effluent to zero, resulting in nothing being discharged into the river and reduces the solid effluent to a minimum that can be disposed of in existing licensed landfills.

The original construction plans had the treated water from the wastewater treatment system discharging into the river. PSNH had to reconfigure the system due to permit and litigation issues during the early part of the system construction. This redesign eliminated the need for the discharge portion to the river. All discharge from the original engineering designs now enters the secondary system. The wastewater treatment system that now includes the primary and

[51] DR-042 Risks in Obtaining the Remaining Operation Permit – Wet Flue Gas Desulfurization (WFGD) Discharge.

secondary wastewater treatment works together to have true zero liquid discharge in conjunction with the wet scrubber[52].

Jacobs' Opinion

The installation of the secondary system was expensive, but it is in line with costs for similar installations that have been and are being installed on other power plant FGD systems. By choosing to add the secondary treatment system, PSNH sought to avoid potential litigation delays that probably would have accompanied a public involvement in the revision of the plant NPDES permit, potentially rendering the Merrimack plant's output unusable. The new EMARS and secondary wastewater systems are providing immediate benefits of eliminating the discharge of metals, especially mercury and arsenic, into the river.

This is a path being taken by a number of utilities in the U.S. to avoid costly and non-environmentally friendly delays. These systems provide the ultimate clean up of the scrubber effluent and in zero heavy metals being discharged into the country's waterways. In Jacobs' opinion, the decision to install the secondary system was the proper one, as it allowed the completion and timely start-up and operation of this relatively environmentally benign power resource.

7.4.4 Change Orders [53]

Throughout the Clean Air Project, numerous change orders were issued that included both additions and subtractions to contracts and for new systems. PSNH tracked the change orders in a spreadsheet and required each change order have a summary sheet, cost estimate, and engineering justification. PSNH used a multi-level approval process for each change order.

Overall, there were 777 change orders totaling $70M, including the additional scope noted above. When the additional scope items are removed from the change order log, the total change order amount is $27.6M, which is 6 percent of the original budget. If the additional work is removed from the final estimate, the change order amount is 6.5 percent of the forecast and is within an acceptable range. Below is a summarize list of change orders by contracts.

[52] Jacobs WWT Inquiry 821.

[53] A change order is work that is added to or deleted from the original scope of work of a contract or system, which alters the original amount, completion date or design.

Figure 10 - Change Order Log Summary[54]

	Original Budget	Final Total	Listed Change Orders	Change Orders (w/ Voided and Unused removed)
Booster Fans & Motors	3,881,890	3,705,469	9	10
BOP Electrical	5,840,030	10,412,187	63	61
BOP Mechanical	2,385,725	5,448,014	69	67
Cable Bus	275,722	279,000	3	3
CEMS	820,575	889,325	10	10
Chimney	12,614,364	12,873,510	12	11
Coatings	123,500	134,958	3	3
Construction Services*	4,500,000	3,683,316	21	18
DCS	1,177,489	2,222,519	17	17
Duct Isolation Dampers	812,484	862,921	4	5
Ductwork Expansion Joints	390,020	416,750	3	3
Ductwork Steel Fabrication	2,954,017	3,141,157	16	16
Duct/Structural Steel Erection	12,873,777	14,510,352	46	45
Site Finalization Phase 1 2 (Cairns)	3,166,885	4,013,885	44	44
FGD	95,403,300	95,869,486	55	53
FGD Substation	5,790,158	6,091,005	4	4
Foundations	9,998,703	18,739,572	89	87
FRP Fabrication Field Inspection*	400,000	131,405	2	2
LV MCC	808,591	851,968	11	11
LV Unit Substation / MV Switchgear	2,200,514	2,286,054	11	11
Material Handling System	34,728,878	39,111,566	66	62
Medical Services*	650,000	525,749	5	5
Meeting Place	1,623,000	1,639,544	4	4
PAP Engineering Phase 1*,**	45,000	31,177	0	0
PAP Engineering Phase 2*,**	300,000	180,303	0	0
PAP Equipment**	648,000	646,701	1	1
Pickling/Passivation	62,500	75,000	2	2
Performance Testing	174,936	298,927	1	2
Phase 1 Site Prep (Cairns)	6,352,240	7,782,964	46	42
Phase 2 Site Prep	3,775,687	3,855,077	33	23
Program Management*	38,500,000	45,267,561	73	8
Quench Water Pumps	200,089	299,168	4	4
Service Water Pumps	144,135	316,772	3	3
Startup Electrical Testing	149,278	174,859	3	3
Structural Steel Procurement	1,348,335	2,215,810	20	20
Third Party Testing*	225,000	102,595	2	2
Truck Wash System	241,183	245,672	4	4
UPS / DC System	146,370	153,728	3	3
Wastewater Treatment	13,593,280	19,704,312	45	31
Supplemental WWT Program Management*,**	4,900,000	4,200,000	0	0
SWWT Equipment**	5,422,300	7,963,473	16	16
SWWT Electrical Equipment**	827,656	843,404	2	2
SWWT DCS**	343,800	698,415	7	7
SWWT BOP Electrical**	1,595,889	2,583,707	20	19
SWWT BOP Mechanical 2**	219,000	232,064	4	4
SWWT BOP Mechanical 1**	9,900,000	10,500,000	0	6
SWWT Structural Steel Fabrication**	320,800	332,246	3	3
SWWT - UG Utilities Foundations**	1,143,658	1,989,239	21	20
Total**	293,998,758	338,532,886	880	777
Total	268,270,155	338,532,886		

*T&M Original Budget is PO NTX
**Total Includes New Scope

[54] DR-55 2012-08-30 Jacobs CO Log w PSNH comments 8 30 12.xlsx

7.4.5 Project Work Orders

To track the performance of the project, PSNH divided the project into four work orders and used Excel spreadsheets to enter in the cost of purchase orders for individuals' cost groups, such as NU labor, contingency, reserves, outside services, fees and payments, indirect, AFUDC and miscellaneous cost for each work order. These costs are rolled up by work order and matched against budgeted amounts to determine the variances on the individuals' cost groups as shown in the table below.

Figure 11 - Project Cost Summary

Work Order	Description	NU Labor	Material	Contractor Labor	Outside Services	Employee Expense	Vehicles	Fees & Pmts	Rents & Leases	Indirect Costs	AFUDC*	Reserve	Contingency	**Total**
C04MK220	Scrubber	5,268,815	19,091,613	294,463,660	4,357,283	185,861	455	8,513,540	161,217	4,204,359	32,644,431	500,000	0	**369,391,236**
C04MK221	E-Warehouse	47,173	9,015	992,884	11,220	612	34	0	0	3,654	10,315	0	0	**1,074,907**
C04MK222	Electric Power Supply	780,276	1,825,158	12,885,583	114,779	26,882	16,820	0	29,832	192,235	1,085,408	0	0	**16,956,972**
C04MK225	New Yellow Building	50,857	122,257	1,716,272	71,938	0	0	0	0	22,610	30,780	0	0	**2,014,714**
C04MK226	Secondary WWT System	185,560	10,052,748	19,372,731	174,375	6,398	5,349	0	4,922	375,515	884,574	1,500,000	0	**32,562,171**
Total		**6,332,681**	**31,100,790**	**329,431,130**	**4,729,595**	**219,753**	**22,658**	**8,513,540**	**195,970**	**4,798,374**	**34,655,508**	**2,000,000**	**0**	**422,000,000**
Budget		7,500,000	35,000,000	310,000,000	3,000,000	150,000	1,000	11,820,000	29,000	5,500,000	55,000,000	0	29,000,000	457,000,000
Variance		-1,167,319	-3,899,210	19,431,130	1,729,595	69,753	21,658	-3,306,460	166,970	-701,626	-20,344,492	2,000,000	-29,000,000	-35,000,000

[55]

A monthly report was produced and used to determine the percentage of the project completed.

[55] PSNH Cost Forecast 2012-04.xls.

7.4.6 Commissioning

Early in 2011, URS developed an outage readiness review, a highly focused proprietary process that incorporated all major equipment manufacturers and PSNH. Station personnel from the Mechanical, Electric, and Instrumentation departments were assigned to work directly with the project team to review as-built drawings, observe, and participate in equipment installation, testing, and system commissioning. URS and equipment manufacturing representatives gave oversight to PSNH personnel during initial start-up operations. During the third quarter of 2011, five station operators, one per shift, were assigned to the commissioning effort so they could be involved with testing, start-up, and operational activities of all equipment. During this process, a large list of items that needed corrective action was developed, and station personnel were in involved in remediation in order to learn the proper function and set points for the equipment. The equipment vendors with assistance of station personnel developed the accurate standard operating procedures for each piece of equipment.

During commissioning, experienced and knowledgeable people from every equipment manufacturer were onsite and worked closely with the URS Commissioning Team. These experts methodically check all equipment for proper installation; operational readiness; initial elements start-up; and then full systems operation to ensure proper temperature, pressures, vibrations, and other operating parameter were acceptable. This knowledge base insured positive efficiencies in communications and actions and proved helpful during start-up activities with the initial operations of the Scrubber, with Unit 1 in particular.

As each piece of equipment or system successfully achieved commission, URS provided the station with detailed turnover packages that included technical data and other documents relevant to the equipment or system. Over 100 of these turnover packages were produced.

Since gypsum is one of the plant's by-products, PSNH hired an outside company that has the experience in producing gypsum at other scrubbers, to give guidance that will allow the station personnel to develop firsthand knowledge in the production of salable gypsum. PSNH also hired an outside company to provide technical, operational, and maintenance support for the primary and secondary Wastewater Treatment Systems while station personnel develop this expertise.

7.5 Findings

- Units were tied-in and operational 22 months earlier than mandated and 10 months ahead of PSNH schedule.

- PSNH reduced the budget by $35M for a final estimate of $422M due to higher productivity and lower commodity costs.
- URS was engaged as the Program Manager to direct the construction activities of the project.
- The project was broken into major system work areas, called islands, and the islands were contracted on a lump sum turnkey basis.
- Performing the project, using an island concept, streamlined coordination as each island contractor was responsible for coordination within their area.
- When benchmarked against OSHA safety data, the project recordable incident rate was 16.3 percent lower than the industry average and no lost time accidents were recorded.
- As Program Manager, URS was responsive to the requests by PSNH on replacing personnel that were not deemed satisfactory.
- Fees for URS project management total $43.6M, which is approximately 9.5 percent of the original total project estimate. In Jacobs' experience, we have found project management and balance of plant engineering fees for non-regulated industries typically are in a range of 6 to 8 percent of a project's budget. In regulated industries, the range for these fees tends to be somewhat higher.
- During the course of the Clean Air Project, nine project scope changes totaling $42.7M were encountered. These changes included a limestone truck unloading and scales, corrosion protection of the FGD vessel, acoustic study changes, and an enhanced wastewater treatment system.
- The installation of an enhanced wastewater treatment system was required to meet the NHDES imposed emission limits on water discharge by providing removal of mercury and arsenic downstream discharge.
- The single largest project scope change was the secondary wastewater treatment system that was installed to avoid further potential litigation and possibly years of delay in placing the unit into operation.
- The output of the secondary wastewater treatment system reduces the liquids effluent to zero, resulting in nothing being discharged into the river and reduces the solid effluent to a minimum that can be disposed of in existing licensed landfills.
- There were change orders totaling $23M, which is 5 percent of the original budget and is within an acceptable range based on industry practices.
- PSNH was proactive in getting the project underway as soon as possible, and through good management, by PSNH and URS, this brought the project to completion a year ahead of schedule. A key factor in this performance was that, in anticipation that there might be sizeable delays; either due to weather or interveners, a more than adequate

schedule was set up from the beginning. Because these delays did not happen, the project was completed ahead of schedule.

- A conservative project cost estimate was established, and due to the timing of the project, this resulted in favorable equipment purchases. Because of the overall good management of the project, the project came in well below the budget.
- Because URS set up in advance an excellent commissioning team and process, which involved all parties, a smooth commissioning process resulted.

7.6 Conclusion

Given the size and complexity of the Merrimack Clean Air Project, the construction approach functioned as planned. The various contractors have worked well together and produced a project that has been on schedule and within budget. The project safety performance was above (worse) the national average and after the development of a recovery plan, the project experienced a reduction in their recordable incident rate. URS performed the project management role adequately developing a commissioning plan that led to unit tie-in with minimal problems. Their profit compensation was in the upper range for providing program management services to regulated industries. The system, based on early testing, will perform at or above the guaranteed mercury and sulfur removal performance levels and meet the state mandated requirements.

The installation of the secondary system was expensive, but it eliminated the potential litigation delays that most certainly would have accompanied a public involvement in the revision of the plant NPDES permit. The secondary wastewater treatment system reduces the liquids effluent to zero, resulting in nothing being discharged into the river and reduces the solid effluent to a minimum that can be disposed of in existing licensed landfills.

8 Ongoing Operations

Now that we have a functioning FGD at the Merrimack Station, what ongoing capital and operations, and maintenance costs can be anticipated, and how many additional employees will be required? In this section, we attempt to anticipate what ongoing operations costs will look like.

8.1 Capital and Operations and Maintenance Cost [56]

With little to no historical data representing scrubber system costs at Merrimack to rely on, the Clean Air Project Engineering Team spoke with representatives of other generating stations with scrubbers and investigated other scrubber installations. Management reviewed operating costs of the scrubber, associated systems since start-up, and provided best estimates for costs. It is expected that these costs will be refined as there is more actual cost data and experience at the station. In addition, it is recognized that much of the projected incremental costs of scrubber operations and maintenance into the future are fully dependent on the capacity factor of the two units, which is expected to be different from prior years, which cannot be precisely defined.

PSNH has not planned or anticipated any additional capital cost due to the new condition of the equipment and demonstrated positive operation to date.

PSNH's 2013 expected costs associated with routine maintenance of the absorber, material handling, reagent preparation, etc. based on a reduced capacity factor as experienced in 2012 is estimated at $2.8M. Operations related expense associated with lubricants, chemicals, technical process consultants, etc. for 2013 is estimate at $1.5M.

Fuel and combustion related management and various process treatment expenses and related by-product disposal costs, including limestone, gypsum, wastewater disposal, etc. is estimate at $2.9M for 2013.

8.2 Additional Staff [57]

PSNH reviewed the makeup of its station staff based on the knowledge acquired from other facilities where similar wet flue gas desulphurization systems were installed, and PSNH added nine actual station staff: five operators or shift workers — one per shift group, one

[56] DR-051 and DR-052 Ongoing Capital and O&M Cost
[57] DR-052 Number of Additional Staff

engineer/ FGD operations expert, one chemist, one instrumentation technician, and one mechanic.

The job duties that each position performs are:

- Operators observe equipment conditions, start and stop equipment, ensure proper operations procedures are used to place equipment in service or perform shutdown activities. They check for vibration and proper lubricant levels, respond to alarms, issue and hang safety isolation tags, etc. and generally ensure overall proper operations activities.
- Instrumentation technicians and mechanics perform maintenance and calibrations on associated scrubber equipment.
- The chemist performs observation of all chemical processes in many areas of the Clean Air Project, including service water, wastewater treatment, gypsum generation, absorber slurry chemistry, etc. They also process wastewater through the primary and secondary wastewater treatment systems by managing proper chemistry, additive feed rates, etc.

8.3 Findings

- PSNH has limited operating data from which to develop projected budget needs.
- The units' capacity factor will determine the budget needs; as the capacity rises, cost will be higher, and if lower, then cost will be reduced.
- PSNH will add nine additional staff for operation and maintenance of the scrubber.
- All operation and maintenance personnel will be bargaining unit employees with exception of the engineer being an exempt employee.

8.4 Conclusions

With the uncertainty of the unit's capacity factor, PSNH will need flexibility for the scrubber's operation and maintenance budget. As more operating and maintenance information is developed, PSNH will be able to refine cost and operation parameter. PSNH has added sufficient additional staff to effectively maintain and operate the scrubber.

9 Appendix

9.1 Data Request

Item	Description	Date Requested	Priority
1	Please provide a project execution manual that describes procedures on how to design, bid, contract, and manage the project.	4/16//10	1
2	Please provide a schedule by discipline from start to finish for the entire project.	4/16/10	1
3	Please provide major RFPs and contracts on the completed portions of the project.	4/16/10	1
4	Please provide an original, detailed estimate for the entire project.	4/16//10	1
5	Please provide an updated, detailed estimate for the entire project.	4/16//10	1
6	Please provide the cost reports on the completed portions of the project.	4/16/10	1
7	Please provide the high-voltage plan and analysis that describes the justification and need for the additional switchyard.	4/16/10	1
8	Please describe the reasons for the increase between the estimates of S&L dated 2006 and URS Washington dated 5/08 for the following items: • Engineered Equipment Balance • Subcontracts FGD System • Subcontracts Material Handling • Subcontracts Wastewater Treatment Subcontracts RE Unloading Pit: • Growth • Indirect cost totals • Design engineering and home office support • Escalation	8/19/10	1
9	Copy of S&L estimate of 2006	8/19/10	1
10	Please describe the reasons for the increase between the estimates of URS Washington dated 5/08 and Final CAP Cost Estimate 6/16/08.	8/19/10	1
11	Please provide an organization chart, which identifies the Clean Air project leadership and support roles.	8/19/10	1
12	Please provide position descriptions that define the respective role/responsibilities in the Clean Air Project for those identified in Item 11 (above).	8/19/10	2
13	Please provide a description of the project controls and software used to manage the project.	8/19/10	2

14	Identify any key performance indicators (KPI) or measures developed to help manage the project. For those KPIs utilized, please provide results from project inception to date.	8/19/10	2
15	Please provide copies of any internal audits performed regarding the efficacy of the project's estimate and/or controls.	8/19/10	2
16	Provide the date that the current major project management oversight process at NU was formalized.	11/03/10	1
17	Provide the RFP, which resulted in the Sargent and Lundy project estimate.	11/03/10	1
18	Provide all reports given to or provided by the Risk and Capital Committee (RACK).	11/03/10	1
19	Describe the project through a timeline starting with Sergeant and Lundy's estimate to the present date. Please include all supporting materials.	11/03/10	1
20	Provide both the August 2010 PowerPoint presentation, as well as the September 8, 2010 write-up, presented to the New Hampshire Commission.	11/03/10	1
21	All reports provided or presented to the NU BOARD OF Trustees concerning the PSNH Clean-Air Project.	11/03/10	1
22	Contractor bid evaluation sheet that resulted in URS' selection.	11/03/10	1
23	NU's charters for the Risk and Capital Committee (RaCC) and the Executive Review Steering Committee.	11/03/10	1
24	Prints or drawings of the existing Merrimack Power Station (pre-scrubber), the Sargent and Lundy picture, and the URS rendering.	11/03/10	2
25	The Janus Report, which summarizes the entire project from inception to the present date, once available.	11/03/10	2
26	Compare Sargent and Lundy and URS design changes for each construction island (scrubber, E-warehouse, electric power supply, new yellow building) listing items that appear in URS' estimate, but are not, or are different in the Sargent and Lundy estimate. For each item identified describe in detail why it was needed quantifying the additional cost impact.	11/03/10	1
27	Provide the URS monthly PowerPoint progress reports for 2010 and all subsequent reports until project completion.	11/03/10	2
28	Provide the URS weekly action items lists for October 2010 and all such reports until project completion.	11/03/10	2
29	Provide the current Project Manager's spreadsheet reports describing project costs for the Merrimack Station Clean-Air Project. Report titles include - Total Summary, Resource Summary by Month, Main Scrubber System, Electric Power Supply, and Construct New Yellow Building. Also, please provide subsequent reports until project completion.	11/03/10	2
30	Quarterly update report, which describes incentive goal obtainment by URS.	11/03/10	2
31	Report produced by Power Advocate, which describes the cost of various comparable scrubber projects.	11/03/10	1

32	In connection with the potential absorber vessel material issue, please provide a description of work or research study letter quote awarded to Sargent and Lundy.	11/03/10	2
33	Provide a document describing the information shared with contract employees regarding quality of workmanship based on lessons learned from other scrubber installations. Also, please confirm our understanding this information was presented by the Director-Generation.	11/03/10	2
34	Copy of the Contract Strategy Report prepared by R.W. Beck.	11/03/10	1
35	Describe the role intended for R.W. Beck in providing project oversight. Please provide all of the monthly reports that R.W. Beck has prepared for John McDonald. Also, please provide subsequent reports until project completion.	11/03/10	2
36	Copy of the public presentation made by the Director-Generation during the summer of 2010.	11/03/10	2
37	Reference DR 17 page 3 Section III item 2 - "Determine mercury capture, including guarantees of scrubbing system. Determine any other controls that would be required to meet 90 and 95 percent mercury capture." Please explain the difference from DR 26 item 2 "1.) No specific mercury or SO3 guarantee required with S&L."	1/7/11	1
38	During our interview with PSNH personnel the following differences between S&L and URS estimates were identified: • Two limestone bins • Limestone rotary plow – deep well excavation • Large absorber tank • Large gypsum building and equipment • Additional tray level • DMT 15 addition to keep oxide mercury • Bromine added to coal belt increase chlorine • S&L 250m not based on 85 percent removal • Removed buildings and built new warehouses • Build new conference building. • Additional foundation work • Service water – recycles used water • Switchyard expansion and added two lines in high yard per ISO New England requirements • Truck unloading for limestone • Truck wash station to reduce traffic, can use truck to haul both ways • Two-day bins • S&L had only one conveyor for gypsum, now three • Added truck unloading (town wanted it inside) • Owner cost increase • Fan enclosure • Unit 1 flue gas will flow to Unit 2 stack to operate when scrubber is off.		1

	Site prep Please give an estimated cost variance for each item.		
39	Provide the S&L analysis report of the absorber tower metal corrosion.	3/17/11	1
40	Please describe and explain the shift of funds from future years to 2011.	3/17/11	1
41	Please provide a hard copy of the Janus report.	3/17/11	1
42	Wastewater treatment at the New Hampshire Clean Air Project at Merrimack Power Station originally was configured for an enhanced primary wastewater system, a $2.6M addition. It is now our understanding that the primary system will be supplemented by a secondary wastewater treatment system, a $26.2M addition. Please provide a discussion as to the need for the secondary water treatment system. Your comments should address questions like is the secondary water treatment system actually required by today's regulations? Does PSNH believe it is a good idea to install in case there are more stringent regulatory requirements in the future?	3/17/11	1
43	Please provide the URS Outage Readiness Review and actions items.	8/29/11	1
44	Please provide a description of PSNH preparation for unit 1 and 2 tie-in to the scrubber.	8/29/11	1
45	Last URS safety report.	4/12/12	1
46	Per contract, please describe what out of scope work was completed and what in scope work was not done.	4/12/12	1
47	Copy of the original project work order budget sheet.	4/12/12	1
48	Copy of the three completed work orders final cost sheet.	4/12/12	1
49	Change Order Excel spreadsheet containing all contracts.	4/12/12	1
50	Please provide estimates of ongoing maintenance and inspection cost for all of the scrubber systems.	05/01/12	1
51	Please provide estimates of ongoing additional operation cost for all of the scrubber systems.	05/01/12	1
52	Please provide estimates of ongoing additional capital cost for all of the scrubber systems	05/01/12	1
53	Please provide the number of additional staff with job titles for all of the scrubber systems	05/01/12	1
54	Please provide a description of additional staff roles and functions	05/01/12	1
55	Please provide 2012-08-30 Jacobs CO Log w PSNH comments 8 30 12.xlsx containing update CO amounts	09/6/12	1
56	Please provide an updated plant rendition labeled 2012 CAP Schematic.jpg	09/6/12	1
57	Please provide the updated WWT process flow labeled cap wwt picture edit 8 30 12.pptx	09/6/12	1

9.2 Acronyms

ACI	Activated Carbon Injection
AFUDC	Allowance for Funds Used during Construction
BOP	Balance of Plant
CAP	Clean Air Project
CII	Construction Industry Institute
CO_2	Carbon Dioxide
CPM	Critical Path Method
EPCM	Engineering, Procurement, and Construction Management
ERMC	Executive Risk Management Council
FGD	Flue Gas Desulphurization
GPPMA	General President's Project Maintenance Agreement
Hg	Mercury
NHCPA	New Hampshire Clean Power Act
NMA	National Maintenance Agreement
NOx	Nitrogen Oxide
NTX	Not-to-Exceed
NU	Northeast Utilities
OEM	Original Equipment Manufacturers
PO	Purchase Order
PM	Program Manger
PSNH	Public Service of New Hampshire
RaCC	Risk and Capital Committee
RFP	Request for Proposal
RFQ	Request for Qualifications
RIR	Recordable Incident Rate
RMC	Risk Management Council
S&L	Sargent and Lundy
SO_2	Sulfur Dioxide
SO_3	Sulfur Trioxide

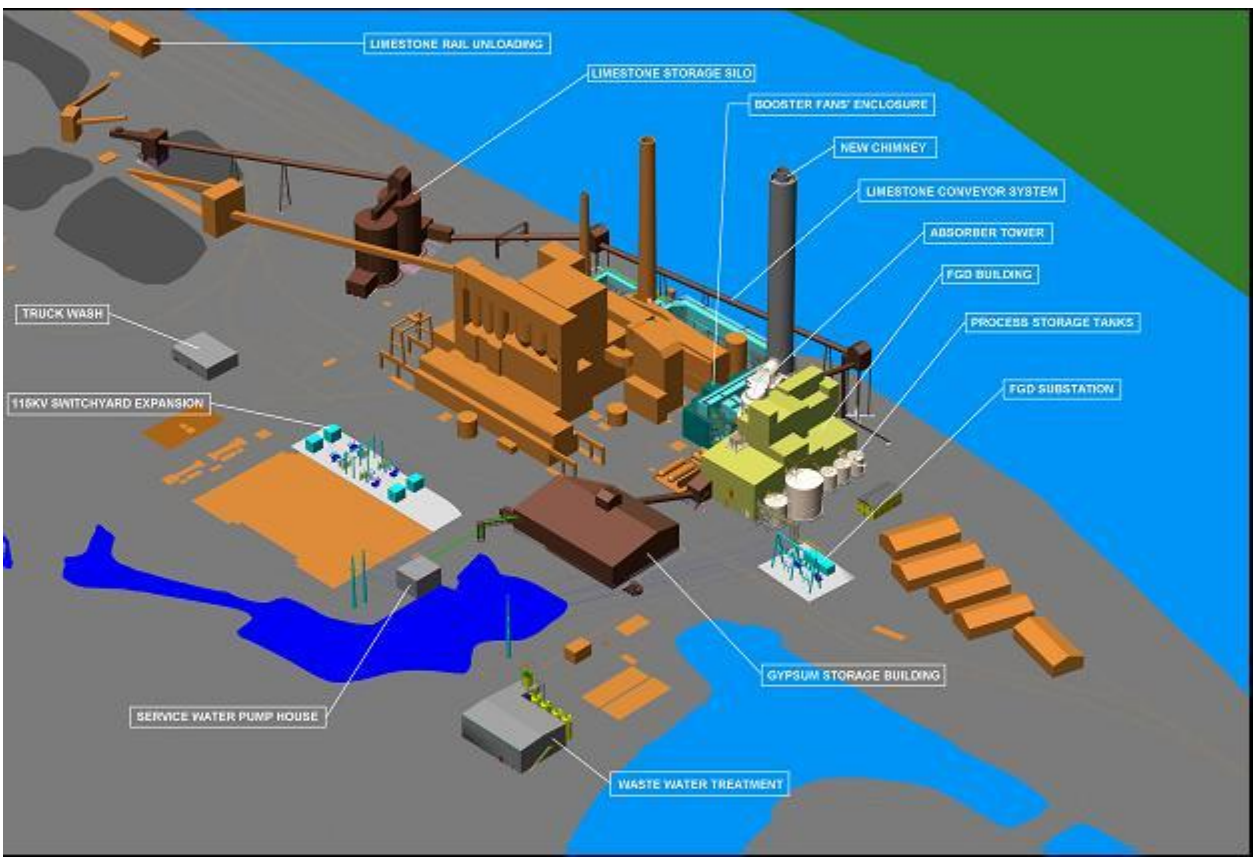
9.3 Industry Terms

Balance of Plant: Is the sum of all equipment for safe operation as well as the technical coordination of all concerned parts of a power plant.

Turnkey Contract: A single EPC contractor that provides a complete project “wrap,” including other subcontracts; i.e., scrubber island, material handling, stack, construction labor, etc.

Flue-Gas Desulphurization: Technology used to remove sulfur dioxide (SO_2) from the exhaust flue gases of fossil fuel power plants.

Activated Carbon Injection: System from which powdered activated carbon is pneumatically injected into the flue gas ductwork of a coal-fired power plant or industrial boiler.



9.4 Contracts

Scrubber (FGD) Island Contractor Bid

In January 2008, the Program Manager issued a RFP for turnkey services for the supply and installation of the Scrubber Island. The scope included engineering, supply, construction, and testing for the FGD system, including the limestone silos through gypsum dewatering with all mechanical and electrical installation, and all architectural/structural work above the foundations. The RFP was issued to the following potential bidders:

- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- Siemens Environmental Systems & Services (SESS)

Contract negotiations with SESS resulted in a final contract price of $95,403,300 with acceptable terms and conditions on all legal, commercial, and risk management issues. PSNH executed the full contract with SESS on October 20, 2008. On October 31, 2008, PSNH opened a Purchase Order (PO) with a Not-to-Exceed (NTX) amount of $101M for the FGD island work.

Island Procurement Strategy

In January 2008, the PSNH Clean Air Project team made a presentation to the RMC requesting authorization to issue RFPs for supply and installation of the following "islands":

- Chimney
- Material Handling System
- Wastewater Treatment System

The scope of work for each of these proposed RFPs included:

- Chimney - supply and installation of the chimney shell and fiber-reinforced plastic flue liner.
- Material Handling System - supply and installation of the limestone railroad unloading system, limestone storage silo, and conveyor transfer system, as well as the gypsum conveyor transfer and storage building.

- Wastewater Treatment System - supply and installation of the FGD Wastewater Treatment System, including all equipment, piping, tankage, electrical and instrument and control systems.

PSNH established pricing format to be firm, lump sum pricing to the greatest extent possible.

The NU/PSNH Large Project Procedure previously described in Section 3 was followed throughout the contract letting process. The RMC approved release of all three RFPs and the ERMC approval for release of the RFP for the Material Handling System on March 25, 2008. The ERMC approval was required since the Material Handling System was greater than $25M.

Material Handling Contractor Bid

Request for Proposal 29834-15-6-714-SC was issued on March 26, 2008, for the supply and installation of the Material Handling System. The RFP was issued to the following potential bidders:

- Dearborn Midwest Conveyor Co. (DMW)
- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**

Negotiations with DMW resulted in acceptable terms and conditions on all legal, commercial, and risk management issues. On December 19, 2008, NU executed a contract with DMW for $34,728,878, and on January 26, 2009, PSNH opened a PO with a NTX amount of $37,200,000 for the material handling contract.

Chimney Contractor Bid

Request for Proposal 29834-13-6-901-SC was issued on January 30, 2008, for the supply and installation of the reinforced concrete chimney. The RFP was issued to the following potential bidders:

- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- Hamon Custodis
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Negotiations with Hamon Custodis resulted in a final contract price of $12,614,364, with acceptable terms and conditions on all legal, commercial, and risk management issues. On December 9, 2008, NU executed the full contract with Hamon Custodis and on December 16, 2008, PSNH opened a PO with a NTX amount of $13,200,000 for the chimney contract.

Wastewater Treatment System Contractor

RFP 29834-21-6-403-SC was issued on February 27, 2008, for the supply and installation of the wastewater treatment system. The RFP was issued to the following potential bidders:

- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- Siemens Water Technologies (Siemens)

On December 5, 2008, NU executed a contract with Siemens for $13,593,280 and on December 16, 2008, PSNH opened a PO with a NTX amount of $14,200,000 for the WWTS contract.

Phase I Site Preparation (Pre-Construction) Contractor Bid

PSNH was authorized by the RMC in July 2008 to issue the RFP for Phase I Pre-Construction Site Preparation. The scope of work included site development for the craft parking lot, fabrication, and lay-down areas, temporary power, and removal of miscellaneous temporary buildings and foundations. The estimated value of the work was $8M. The contract was intended to be a lump sum with unit pricing for additions and deletions. PSNH and URS modeled the proposed integrated contract upon prior NU Transmission civil project contracts.

On August 8, 2008, RFP 29384-12-6-001-SC was issued for Phase I Site Preparation to the following bidders:

- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- George Cairns & Sons, Inc. (Cairns)
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The Phase I Site Preparation Contract for $6,352,240 was awarded to Cairns on October 31, 2008, and PO 02246117, effective November 17, 2008, with a NTX amount of $7,300,000 was issued.

Booster Fans & Motors Contractor Bid

The RMC in August 2008 authorized PSNH to issue a RFQ for the supply of booster fans and motors. The estimated value of this contract was $5,133,730, which was executed on a lump sum fixed price basis.

The following firms identified as qualified bidders are shown below:

- FlaktWoods Americas Operations
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A contract for $3,881,890 was awarded to FlaktWoods for Booster Fans and Motors on February 2, 2009. The amount included a fixed amount of $3,761,890 plus an estimated $120,000 for freight and PO 02247380 was issued on February 2, 2009, with a NTX amount of $4,500,000. Additionally, PO 02248788 for long-term spares was also issued in the amount of $810,752, plus freight.

Phase II Site Preparation Contractor (Construction) Bid

NU issued RFQ No. 29384-12-6-002-SC, on March 6, 2009, for Site Preparation Phase II Construction Work to the following prospective bidders:

- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
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- Daniel O'Connell's Sons (O'Connell)
- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**

Phase II Site Preparation work scope included, among other items:

- Installation of underground storm drains system.
- Demolition of the existing "yellow" building.
- Relocation of the existing north-south road (west of the station).
- Relocation of the utility trench.
- Installation of underground process piping.

On June 8, 2009, the Phase II Contract for $3,775,687 was awarded to Daniel O'Connell's Sons Inc. (O'Connell). NU opened PO 2249996 on June 10, 2009, with a NTX amount of $4,900,000.

Construction Services Contractor Bid

Request for Proposal 29834-13-6-550-SC was issued on November 25, 2008, to the following pre-qualified bidders for the construction services contract:

- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- CCB Inc. (CCB)
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The scope of work included ongoing general site services, maintenance services, operations and maintenance services, miscellaneous constructions activities as directed by the owner and provision of Construction Power, Water Distribution, and Sanitary Systems. The selected contractor would be paid on a time and material basis.

The Construction Services contract for $1,500,590 was awarded to CCB in February 2009, and PSNH opened PO 02247576 on March 4, 2009, with a NTX amount of $4,500,000.

Concrete Foundation Installation Contractor Bid

On November 24, 2008, the Project requested and received RMC authorization to issue the RFP for Foundation Installation. The scope of this work was excavation and installation of foundations with an estimated value of $15M. The following contractors were identified as qualified bidders through a pre-qualification submittal process that included a review of safety records. The contract was pricing was structured to be a lump sum for foundations that were already designed and unit prices for estimated quantities based on the degree of complexity for foundations that would be designed in the future.

Request for Proposal 29834-12-8-001-SC was issued on December 2, 2008, to the following pre-qualified bidders:

- **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**
- Francis Harvey & Sons Inc. (Harvey)
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The scope of work included provision of foundations for the following:

- Chimney
- Absorber Vessel
- Booster Fans (one for MK1 and two for MK2)
- FGD Building
- Ball Mills (FGD Building)
- FGD Building Tanks
- Gypsum Storage Enclosure, including exterior slab
- FGD Service Water House
- Two Limestone Storage Silos
- Duct Supporters

- Truck Wash Building
- Utility Bridge from FGD Substation to FGD Building
- Ash Silos- Relocation
- Limestone Conveyor Transfer Towers
- Limestone Receiving Chute
- Gypsum Conveyor Belts
- Limestone Bucket Elevator and Emergency Reclaim Dozer Trap

On February 4, 2009, the Concrete Foundations Installation Contract for $9,998,703 was awarded to Francis Harvey & Sons and NU opened PO 022474589 with an NTX amount of $11,000,000 on February 6, 2009. The final contract amount was revised from the initial evaluation estimate based on information received after the evaluation was completed. The adjustment in pricing lowered the estimate from $10,538,496 to $9,998,703 as the initial amount of the contract.

Permanent FGD Substation Contractor Bid

RFX-00213-2008 was issued to nine prospective bidders on July 15, 2008. This RFX was issued by NU/PSNH without URS involvement. PSNH had greater experience with substations of this type including PSNH's experience at the Northern Wood Power Project at Schiller Station.

The scope of work included engineering, design, development of protection and control settings, procurement of materials, and the installation, testing, and commissioning of a complete 115 kV — 4.16 kV two-transformer substation. The RFX requested lump sum pricing.

The RFX estimate was $4M; therefore, prior RMC authorization was not requested. Three bids, all over $5M, were received from the following bidders:

- Eaton Electric (Eaton)
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On December 26, 2008, Eaton was awarded a contract for $5,709,158 and PO 02246779 was issued for $6,380,000, including 10 percent contingency.

Balance of Plant Mechanical Contractor Bid

On September 9, 2009, authorization was sought and received from the RMC to issue the RFP for Balance of Plant (BOP) Mechanical Equipment / Piping Installation, mechanical work that was not logically scoped into the other "island" packages, including non-ductwork insulation. The contract was anticipated to be a lump sum for completed design with unit prices for additional scope. Nine prospective bidders were pre-qualified based on their submittals, review of their safety records and their membership in local building trades. Prospective evaluative criteria and weighting as well as a summary of contract risks and mitigation measures were presented to the RMC.

On November 25, 2009, RFP 29384-15-6-531 was issued to eight prospective bidders including:

- AZCO, Industrial Construction & Fabrication (AZCO)
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Following further negotiations, on March 25, 2010, PSNH opened a PO with AZCO for the BOP mechanical work with a NTX amount of $3,500,000.

Balance of Plant Electrical Contractor Bid

On September 9, 2009, PSNH sought authorization and received approval from the RMC to issue the RFP for balance of plant Electrical Power, electrical work that was not logically scoped into the other "island" packages, including the digital control system and continuous emissions monitoring system installation. The contract was planned to be lump sum for completed design with unit prices for additional scope.

PSNH / URS pre-qualified ten prospective bidders based on their submittals, review of their safety records, and their membership in local building trades. PSNH / URS developed prospective evaluative criteria and weighting as well as a summary of contract risks and mitigation measures, which were presented to the RMC.

On December 15, 2009, RFP 29384-17-6-754 was issued to eight prospective bidders including:

- E.S. Boulos (Boulos)
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On April 23 2010, PSNH issued a PO to Boulos for the BOP electrical work with a lump sum total of $5,840,030 (including OCIP and base scope revisions) and a NTX amount of $8,000,000.

Ductwork Fabricator Bid

On April 27, 2009, authorization was sought and granted by the RMC to issue the RFP for Ductwork Fabrication. The scope of work included furnish, fabricating, and delivering steel ductwork. The estimated value of the contract was $8.3M. The contract was intended to be lump sum for those designs that were complete and unit pricing for estimated quantities for future designs. Award was anticipated for July 2009. Delivery of ductwork was planned to start in February 2010 and completed in July 2010. Liquidated damages would be applied for failure to meet the delivery schedule.

On April 29, 2009, RFQ 29834-13-6-513, Ductwork Fabrication was issued to the following pre-qualified prospective bidders:

- Merrill Iron & Steel, Inc. (Merrill)
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On August 5, 2009, PO 02250987 was opened for Merrill Iron and Steel, Inc. for Ductwork Fabrication. NU entered into a contract with Merrill for $2,954,017. The NTX amount was $4,000,000, which considered $550,000 for future work authorization, plus $12,000 for a letter of credit option.

Ductwork and Structural Steel Erector Bid

On August 5, 2009, CA Project Management requested and received RMC authorization to issue the RFP for Ductwork and Structural Steel Erection. The scope of work included erection of the ductwork and structural steel to be fabricated and delivered by Merrill (see above discussion). The estimated value of this work was approximately $18.54M. The contract was intended to be lump sum for complete designs and with unit prices and estimated quantities for future designs.

The following were pre-qualified as prospective bidders:

- Merrill Iron & Steel Inc. (Merrill)
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Contract Award

PO 02252748 was issued to Merrill Iron and Steel, Inc. for Ductwork and Structural Steel Erection. PSNH entered into a contract with Merrill for $12,873,777, including adjustments based upon information received after the bid evaluation was completed. The NTX PO opened on December 24, 2009 had a value of $16,000,000.

9.5 Contract Additions

Enhanced Wastewater Treatment System [58]

On March 16 2010, URS issued an RFP to four bidders for an Enhanced Wastewater Treatment System to provide for polishing treatment of mercury and arsenic downstream of the Wastewater Treatment System, which was being built by Siemens. This system was required to meet the rigorous emission limits of the water discharge permit limitations imposed by the NHDES.

Siemens Water Technologies / Northern Peabody Inc. (Siemens) and **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL** submitted proposals. The procurement team evaluated the Siemens and **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL** proposals with final evaluation scores of **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL** and **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**, respectively. Siemens' bid was considered to have a proven technology, and the evaluated cost plus recommended options was reasonable.

URS recommended to the PSNH Clean Air Project Team that Siemens be awarded the Enhanced Wastewater Treatment System contract work for $2,172,600. The resultant authorized value of $2,572,600, which included $400,000 for future work authorization, if needed, was added to the existing Siemens Wastewater Treatment System contract with a NTX value of $2,700,000.

Potential Adjustment Protection System [59]

In mid 2010, PSNH became aware of a potential problem with the A-2205 material used in the absorber tank. High Alloy Stainless Steels have been used for FGD reaction vessels as an industry standard for years and A-2205 is the material most commonly used. In very limited cases, A-2205 materials have not stood up to certain corrosion mechanisms.

PSNH obtained more knowledge of the problem by speaking to utilities that had experienced the problem and engineering firms which have specific and current knowledge and expertise on this topic. It was determined the Sargent and Lundy (S&L) had the most firsthand knowledge of this issue and a PO was issued on November 9, 2010.

After a full analysis of the absorber tank and a review of all industry knowledge, it was concluded that a Potential Adjustment Protection System is the most effective way to ensure corrosion protection. Potential Adjustment Protection systems have been successfully used in many

[58] DR 040 Operating Permit Overview
[59] DR 039 S&L A2205 Report

industries for this type of problem. Corrosion Service Inc. is an industry leader and they can provide corrosion protection guarantees. Sole sourcing was used for the specialized design and supply of equipment (tank internals and external controls) and a PO was issued in January 2011.

Secondary Waste Water Treatment System [60]

As discussions were being held with the NHDES and EPA in 2009, PSNH anticipated the risk of delay and began initial contacts with secondary water treatment system and equipment suppliers. URS conducted several preliminary studies. In July 2009, URS issued a preliminary Wastewater Permit Project Impact Evaluation studying two options to the meet NHDES/ EPA requirements. In February 2010, URS evaluated budgetary bids for a secondary WWTS system.

With the decision to further pursue the secondary WWTS option, PSNH hired B&M on November 17, 2010, to provide technical assistance based on their unique knowledge and expertise. B&M was engaged to provide engineering and construction oversight under the pre-existing contract arrangement with NU/PSNH due to the unique first hand experience with the only other similar system at a generating plant in the United States.

B&M's analysis of the Clean Air Project WWTS and effluent concluded that the installation of a brine concentrator and crystallizer would reduce the liquid waste stream to zero to five gpm, which may allow for re-use. An additional crystallizer and dewatering device was also to be installed to ensure zero discharge optionality.

On January 12, 2011, the RMC reviewed the procurement strategy and the plans for the release of RFPs for equipment and construction for the Secondary WWTS. The RMC approved immediate release of the equipment RFP and the release of the construction RFP later in the spring of 2011. Recommended bidders for the equipment supply who are fully qualified included Aquatech International Corp. (Aquatech) and **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL**.

On January 20, 2011, the RMC reviewed evaluations of the equipment supply bids received from Aquatech and **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL** under RFP-00014- 02011.

[60] PSNH Final Response 05_18_11

Discussions were then held with both bidders to further clarify scope of work, schedule, and guarantees. Both bidders provided best and final offers.

Negotiations continued with Aquatech. **BEGIN CONFIDENTIAL [ ] END CONFIDENTIAL** was eliminated due to long delivery and the equipment being of foreign manufacture. In addition, the vendor would not accept schedule risk associated with delays in shipping.

Final results of the bid evaluation were:

Bidder	**Base Bid Price (excluding shipping)**	**Commercial Score** [redacted]	**Technical Score** [redacted]	**Scorecard Evaluation**
Aquatech	$4,250,000	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

On February 3, 2011, a PO in the NTX amount of $5,900,000 was initiated with Aquatech.

On February 16, 2011, CAP management informed NU senior management of the need for the secondary WWTS with the corresponding shifting of added expenditures into 2011 from 2013.

During February and into March 2011, B&M continued engineering for the secondary WWTS. By early March, general arrangement and P&ID drawings were prepared and reviewed and purchasing activities were underway.

By early April 2011, the electrical equipment and Distributed Control System (DCS) contracts were awarded. A purchase order for electrical equipment, including two 4.16kV-480V transformers, two 480V switchgear lineups, and two 480V motor control centers (MCCs) was issued to Siemens Energy, Inc. The purchase order value had a value of $900,000.

A purchase order for the DCS was issued to Emerson Process Management Power & Water Solutions, Inc. in the amount of $450,000.

Also by early April, bids were received for the building steel.