PNM EXHIBIT "B"
TO NOTICE OF INTENT

STATE OF NEW MEXICO
BEFORE THE ENVIRONMENTAL IMPROVEMENT BOARD

IN THE MATTER OF THE PROPOSED REVISIONS TO THE STATE IMPLEMENTATION PLAN FOR REGIONAL HAZE — **No. EIB 11-01(R)**

PRE-FILED TESTIMONY OF GERARD T. ORTIZ SUBMITTED ON BEHALF OF PUBLIC SERVICE COMPANY OF NEW MEXICO

INTRODUCTION

My name is Gerard T. Ortiz. I am the Executive Director of New Mexico Retail Regulatory Services for Public Service Company of New Mexico ("PNM" or "Company"). My business address is Public Service Company of New Mexico, Alvarado Square – MS-0810, Albuquerque, NM 87158. A statement of my qualifications is attached as PNM Exhibit GTO-1. My testimony addresses the anticipated impact of implementing selective catalytic reduction ("SCR") and selective non-catalytic reduction ("SNCR") at PNM's San Juan Generating Station ("San Juan") on PNM's customers' rates.

PNM provides electricity and electric transmission and distribution services to over 500,000 retail customers in the metropolitan area of Albuquerque (including Rio Rancho, Bernalillo, Los Lunas and Belen), the cities of Santa Fe, Las Vegas, Deming and Clayton, and surrounding areas ("PNM North"), and the communities of Silver City, Lordsburg, Alamogordo, Tularosa and Ruidoso ("PNM South"). Currently, the costs associated with San Juan are not included in rates to PNM South customers, so the customer impacts I am presenting in my testimony and exhibits are limited to customers in PNM North. In 2010, PNM's retail sales to PNM North customers totaled 8,103,999 MWh.

PNM's services to retail customers in New Mexico and its retail rates are regulated by the New Mexico Public Regulation Commission ("NMPRC" or "Commission"). Rates are designed to recover on-going operational and maintenance ("O&M") costs and the cost of and return on capital investment and to provide PNM with the opportunity, but not assurance, to earn a fair rate of return. The costs to install Best Available Retrofit Technology ("BART") at PNM's San Juan Generating Station ("San Juan") will be capital investment costs that must be recovered from customers and that will impact PNM's rates to retail customers and their monthly bills. The purpose of this testimony before the New Mexico Environmental Improvement Board ("NMEIB") is to explain how the projected capital costs for BART installed at San Juan, whether SNCR technology or SCR technology, will flow through rates and impact customers.

As explained in more detail below, PNM estimates that the projected first-year cost of installing and operating SNCR technology at the San Juan plant for residential customers is $10.93, based on average monthly consumption of 600 kWh. The projected first-year impact to PNM's residential customers of installing SCR technology at the San Juan plant would be about $85.31 per year – over a 7 fold higher bill impact. These impacts and the other relevant back-up information are shown on PNM Exhibits GTO-2 and GTO-3, respectively, which are attached to my testimony.

OVERVIEW OF RATE CASE PROCESS

PNM's rates are set by the NMPRC through a rate setting process. As you may know, PNM is currently involved in a general rate case. Rate cases typically involve many intervening stakeholders and can take 9 to 12 months or longer. For example, PNM initially filed at the Commission its current rate case application on June 1, 2010. Besides the Commission's Staff and the Office of the Attorney General, there are 26 other intervening stakeholders involved – each representing the interest of a particular customer or class of customers such as industrial, commercial, low income, or various public interest advocates.

While there are many issues in every rate case, typical major issues relevant to considering the cost impact of installing and operating SNCR or SCR at San Juan, include:

- The capital investment in plant and equipment that is to be recovered, for example, the total plant investment, the annual depreciation thereof, and the recovery of a return on that investment by PNM,
- The cost for O&M incurred to operate and maintain plant and equipment,
- The calculation of the overall revenue requirement, and
- The allocation to the various customer classes of the revenue requirement.

All of these factors affect the rate and bill impact analysis for the environmental upgrades that are proposed for San Juan.

CAPITAL INVESTMENT

Capital Investment costs for SNCR and SCR are shown in PNM Exhibits GTO-2 and 3, respectively. The installation of SCR will require additional plant outages to install the necessary equipment while installation of SNCR can be scheduled within normal plant outages. PNM must acquire replacement power from other sources to compensate for the loss of energy production at San Juan during the additional SCR outages. The estimated cost of this power is $36.3 million. For purposes of my testimony and exhibits, I have not included these replacement power costs, since they would be collected from ratepayers through mechanisms other than base rates established in a rate case. Therefore, the actual total impacts to the customers' bills shown in PNM Exhibit GTO-3 are understated.

PNM Exhibit GTO-2 shows that the projected capital costs for SNCR at San Juan total $76.5 million, including an allowance for funds used during construction ("AFUDC"). PNM's share of that cost would be $35.8 million. PNM Exhibit GTO-3 shows that construction costs for SCR at San Juan total $829.4 million, including AFUDC. In addition, there are capital costs, including AFUDC, for sorbent injection of $40.3 million. Thus, the total capital cost for SCR, including AFUDC, is $869.7 million – more than 10 times the total construction cost of SNCR. PNM's share of these construction costs would be $408.3 million for SCR.

The recovery of the costs associated with generation plant is a major portion of PNM's base rates, approximately 55%. Typically, capital investment in plant and equipment is examined by the Commission and intervenors to determine whether they were required to meet customer load growth or to assure the continued reliable operation of the system, i.e., replace aging plant.

Another issue related to capital investment is the rating of PNM by the credit rating agencies. Ratings are used by investors to evaluate the relative degree of PNM's investment attractiveness compared to other public utilities. In establishing ratings for a public utility, the agencies take into account forecast capital requirements, the credit metrics that the utility has been experiencing, and the overall regulatory environment in which the utility operates.

For example, PNM's current credit rating by Standard and Poor's Rating Services ("S&P") is below investment-grade. Moody's Investor Services ("Moody's") has PNM rated at its minimum investment grade. PNM is rated by S&P as the second to last of 187 regulated electric utilities. Consequently, PNM will pay a higher rate of interest to finance the capital required to construct SCR or SNCR than will a utility with a better credit rating, which adds to the costs used to set rates.

The potential impact of the costs for BART at San Juan for PNM's retail ratepayers is more than just the cost of its installation and operating costs; the potential impact is that these costs will stress PNM's credit ratings and the costs to ratepayers for the other investments in plant and equipment that PNM must finance. Currently, PNM forecasts an overall capital investment requirement of $1.1 billion over 2010 through 2014. This amount does not include PNM's share of the estimated investments to install BART at San Juan. PNM's forecasted capital investment requirement would increase over 37% if SCR were required at San Juan.

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O&M COSTS

O&M costs are always examined in rate cases to determine whether past O&M costs, for an historical test period, are reasonably expected to be recurring in the future and whether projected new O&M costs, for a future test period, can be justified.

As shown in PNM Exhibits GTO-2 and 3, O&M costs for SNCR and SCR are high – approximately $9.4 million for SNCR and $28.5 million for SCR, including the O&M costs due to sorbent injection. PNM's share of these annual O&M costs would be $4.4 million for SNCR and $13.3 million for SCR. These are not one-time costs, but continuing annual costs that are likely to rise in the future.

REVENUE REQUIREMENT

The revenue requirement determined by the Commission is the total revenue authorized to be recovered by PNM based on the expenses incurred within a 12 consecutive month period that is called a test period plus the plant balance as of a certain date. It includes recovery of annual depreciation of plant and equipment, O&M costs, interest, taxes, operating expenses, and PNM's authorized rate of return, although there is no guarantee that PNM will be able to earn its authorized rate of return. For example, once the new rates go into effect, capital requirements and/or O&M costs may be higher than included in the projections used by the Commission in setting rates. Interest rates may be higher. Customer load may be lower than projected causing lower revenues or load could be higher, causing additional capital requirements for plant and equipment.

Calculation of the first year revenue requirements associated with SNCR and SCR are included in PNM Exhibits GTO-2 and 3. The projected revenue requirement for SNCR investment and operations at the San Juan plant is $10.5 million. This would be a 1.4% increase in annual revenue requirements over PNM North's total revenues in 2010. For SCR, the projected revenue requirement would be $81.6 million, an increase of 11.3% compared to PNM North's revenues in 2010. These are first year revenue requirements. As the plant investment depreciates the annual revenue requirement over time would be expected to decrease, although some of the decrease potentially could be offset by rising O&M costs.

It is important to note that these projected costs would be in addition to costs included in PNM's pending request for rate relief. They are also in addition to any other factors that could support future rate increases.

ALLOCATION OF REVENUE REQUIREMENTS

The allocation of revenue requirements among customer classes is often one of the most contentious issues in a rate case as advocates for particular customer classes or public policy issues seek to avoid or mitigate the impacts of a rate increase. Of special concern are low-income residential customers served by PNM. Resources to assist them, such as LIHEAP, Salvation Army and PNM's Good Neighbor Fund, are already stretched beyond their limits.

In the current rate case, PNM has entered into a stipulated agreement ("Stipulation") with the Commission Staff, the Attorney General and certain other intervenors. The Stipulation is being contested by other parties to the case. In the Stipulation, PNM has agreed that the revenue increase that would be authorized by the Stipulation will be spread evenly across all customer classes as a same percentage increase, with certain exceptions. For example, the lowest rate tier for residential customers would receive no increase in order to help reduce the impact of rising rates on low-income customers. Additionally, the Stipulation consolidates PNM North and PNM South which would result in the costs for SNCR or SCR at San Juan would be spread over a larger customer base and somewhat moderate the cost per customer impacts. Of course, these issues are still pending before the NMPRC and no final rates under the Stipulation have been approved or implemented.

In determining the rate and bill impacts of the revenue requirement associated with implementing SNCR or SCR at the San Juan plant, shown in PNM Exhibit GTO-2 and 3, PNM used this same methodology. This means that all customer classes would experience about the same average allocation of the increase revenue requirement due to SNCR or SCR, that is, about 1.4% for SNCR or 11.3% for SCR. The result is that the first year revenue requirement for residential customers would increase by about $4.6 million under SNCR; it would increase by $35.9 million under SCR.

RATE OR BILL IMPACT

The impacts for SNCR or SCR on PNM North customer rates and bills are shown in the lower half of PNM Exhibits GTO-2 and 3.

As demonstrated in PNM Exhibit GTO-2, the cost impact of the increased revenue requirement resulting from the implementation of SNCR at San Juan will be to increase the total bill to residential customers by $10.93 annually, based on average monthly consumption of 600 kWh. The primary difference between this estimate and a prior reported rate impact estimate of $11.50 is due to inclusion of O&M costs for dibasic acid additions ("DBA") in our initial analysis. PNM, however, no longer anticipates that this potential additional expense will be required specifically for SNCR. (A secondary factor causing the difference is related to an incorrect treatment of AFUDC in the initial analysis.) Revenues remaining to be paid by other, non-residential customers would be about $5.9 million annually and generally increase their annual bills by about 1.4%.

In contrast, as demonstrated by PNM Exhibit GTO-3, the cost impact of the increased revenue requirement resulting from the implementation of SCR at San Juan will be to increase the total bill to residential customers by $85.31 annually. Revenues remaining to be paid by other, non-residential customers would be about $45.7 million, and generally increase their annual bills by about 11.3%. The current estimated annual residential bill impact of $85.31 is higher than an earlier estimate of $81.86. The entire difference is due to an exclusion of AFUDC in the calculation of return on rate base, although it was included in the return of rate base. The revised estimate of $85.31 correctly includes AFUDC in both revenue requirement components.

OVERALL SUMMARY

In summary, PNM's rates are set by the NMPRC through a rate setting process in which many parties can and do actively participate. PNM will seek recovery in rates of its share of the costs associated with installing and operating either SNCR or SCR at the San Juan plant. These costs include plant construction costs, which for SCR include the cost to construct SCRs and the sorbent injection facilities as well as O&M costs. The revenue requirements associated with these investments and increased O&M costs would increase PNM North's total revenue requirements by 1.4% for SNCR and 11.3% for SCR. Assuming an allocation methodology in which these increases are allocated to customer classes so that each customer class bears the same portion of these costs as they bear for costs currently being collected in rates, each customer class' rate and monthly and annual bill would increase commensurately by those same percentages.

This concludes my testimony.

Gerard T. Ortiz Experience and Qualifications

Name: Gerard T. Ortiz

Address: PNM Resources Inc.
Alvarado Square
Albuquerque, NM 87158

Position: Executive Director, New Mexico Retail Regulatory Services

Professional Engineer Registration: State of New Mexico - #9687

Education: B.S., Electrical Engineering, New Mexico State University, 1981
M.B.A., Finance Concentration, University of New Mexico, 1988

Employment: Employed by Public Service Company of New Mexico since 1981. Positions held within the Company include:

Director, Regulatory Policy and Case Management
Director, Market Services
Director, Business Resource Planning
Marketing Manager, Healthcare/Communications Segment
Engineering Supervisor
Distribution Engineer

Testimony Filed:

Proceeding	Regulatory Body	Docket Number
In the Matter of the City of Albuquerque To Institute Retail Pilot Load Aggregation Program and Its Request for Related	NMPUC	2782
In the Matter of PNM's transition plan Pursuant to the Electric Utility Industry Restructuring Act of 1999 – Part II Testimony in Support of Merchant Plant	NMPRC	3137
In the Matter of the application of PNM For Approval of Voluntary Renewable Energy Rider	NMPRC	03-00101-UT

Exhibit GTO-1

Proceeding	Regulatory Body	Docket Number
In the Matter of the application of PNM For Approval of Rio Rancho 2003 Underground Projects Rider Pursuant to Advice Notice No. 299	NMPRC	03-00352-UT
In the Matter of the application of PNM For Approval of Gas Energy Efficiency Programs and Program Cost Rider Pursuant To the New Mexico Public Utility and Efficient Use of Energy Acts	NMPRC	05-00261-UT
In the Matter of the application of PNM For a Certificate of Public Convenience And Necessity for the Afton Generation Station	NMPRC	05-00275-UT
In the Matter of the application of PNM For Approval of Rio Rancho 2005 Underground Projects Rider Pursuant to Advice Notice No. 319	NMPRC	05-00418-UT
In the Matter of Staff's Petition for the Docketing of a Case to Address Issues Arising from PNM's Fiber Optic Network Pilot Program	NMPRC	05-00443-UT
In the Matter of the application of PNM For Approval of Rio Rancho Unser Boulevard Road Widening Project Underground Rider Pursuant to Advice Notice No. 323	NMPRC	06-00095-UT
In the Matter of the application of PNM For Approval of Rio Rancho 2006 Underground Project Rider Pursuant to Advice Notice No. 326	NMPRC	06-00302-UT
In the Matter of the application of PNM For Approval of the ML Tap Underground Project Rider Pursuant to Advice Notice No. 328	NMPRC	06-00354-UT

Exhibit GTO-1

Proceeding	Regulatory Body	Docket Number
In the Matter of the application of PNM For Approval of Electric Energy Efficiency Programs and Load Management Programs Program Cost Tariff Riders Pursuant to the New Mexico Public Utility and Efficient Use of Energy Acts	NMPRC	07-00053-UT
In the Matter of the Investigation of the Continuation of PNM's Gas Energy Efficiency Programs and Program Cost Tariff Rider	NMPRC	07-00151-UT
In the Matter of the application of PNM For Approval of the City of Santa Fe 2007 Underground Projects Rider Pursuant to Advice Notice No. 335	NMPRC	07-00170-UT
In the Matter of the application of PNM For Approval of the Santa Fe County 2007 Underground Projects Rider Pursuant to Advice Notice No. 339	NMPRC	07-00373-UT
In the Matter of the application of PNM For Approval of the City of Albuquerque Unser 12 2007 Underground Project Rider Pursuant to Advice Notice No. 344	NMPRC	07-00463-UT
In the Matter of the application of PNM For Approval of the City of Rio Rancho 2008 Underground Projects Rider Pursuant to Advice Notice No. 346	NMPRC	08-00100-UT
Inquiry into Charges to Customers Of Public Service Company of New Mexico's Voluntary Renewable Energy Program Under Rider 11 and the Emergency Fuel Adjustment Clause	NMPRC	08-00229-UT
In the Matter of the application of PNM For Approval of the County of Santa Fe 2009 Underground Projects Rider Pursuant to Advice Notice No. 367	NMPRC	09-00056-UT

Exhibit GTO-1

Proceeding	Regulatory Body	Docket Number
In the Matter of the application of PNM For Approval of the City of Rio Rancho 2009 Underground Projects Rider Pursuant to Advice Notice No. 369	NMPRC	09-00091-UT
In the Matter of the Application of Public Service Company of New Mexico For Approval of a Plan to Manage Fuel and Purchased Power Costs By Entering into Certain Forward Market Transactions	NMPRC	09-00321-UT
In the Matter of the Application of Public Service Company of New Mexico For Approval of a New Voluntary Renewable Energy Program to Replace The Company's Existing Sky Blue Program and for Approval to Terminate The Sky Blue Program	NMPRC	10-00018-UT
In the Matter of an Investigation by the Pipeline Safety Bureau of the New Mexico Public Regulation Commission Concerning A Complaint Filed by the International Brotherhood of Electrical Workers	NMPRC	10-00042-PL
In the Matter of the Application of Public Service Company of New Mexico For Approval of the City of Rio Rancho 2010 Underground Projects Rider Pursuant to Advice Notice No. 388	NMPRC	10-00073-UT
In the Matter of the Application of Public Service Company of New Mexico For Approval of the City of Albuquerque 2010 Underground Projects Rider Pursuant to Advice Notice No. 391	NMPRC	10-00100-UT

Exhibit GTO-1

Proceeding	Regulatory Body	Docket Number
In the Matter of the Application of Public Service Company of New Mexico For Approval of 2010 Electric Energy Efficiency And Load Management Programs and Revisions to Program Cost Tariff Riders Pursuant to the New Mexico Public Utility and Efficient Use of Energy Acts	NMPRC	10-00280-UT
In the Matter of the Application of Public Service Company of New Mexico For Approval of the County of Santa Fe Underground Project Rider Pursuant to Advice Notice No. 401	NMPRC	10-00286-UT

PNM Exhibit GTO-2

San Juan Generating Station
Impact of BART Technology

First Year Only

Costs in $1,000

	SNCR - Plant Total				
	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Total**
Capital Cost including AFUDC	$ 17,048	$ 17,048	$ 21,220	$ 21,220	$ 76,536
O&M	$ 1,922	$ 1,922	$ 2,792	$ 2,792	$ 9,428
PNM Share	50.0%	50.0%	50.0%	38.5%	

	Total - PNM Share				
	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Total**
Capital Cost	$ 8,524	$ 8,524	$ 10,610	$ 8,170	$ 35,828
AFUDC	$ (305)	$ (305)	$ (379)	$ (292)	$ (1,280)
Construction Costs	$ 8,220	$ 8,220	$ 10,231	$ 7,878	$ 34,548
O&M	961	961	1,396	1,075	4,392

	Revenue Requirement				
	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**	**Total**
Return on Rate Base 8.56%	$ 730	$ 730	$ 909	$ 700	$ 3,068
Tax Gross-up	$ 287	$ 287	$ 357	$ 275	$ 1,206
Return of Rate Base - 20 years	$ 426	$ 426	$ 531	$ 408	$ 1,791
Operating Expenses	$ 961	$ 961	$ 1,396	$ 1,075	$ 4,392
Revenue Requirement	**$ 2,404**	**$ 2,404**	**$ 3,192**	**$ 2,458**	**$ 10,458**

Total 2010 Annualized Revenue	$ 724,231
Percent Increase in Revenue Requirement	1.4%
MWh in 2010	8,103,999

Totals Summary by Rate Schedule	kWh	Revenue	Percent of Total Revenue	Revenue Requirement	Impact in $/kWh
1 - Residential	3,027,146,801	$ 318,295,506	43.95%	$ 4,596,222	$ 0.0015
2 - Small Power	862,057,260	$ 93,716,571	12.94%	$ 1,353,278	$ 0.0016
3B/3C - General Power	1,772,932,899	$ 150,577,217	20.79%	$ 2,174,352	$ 0.0012
4B - Large Power	1,448,943,628	$ 99,424,500	13.73%	$ 1,435,701	$ 0.0010
5B - Mines 46/115 kV	86,593,959	$ 5,568,668	0.77%	$ 80,412	$ 0.0009
10 - Irrigation	17,775,708	$ 1,456,361	0.20%	$ 21,030	$ 0.0012
11B - Wtr/Swg Pumping	184,346,482	$ 11,311,332	1.56%	$ 163,337	$ 0.0009
14B - Mines 115 kV	-		0.00%	$ -	
15B - Universities 115 kV	114,899,718	$ 6,821,126	0.94%	$ 98,498	$ 0.0009
17B - Manuf. (8 MW)	-		0.00%	$ -	
30B - Manuf. (30 MW)	530,864,595	$ 28,646,857	3.96%	$ 413,664	$ 0.0008
6 - Private Lighting	12,020,112	$ 1,976,194	0.27%	$ 28,536	$ 0.0024
20 - Streetlighting	46,417,572	$ 6,436,299	0.89%	$ 92,941	$ 0.0020
Total	8,103,998,734	$ 724,230,631	100.00%	**$ 10,457,970**	

Residential Rate Impact at 7,200 kWh annually:	**$ 10.93**
Residential Rate Impact at 600 kWh monthly:	0.91
Incremental Revenue to be Collected from Other (Non-Residential) Customers:	$ 5,861,748

PNM Exhibit GTO-3

San Juan Generating Station
Impact of BART Technology

First Year Only

Costs in $1,000

SCR - Plant Total	Unit 1	Unit 2	Unit 3	Unit 4	Total
Capital Cost	$ 178,434	$ 193,985	$ 238,280	$ 218,703	$ 829,402
AFUDC	$ (16,853)	$ (18,318)	$ (22,481)	$ (23,674)	$ (81,326)
Construction Costs	$ 161,581	$ 175,667	$ 215,799	$ 195,029	$ 748,076
O&M	$ 5,252	$ 5,406	$ 7,363	$ 7,155	$ 25,176

Sorbent Injection - Plant Total	Unit 1	Unit 2	Unit 3	Unit 4	Total
Capital Cost including AFUDC	$ 7,927	$ 7,927	$ 12,206	$ 12,206	$ 40,266
O&M	$ 701	$ 701	$ 979	$ 979	$ 3,360

Total - Plant Total	Unit 1	Unit 2	Unit 3	Unit 4	Total
Capital Cost including AFUDC	$ 186,361	$ 201,912	$ 250,486	$ 230,909	$ 869,668
O&M	$ 5,953	$ 6,107	$ 8,342	$ 8,134	$ 28,536
PNM Share	50.0%	50.0%	50.0%	38.5%	

Total - PNM Share	Unit 1	Unit 2	Unit 3	Unit 4	Total
Capital Cost including AFUDC	93,181	100,956	125,243	88,900	408,279
O&M	2,977	3,054	4,171	3,132	13,333

Revenue Requirement	Unit 1	Unit 2	Unit 3	Unit 4	Total
Return on Rate Base 8.56%	$ 7,980	$ 8,646	$ 10,726	$ 7,613	$ 34,965
Tax Gross-up	$ 2,953	$ 3,199	$ 3,972	$ 2,779	$ 12,904
Return of Rate Base - 20 years	$ 4,659	$ 5,048	$ 6,262	$ 4,445	$ 20,414
Operating Expenses	$ 2,977	$ 3,054	$ 4,171	$ 3,132	$ 13,333
Revenue Requirement	**$ 18,569**	**$ 19,946**	**$ 25,131**	**$ 17,969**	**$ 81,615**

Total 2010 Annualized Revenue	$ 724,231
Percent Increase in Revenue Requirement	11.3%
MWh in 2010	8,103,999

Totals Summary by Rate Schedule	kWh	Revenue	Percent of Total Revenue	Revenue Requirement	Impact in $/kWh
1 - Residential	3,027,146,801	$ 318,295,506	43.95%	$ 35,869,266	$ 0.0118
2 - Small Power	862,057,260	$ 93,716,571	12.94%	$ 10,561,081	$ 0.0123
3B/3C - General Power	1,772,932,899	$ 150,577,217	20.79%	$ 16,968,805	$ 0.0096
4B - Large Power	1,448,943,628	$ 99,424,500	13.73%	$ 11,204,317	$ 0.0077
5B - Mines 46/115 kV	86,593,959	$ 5,568,668	0.77%	$ 627,543	$ 0.0072
10 - Irrigation	17,775,708	$ 1,456,361	0.20%	$ 164,120	$ 0.0092
11B - Wtr/Swg Pumping	184,346,482	$ 11,311,332	1.56%	$ 1,274,693	$ 0.0069
14B - Mines 115 kV	-		0.00%	$ -	
15B - Universities 115 kV	114,899,718	$ 6,821,126	0.94%	$ 768,684	$ 0.0067
17B - Manuf. (8 MW)	-		0.00%	$ -	
30B - Manuf. (30 MW)	530,864,595	$ 28,646,857	3.96%	$ 3,228,263	$ 0.0061
6 - Private Lighting	12,020,112	$ 1,976,194	0.27%	$ 222,701	$ 0.0185
20 - Streetlighting	46,417,572	$ 6,436,299	0.89%	$ 725,318	$ 0.0156
Total	8,103,998,734	$ 724,230,631	100.00%	**$ 81,614,790**	

Residential Rate Impact at 7,200 kWh annually:	**$ 85.31**
Residential Rate Impact at 600 kWh monthly:	$ 7.11
Incremental Revenue to be Collected from Other (Non-Residential) Customers:	$ 45,745,525

PNM EXHIBIT "C"
TO NOTICE OF INTENT

STATE OF NEW MEXICO
BEFORE THE ENVIRONMENTAL IMPROVEMENT BOARD

IN THE MATTER OF THE PROPOSED REVISIONS TO THE STATE IMPLEMENTATION PLAN FOR REGIONAL HAZE **No. EIB 11-01(R)**

PRE-FILED TESTIMONY OF BLACK & VEATCH CORPORATION (DIANE M. FISCHER AND KLYE J. LUCAS) SUBMITTED ON BEHALF OF PUBLIC SERVICE COMPANY OF NEW MEXICO

INTRODUCTION

Black & Veatch Corporation ("B&V") submits the following testimony on behalf of Public Service Company of New Mexico ("PNM") in this proceeding. The B&V personnel providing this testimony are Diane M. Fischer, Air Quality Control Project Manager, and Kyle J. Lucas, Air Quality Scientist. Copies of the statements of qualification for Ms. Fischer and Mr. Lucas are attached hereto as PNM Exhibit B&V-1 and PNM Exhibit B&V-2, respectively.

B&V is a leading global engineering, consulting and construction company. Founded in 1915, B&V specializes in infrastructure development in energy, water, telecommunications, federal, management consulting and environmental markets. B&V is employee-owned, has more than 100 offices worldwide and is ranked on the Forbes "500 Largest Private Companies in the United States" listing.

B&V was retained by PNM in 2006 to undertake an analysis of the San Juan Generating Station ("SJGS" or "San Juan") for the purpose of analyzing the Best Available Control Technology ("BART") requirements under the EPA's Regional Haze Rule. B&V has performed considerable work and analysis with respect to the San Juan BART determination. In furtherance of this analysis, B&V prepared the following materials for submission to the New Mexico Environment Department ("NMED"):

- PNM BART Analysis, dated June 6, 2007
- PNM SCR and SNCR Hybrid Cost analysis, dated July 11, 2007.
- Updated Visibility Cost Effectiveness Data, dated August 23, 2007.
- PNM Response to NMED Questions on BART Analysis.
- PNM SCR Schematic.
- BART Modeling Refinements, dated November 5, 2007.
- Discussion of OAQPS Cost Manual Method, dated March 31, 2008
- Final BART Modeling Response with Attachments, dated March 31, 2008.
- BART SNCR Analysis, dated May 30, 2008.
- Final Discussion of SJGS Coal and Classification.
- Nalco-Mobotec NOx BART Analysis, dated August 28, 2008.
- Final PM BART Analysis, dated August 28, 2008.
- PNM SO_3 Removal Report, dated March 16, 2009.
- Revised SNCR Analysis, dated February 11, 2011.

The materials and data submitted to the NMED can be found at the following NMED website link. http://www.nmenv.state.nm.us/aqb/reghaz/Regional-Haze_index.html

PURPOSE OF B&V TESTIMONY

The purpose of B&V's testimony in this proceeding is to provide the New Mexico Environmental Improvement Board ("Board" or "EIB") with an overview of the required elements for a BART analysis under the EPA Regional Haze Rule. We also explain the analysis that B&V undertook with respect to San Juan, and the results of the San Juan BART analysis relating to the control of emissions of oxides of nitrogen ("NOx"). Our testimony focuses on the analysis of the cost effectiveness of the various control technologies that were analyzed. Finally, we discuss some of the differences in the EPA's BART analysis for San Juan that was conducted as part of the proposed Federal Implementation Plan ("FIP") for New Mexico under the "good neighbor" provisions of the EPA's Interstate Transport Rule.

OVERVIEW OF BART ANALYSIS GENERAL REQUIREMENTS

A. What is BART?

BART or Best Available Retrofit Technology means an emission limitation based on the best system of continuous emission reduction for each pollutant that is emitted by an existing stationary facility. The emission limitation must be established, on a case-by-case basis, taking into consideration the technology available, the costs of compliance, the energy and non-air quality environmental impacts of compliance, any pollution control equipment in use or in existence at the source, the remaining useful life of the source, and the degree of improvement in visibility which may reasonably be anticipated to result from the use of such technology.

B. Factors to Consider in Determining BART

The Clean Air Act requires the consideration of five basic factors in determining BART for a specific unit. Each of the five statutory factors as applied to San Juan is summarized below.

1. Cost of compliance.

The first factor considered when determining BART at SJGS is the cost of compliance of each technically feasible control technology/method for the reduction of NO_x emissions at SJGS. To address this factor, B&V developed the cost of compliance based on the requirements for implementing each of these technologies. The cost of compliance includes the total capital investment for each control technology when applied specifically to the SJGS units and the annual operating and maintenance costs associated with operating the control technology to obtain the required NO_x emission as defined in the BART analysis.

2. Energy and non-air quality environmental impacts of compliance.

The second statutory factor requires consideration of energy and non-air quality environmental impacts. B&V estimated energy impacts for each control technology that would consume auxiliary energy during its operation. Only direct energy impacts for each control technology, such as the auxiliary power consumption of the control technology and the additional draft system power consumption to overcome the additional system resistance, were accounted for in the analysis. Indirect energy impacts, such as the energy to produce raw materials used for the control technology system, were not considered. The auxiliary power consumption of the various control technologies was estimated on the basis of the typical power consumption of similar equipment of an equivalent size. The additional draft system power consumption was calculated on the basis of the volumetric flow rate of the flue gas through the control technology system and the flue gas pressure drop defined in the design parameter of the control technology.

The major non-air quality impacts evaluated were the water consumption and disposal requirements for the byproduct and waste generated by each control technology. All quantities of water consumption and byproduct or waste generated by each control technology were calculated on a yearly basis.

3. Existing pollution control strategies.

The third factor established by the Clean Air Act for determining BART requires consideration of existing pollution control strategies. B&V's BART analysis for NOx reduction at SJGS considered the existing pollution controls, including recent environmental system upgrades at SJGS. The environmental system upgrade for the reduction of NOx included the installation of state-of-the-art low NOx burners ("LNBs") with overfire air ("OFA") ports and a neural network ("NN") system for NOx control. This system upgrade was performed by Babcock & Wilcox (B&W) with the retrofit on all four SJGS units with state-of-the-art integrated low-NOx combustion systems. The systems for all units included LNB (Model DRB-4Z), new dual-zone NOx ports, and an NN system. To accommodate the new combustion system, work was performed on the boiler wind box plenum, secondary air feeder ducts, waterwall panel, and access platforms. Efforts were also made to improve fuel/air balancing.

In addition, underfire air ports were installed on Units 1 and 2 on the bottom two rows of the wall opposite to the burners. These ports serve to break up the reducing atmosphere on the boiler wall to protect the tubes from degradation. B&W provided an emissions performance guarantee for the installation of low NOx burners for NOx reduction. NOx emissions are guaranteed to a level of 0.293 lb/mmBtu on a 30 day rolling average basis for each unit.

4. Remaining useful life of SJGS.

The Clean Air Act also requires consideration of the remaining useful life of the source in question. However, the remaining useful life of a facility is considered only when there would be an effect on the annualized costs of the retrofit controls for capital recovery, which would only occur if the source would have a shorter remaining useful life than the expected service life of the control technology. PNM does not currently have any plans to retire SJGS during the 20-year service life of the controls evaluated in the BART analysis. As such, the remaining useful life of SJGS was not a significant factor in determining BART.

5. Degree of visibility improvement.

The last statutory factor addresses the degree of improvement in visibility that may reasonably be anticipated to result from the use of the evaluated control technology for sources subject to BART. B&V evaluated the visibility impact for each control technology in the BART analysis using a two phase process. First, a visibility model was run using the pre-BART conditions to establish a baseline. For this analysis, the baseline consisted of the existing emission control technologies and unit operations. Second visibility model runs were conducted for the control technologies identified for each unit during the BART engineering analysis. The model results were then tabulated for the pre-BART and post-BART control scenarios over the time period of the meteorology modeled. The difference in the maximum value between the first and second phases is the expected degree of improvement in visibility.

B&V'S SAN JUAN BART ANALYSIS FOR CONTROL TECHNOLOGY

The EPA's BART Guidelines, promulgated as Appendix Y to 40 C.F.R. Part 51, recommend a five-step process for selecting BART in accordance with the statutory factors described above. Those five steps include:

- Identify all available retrofit control technologies
- Eliminate technically infeasible options
- Evaluate control effectiveness of remaining control technologies
- Evaluate impacts and document results
- Evaluate visibility impacts

B&V conducted its BART analysis for San Juan using the EPA's recommended five-step analysis.

A. Identify All Available Retrofit Control Technologies

In Step 1 of the BART analysis, all available retrofit control technologies that have a practical potential for application at SJGS were identified. These technologies are considered "available technologies." The technologies considered could be a change in plant operation method, addition/modification of emissions control system, or a combination of these options for control of a pollutant. For purposes of this discussion, our focus is on control technologies relating to NOx emissions. Information on the working principle, retrofit considerations, advantages, and disadvantages of the various technologies are provided in the descriptions contained in Sections 3.1 through 3.2 of the June 2007 B&V BART report referenced above.

There are two basic approaches for achieving a reduction in NOx emissions: combustion control and post-combustion control. Combustion control methods seek to suppress NOx formation during the combustion process by controlling the flame temperature and fuel/oxygen ratio. Combustion control methods include LNBs, OFA, and NN combustion optimization systems. The post-combustion controls occur after the combustion process and generally consist of selective non-catalytic reduction ("SNCR") and selective catalytic reduction ("SCR") systems. SNCR and SCR are flue gas treatment technologies that reduce NOx after its formation. The SNCR and SCR NOx reduction technologies use either urea or ammonia as a reagent. SCR technology also uses multiple layers of reduction catalyst. Other NOx reduction techniques were also identified in the B&V analysis, including emerging technologies.

The following is a list of NOx control technologies that were identified as available for retrofit at San Juan in the BART analysis:

- LNB, OFA with NN
- SNCR
- SCR
- SNCR/SCR Hybrid
- LNB, OFA, NN and SNCR
- LNB, OFA, NN and SCR
- LNB, OFA, NN and Hybrid
- Gas Reburn
- Mobotec ROFA and ROTAMIX
- NOxStar
- ECOTUBE
- PowerSpan
- Phenix Clean Combustion
- e-SCRUB

B. Eliminate Technically Infeasible Options

Step 2 of the BART analysis involves the evaluation of all the identified available retrofit control technologies to determine their technical feasibility. A control technology is technically feasible if it has been previously installed and operated successfully at a similar type of source. Two terms, "available" and "applicable," are used to define the technical feasibility of a control technology. A technology is considered applicable if it can reasonably be installed and operated on the source type under consideration. A technology is deemed available if it is being offered commercially by vendors or is in commercial demonstration or licensing. The commercially available technology is applicable if it has been previously installed and operated at a similar type of source, or a source with similar gas stream characteristics. Technologies that are still in development and testing stages are generally considered unavailable. Section 5.0 of the B&V BART report provides details of Step 2 of the BART analysis.

The following is a list of NO_x control technologies that were identified as available for retrofit at SJGS in the BART analysis:

- LNB, OFA with NN
- SNCR
- SCR
- SNCR/SCR Hybrid
- LNB, OFA, NN and SNCR
- LNB, OFA, NN and SCR
- LNB, OFA, NN and Hybrid
- Mobotec ROFA and ROTAMIX

The following list of NOx control technologies were identified as infeasible:

- ECOTUBE
- PowerSpan
- Phenix Clean Combustion
- e-SCRUB
- Gas Reburn

C. Evaluate Control Effectiveness of Remaining Control Technologies

Once all the technically feasible control technology alternatives are identified in Step 2, the control effectiveness of each control technology is evaluated in Step 3. The control effectiveness is determined using a metric of average steady-state pollutant emissions. For this study, the metric used is the quantity of pollutant mass emissions per unit heat input (lb/mmBtu). The control effectiveness of a technology was determined by considering the regulatory decisions and/or evaluations addressing the effectiveness of the technology. Other reference sources included performance data provided by manufacturers (usually in the form of performance guarantees), engineering estimates, and demonstrated effectiveness of the technology at another source. The most stringent level of control proven for each technology was used for its control effectiveness, but less stringent levels of control were also considered as additional options. The results for Step 3 of the BART analysis are described in Section 6.0 of the B&V BART report.

B&V notes that its original BART analysis submitted in 2007 assumed SNCR would only be capable of achieving a NOx emission rate of 0.24 lb/mmBtu. However, new developments have recently occurred in the SNCR market since PNM last evaluated SNCR in the context of the BART determination for SJGS. In January 2009, Fuel Tech purchased Advanced Combustion Technologies ("ACT)", which also provides SNCR systems for smaller boilers. ACT's SNCR technology, sold under the brand name HERT, uses a single nozzle injector instead of the multiple nozzle lance system developed by Fuel Tech. The HERT system has shown promising levels of NOx reduction in smaller boilers. Following the purchase of ACT, Fuel Tech developed new alternatives for SNCR NOx reduction at larger units, utilizing techniques adapted from ACT's experience. Fuel Tech has recently performed several confidential tests of NOx reduction on larger boilers firing fuels that are similar to the fuel burned at San Juan.

Based on the most recent test results, Fuel Tech has indicated that it would be willing to guarantee that its SNCR technology can achieve a NOx emission rate of 0.23 lb/mmBtu with an ammonia slip of 5 ppm at SJGS. According to Fuel Tech, SNCR could be installed at each of the SJGS units using their traditional NOxOUT wall injectors, multi-nozzle injection lances, HERT-style injectors, or a combination of one or more injection systems. Fuel Tech's testing program, along with their CFD modeling, would determine the correct technology for the application. According to Fuel Tech, the technology may be able to achieve even lower NOx emission rates, but full-scale testing of the new systems will be necessary to determine whether additional reductions are achievable at SJGS. Based on this new information, the control effectiveness of SNCR in the original B&V BART analysis for NOx should be (and was) revised from 0.24 lb/mmBtu to 0.23 lb/mmBtu. This information was provided to NMED on February 11, 2011, along with updated cost information for SCR and SNCR technologies.

Based on this additional information, B&V believes that SNCR, coupled with the existing LNB and OFA at San Juan, will enable San Juan to meet the BART "presumptive limit" for sub-bituminous coals. The final Regional Haze and BART Rule guidelines issued in July 2005 by the EPA outline the presumptive limits that apply to BART-eligible coal plants for NO_x. The BART NOx presumptive limits vary according to the type of coal burned and the boiler design. The presumptive limit of 0.23 lb/mmBtu was determined to be achievable for the majority of dry-bottom, wall-fired boilers firing sub-bituminous coal and using combustion control technologies. For a similarly configured boiler firing bituminous coal, the presumptive limit for NO_x is 0.39 lb/mmBtu. As noted in the BART study, the coal burned at SJGS can be classified as either sub-bituminous or bituminous. A coal classification of bituminous for San Juan would result in a higher presumption limit. In any case, SJGS can achieve the presumptive NOx limit generally applicable to sub-bituminous coals using SNCR on all four units coupled with the existing combustion controls.

D. Evaluate Impacts and Document Results

1. BART impact analyses

Once the control effectiveness is established in Step 3 for all the feasible control technologies identified in Step 2, additional evaluations of each technology are performed as part of the BART analysis. These evaluations, labeled as "Impact Analyses," address the statutory

BART factors and are included in Section 7.0 of the B&V BART report. The impact analyses performed included the following:

- Costs of compliance
- Energy impacts
- Non-air quality environmental impacts
- Remaining useful life

The first impact analysis evaluated the costs of compliance. This analysis is performed to determine the cost to purchase, retrofit, and install the control technology. The capital and operating/annual costs are estimated based on established design parameters. The design parameters are established in the Design Concept Definitions in Appendix B of B&V's BART report. The estimated cost of control is represented as an annualized cost ($/year). The annualized cost in conjunction with the estimated quantity of pollutant removed (tons/year) allows the cost-effectiveness ($/tons) of the control technology to be determined. The cost-effectiveness compares the potential technologies on an economic basis.

The energy impact of each evaluated control technology is the energy penalty or benefit resulting from the operation of the control technology at the source. Direct energy impacts, such as the auxiliary power consumption of the control technology and the power consumption to overcome the additional system pressure loss, were evaluated. The costs of these energy impacts included additional fuel costs and/or the cost of replacement power that would have to be purchased to implement the control technology.

Non-air quality environmental impacts were evaluated to determine the cost to mitigate environmental impacts caused by the operation of a control technology. Examples of non-air quality environmental impacts include water consumption, wastewater discharges, and solids/waste generation.

Because PNM does not expect to retire the SJGS units within the 20-year life span of the controls under consideration in the BART analysis, the remaining useful life was not a significant factor in determining BART for SJGS.

2. B&V cost analysis methodology

A central issue in the EPA's BART analysis is the methodology used in determining the costs for the various control technologies, particularly SCR. Because of the issues surrounding the cost analysis for SCR, we are providing a more detailed discussion of the cost analysis approach utilized by B&V.

The information in the design basis for the emission control technology was used for equipment sizing, performance calculations, and cost estimates (capital, operating and maintenance, resource consumption estimates, auxiliary power requirements, and byproduct disposal). The design basis was established with consideration of the unit configuration with the existing control technologies already in place. This approach was selected so that the information in the design basis could be used for the evaluation of the additional control technology alternatives for BART consideration. The design basis is shown in Appendix A of B&V's BART report.

The design basis was also developed using the properties of a representative coal typically combusted at SJGS. Combustion calculations were performed using the design basis coal to determine the flue gas flow characteristics for use in equipment sizing and cost estimation. The economic criteria used in the BART analysis were provided by PNM, from its cost analysis models and is provided as Table 2-2 of the BART report.

As described in PNM Exhibit B&V-3, B&V has extensive experience with the design and construction of SCR, SNCR, and NOx reduction control technologies as a whole. B&V utilizes this knowledge of designing and building many NO_x reduction projects to guide and direct its cost estimating effort. B&V developed a cost estimate for the SJGS BART analysis based on an internal database of costs for recent relevant projects. A scaling factor was used in the cost estimate by referencing equipment costs from the reference projects. B&V has provided detailed written documents to explain how each item of the cost estimate was developed in documents submitted to NMED in July 2007 and March 2008. These documents have been posted on the NMED website.

A quotation was provided from Fuel Tech for the SNCR cost estimate. Factors were used to calculate the cost of balance of plant equipment and construction. Fuel Tech has indicated that the capital cost for its SNCR system (in fourth quarter 2010 dollars) has escalated no more that 15 percent from the original estimate provided to PNM in 2007.

The cost estimate generated using this method provides a comparison value to be used for the evaluation of technology/method for regulatory compliance. To allow for a comparison of the costs associated with SNCR to the costs associated with the other available and technically feasible controls that have been evaluated in previous submittals, the cost calculations for those other controls have also been updated to reflect fourth quarter 2010 dollars as well. For the SCR costs, PNM and B&V performed a detailed update of the costs using data from the Bureau of Labor Statistics. For the other controls listed, including SNCR/SCR hybrid, ROFA/Rotamix, ROFA, and Rotamix, a similar calculation was applied. However, the costs associated with ROFA/Rotamix, ROFA, and Rotamix were only updated from February 2008 to fourth quarter 2010, since the budgetary requests from Mobotec were provided in February 2008. As a result, the effect of the update on the calculations for these controls appears somewhat lower than the calculations made for SCR and SNCR/SCR hybrid.

In the BART Report, and revised analysis submitted to the NMED in 2011, the cost estimates for the implementation of control technologies were developed by B&V based on cost information such as:

- CUECost workbook, Version 1.0
- EPA Air Pollution Control Cost Manual - Sixth Edition
- Budgetary quotes from equipment vendors
- References to quotes or cost estimation for previous design/build projects or in-house engineering estimates

The EPA has issued the Office of EPA Air Pollution Control Cost Manual, Sixth Edition, EPA/452/B-02-001, dated January 2002 which is commonly referred to as the "OAQPS Cost Manual." The EPA BART Guidelines refer to the "OAQPS Cost Manual" as a resource for preparing regulatory cost estimates. The OAQPS Cost Manual provides a good overview of various technologies and provides some information on how to estimate certain types of equipment. However, the BART Guidelines do not preclude the use of other relevant data and conditions in deriving cost estimates for control technologies.[1] Indeed, the "OAQPS Cost Manual" has many limitations and its exclusive use in calculating control costs would not result in a cost estimate reflective of the true costs for a given source.

The approach selected by PNM based on cost estimates generated by B&V for the feasible control technologies evaluated in the BART analysis for SJGS supplements the OAQPS Cost Manual with real-world implementation cost considerations, as expected under the BART Guidelines. B&V also took into account site-specific factors, as directed by the BART Guidelines, EPA regulations, and the Clean Air Act visibility provisions. Site-specific factors for a given source are beyond the scope of the OAQPS Control Cost Manual. This cost development method ensures that the representative costs of implementation of NOx reduction technologies are presented to the NMED.

3. The B&V cost comparisons

The following Table 1 is provided to show the costs developed for the various technologies evaluated by B&V. This table is taken from the February 11, 2011 Revised SNCR BART analysis submittal.

[1] The EPA Guidelines provide: "Once the control technology alternatives and achievable emissions performance levels have been identified, you then develop estimates of capital and annual costs. The basis for equipment cost estimates also should be documented, either with data supplied by an equipment vendor (i.e., budget estimates or bids) or by a referenced source (such as the OAQPS Control Cost Manual, Fifth Edition, February 1996, EPA 453/B–96–001). In order to maintain and improve consistency, cost estimates should be based on the OAQPS Control Cost Manual, where possible.15 The Control Cost Manual addresses most control technologies in sufficient detail for a BART analysis. The cost analysis should also take into account any site-specific design or other conditions identified above that affect the cost of a particular BART technology option." 40 C.F.R. Part 51, Appendix Y, IV.D.4.a.5.

PNM EXHIBIT "C"
TO NOTICE OF INTENT

Table 1
Impact Analysis and Cost Effectiveness Results of Additional NOx Control Technologies for SJGS

All Feasible Technologies	Emission Performance Level (lb/MBtu)	Expected Emission Rate (lb/h)	Expected Emission Rate (ton/yr)	Expected Emission Reduction (ton/yr)	Total Capital Investment (TCI) (1,000$)	Total Annualized Cost (TAC) (1,000$)	Cost Effectiveness ($/ton)	Incremental Cost Effectiveness ($/ton)	Energy Impacts (1,000$)	Non-Air Impacts (1,000$)
SJGS Unit 1										
Selective Catalytic Reduction (SCR)	0.07	258.5	866	3,174	104,143	20,525	6,466	2,442	1,430	--
SNCR/SCR Hybrid	0.18	667.3	2,484	1,656	118,683	16,816	10,154	36,917	708	1,762
ROFA & Rotamix (Mobotec)	0.20	741.4	2,760	1,380	30,790	6,902	5,001	7,982	1,413	3
Rotamix (Mobotec)	0.23	852.6	3,174	966	11,022	3,597	3,723	116	51	4
SNCR (Fuel Tech)	0.23	852.6	3,174	966	17,049	3,582	3,708	80	38	--
ROFA (Mobotec)	0.26	963.6	3,566	552	18,256	3,549	6,429	--	1,363	--
SJGS Unit 2										
Selective Catalytic Reduction (SCR)	0.07	256.2	981	3,156	193,790	21,881	6,932	3,036	1,492	--
SNCR/SCR Hybrid	0.18	655.6	2,471	1,648	115,151	17,309	10,503	37,667	348	1,762
ROFA & Rotamix (Mobotec)	0.20	737.6	2,746	1,373	30,790	6,902	5,027	8,024	1,413	3
Rotamix (Mobotec)	0.23	846.2	3,156	961	11,822	3,597	3,742	117	51	4
SNCR (Fuel Tech)	0.23	846.2	3,156	961	17,048	3,582	3,727	50	38	--
ROFA (Mobotec)	0.26	958.9	3,570	549	18,256	3,549	6,462	--	1,363	--
SJGS Unit 3										
Selective Catalytic Reduction (SCR)	0.07	403.1	1,501	4,931	248,416	28,359	5,752	744	2,194	--
SNCR/SCR Hybrid	0.18	1,036.4	3,859	2,572	178,759	26,604	10,342	39,171	507	2,658
ROFA & Rotamix (Mobotec)	0.20	1,151.6	4,287	2,144	35,724	9,810	4,576	7,496	2,810	5
Rotamix (Mobotec)	0.23	1,324.3	4,931	1,501	13,919	4,989	3,324	-378	64	5
SNCR (Fuel Tech)	0.23	1,324.3	4,931	1,501	21,220	4,859	3,238	-578	36	--
ROFA (Mobotec)	0.26	1,497.1	5,574	857	22,081	5,231	6,100	--	2,725	--
SJGS Unit 4										
Selective Catalytic Reduction (SCR)	0.07	395.4	1,472	4,637	239,089	25,592	5,497	339	2,215	--
SNCR/SCR Hybrid	0.18	1,016.8	3,786	2,524	171,412	25,803	10,226	38,034	507	2,659
ROFA & Rotamix (Mobotec)	0.20	1,129.8	4,206	2,103	35,724	9,810	4,664	7,642	2,810	5
Rotamix (Mobotec)	0.23	1,299.3	4,837	1,472	13,919	4,985	3,388	-365	64	5
SNCR (Fuel Tech)	0.23	1,299.3	4,827	1,472	21,220	4,858	3,301	-590	36	--
ROFA (Mobotec)	0.26	1,469.7	5,466	841	22,881	5,231	6,218	--	2,725	--

Notes:

1. Costs for all technologies are shown in fourth quarter 2010 dollars. Costs were escalated from the original BART estimate calculations.
2. Expected emission rates (ton/yr) calculations were based on 85 percent unit capacity factor (refer to Appendix A Design Basis in June 6, 2007 BART Application Document).
3. Expected emission reduction (ton/yr) calculations were based on control effectiveness described in submittal and baseline emission (refer to June 6, 2007 BART Application Document)
4. TCI and TAC are referenced from Attachment 2, 3, and 4.
5. Cost-effectiveness ($/ton) is defined as ratio of TAC over Expected Emission Reduction (ton/yr).
6. Expected emission reduction is based on annual emission reduction from baseline upgrade emission levels.
7. Incremental cost effectiveness are based on increments in expected emission reduction (ton/yr).

E. Evaluate Visibility Impacts

1. Federal Class I Areas

The EPA Regional Haze Rule is intended to protect visibility in federal Class I areas. "Class I areas" include national parks, wilderness areas, monuments, and other areas of special national and cultural significance. Federal Class I areas are afforded special environmental protection through enforcement of Class I increment values established in 40 CFR part 52.21. Additionally, air quality relative values or "AQRVs" were developed to promote the protection of such areas from the environmental effects of a wide range of emission sources. The federal Class I areas of interest in this BART analysis are as follows:

Table 2 Class I Areas	
1. Mesa Verde National Park	9. West Elk Wilderness
2. Weminuche Wilderness	10. Arches National Park
3. San Pedro Parks Wilderness	11. Capitol Reef National Park
4. La Garita Wilderness	12. Pecos Wilderness
5. Canyonlands National Park	13. Wheeler Peak Wilderness
6. Black Canyon of the Gunnison National Park	14. Great Sand Dunes National Park
7. Bandelier National Monument	15. Maroon Bells-Snowmass Wilderness
8. Petrified Forest National Park	16. Grand Canyon National Park

2. Visibility

Visibility refers to the clarity with which distant objects are perceived.[2] Visibility impairment is caused by light scattering and light absorption associated with particles and gases in the atmosphere.[3] Visibility impairment means any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions.[4] The terms "visibility impairment" and "impairment of visibility" shall include reduction in visual range and atmospheric discoloration.[5] Visibility impairment is often perceived as a general haze or a distinct plume.[6]

The three most common metrics used to describe visibility impairment are:

[2] *"Visibility in Mandatory Federal Class I Areas (1994-1998): A Report to Congress". EPA-452/R-01-008. November 2001*
[3] 40 CFR 51 Appendix W Section 6.2.1
[4] 40 CFR 51.301
[5] 42 U.S.C. §7491(g)(6)
[6] The Grand Canyon Visibility Transport Commission. *"Recommendations for Improving Western Vistas".* June 10, 1996. *Website: http://www.wrapair.org/WRAP/reports/GCVTCFinal.PDF*

a. Extinction (bext) - Extinction is a measure of the fraction of light lost per unit length along a sight path due to scattering and absorption by gases and particles, expressed in inverse Megameters (Mm-1). This metric is useful for representing the contribution of each aerosol species to visibility impairment and can be practically thought of as the units of light lost in a million meter distance.

b. Visual Range (VR) - Visual range is the greatest distance a large black object can be seen on the horizon, expressed in kilometers (km) or miles (mi).

c. Deciview (dv) - This is the metric used for tracking regional haze in the Regional Haze Rule. The deciview index was designed to be linear with respect to human perception of visibility. A one deciview change is approximately equivalent to a 10% change in extinction, whether visibility is good or poor. A one deciview change in visibility is generally considered to be the minimum change the average person can detect with the naked eye.

3. BART Visibility Modeling

The impacts to visibility in the relevant Class I areas are determined utilizing computer modeling. The methodologies and databases referenced in the PNM BART Modeling Protocol dated April 2007 are consistent with the CALMET/CALPUFF Protocol for BART Exemption Screening Analysis for Class I Areas in the Western United States dated August 15, 2006. This document was also referred to as the WRAP Protocol in the PNM BART Analysis, as it was developed by the Western Resource Air Partnership Regional Modeling Center ("WRAP RMC").

Potential visibility improvements from the addition of each control technology were determined from the modeling results using CALPUFF. In addition to the physical and operational parameters for each unit, the following pollutants were modeled: SO_2, NOx, and PM (consisting of elemental carbon, fine PM, course PM, H_2SO_4 and secondary organic aerosols). A modeling protocol has been developed by the WRAP RMC and was used as a template for the modeling protocol for the SJGS modeling analysis (located in Appendix E of the BART report). Items that were considered in the modeling protocol include the following:

- Modeling methodology
- Meteorological and terrain data
- Stack height, exhaust temperature, exit velocity, and stack elevation
- Pre- and post-control emissions rates of pollutants
- Receptor data from appropriate Class I areas

After model runs were completed, a determination of the visibility improvement was made. The visibility improvements for the initial BART compliance scenario involving the technologies currently installed at SJGS, and the additional BART compliance scenario with additional control technology alternatives were determined by comparing the 98th percentile modeled visibility values. The visibility improvement is quantified in units of dv, which are defined as a visibility index that linearly scales perceived visual (visibility) changes (Interagency Monitoring of Protected Visual Environments Newsletter, April 1993). For the purposes of the BART analysis, visibility improvement is the calculated difference between the additional control technology and the baseline. A detailed description of the BART modeling for these scenarios has been included in Section 8.0 of the BART report.

4. Updated Visibility Modeling

Following the submittal of the PNM BART Modeling Protocol with the PNM BART Analysis in June 2007, refinements in the air modeling methodology were made and provided to the NMED on November 5, 2007. The refinements relate to nitrate repartitioning and ammonia background concentrations.

Nitrate repartitioning has been included in the updated visibility modeling to better account for the amount of particulate nitrate ("NO_3") by limiting the available ammonia when individual unit puffs overlap. The original visibility modeling conducted for the June 6, 2007 BART Report did not incorporate repartitioning of available ammonia (MNITRATE = 0). The refinements did not allow each overlapping puff(s) to use the full ammonia background value but instead only a portion of the ammonia available (MNITRATE = 1). This concept is reflected in Section 3.1.2.6 of the *CALMET/CALPUFF Protocol for BART Exemption Screening Analysis for Class I Areas in the Western United States* dated August 15, 2006, (hereinafter referred to as the WRAP Protocol). "Nitrate repartitioning" does not refer to the ammonia limiting method or "ALM."

Refinements to the modeling were also made with respect to background ammonia concentrations. The Sithe Global Power, LLC's Desert Rock Energy Facility and the Toquop Energy Projects located in the southwestern United States recently used variable monthly background ammonia concentrations, based on ammonia background concentrations monitored at several western Class I areas which was accepted by the EPA. Based on this information, SJGS's BART modeling reflects these approved values, presented in Table 3 for reference.

Table 3
Variable Monthly Ammonia
Background Concentration[1]

Month	Background Ammonia Concentration (ppb)
January	0.2
February	0.2
March	0.2
April	0.5

May	0.5
June	1.0
July	1.0
August	1.0
September	1.0
October	0.5
November	0.5
December	0.2
[1]The ammonia data and supporting information for the values contained in Desert Rock Energy Facility and the Toquop Energy Project visibility analyses were included in detail in Attachment 1 of the March 31, 2008 report submittal.	

In the Revised SNCR BART Analysis submitted to NMED on February 11, 2011, updated results based on visibility modeling of SNCR at the revised control effectiveness level provided by Fuel Tech was performed. The maximum visibility improvements for SNCR were determined during this process. The results of the refined visibility modeling for SJGS, assuming the same SNCR control technology is installed on all four units, are illustrated in Tables 1 through 3 of Attachment 6 in the Revised SNCR BART Analysis submittal. The maximum visibility improvements between the baseline and the SNCR control scenarios for the facility range from 0.05 dv to 0.25 dv. These tables summarize the scenarios and the maximum visibility (deciview) impact projected at any of the 16 Class I areas at any time over the 2001 to 2003 period.

These maximum visibility improvements between the baseline and the SNCR control scenario for each unit are similar to that of the combined SJGS. The visibility improvements are summarized below:

- Unit 1 improvements range from 0.02 dv to 0.17 dv
- Unit 2 improvements range from 0.02 dv to 0.18 dv
- Unit 3 improvements range from 0.02 dv to 0.17 dv
- Unit 4 improvements range from 0.03 dv to 0.18 dv

5. Revised SO2 emission limits and permit modification

The NMED notes that SO_2 emissions can have an even greater impact on visibility than NOx emissions. The proposed NMED Visibility Interstate Transport SIP includes a proposal to reduce allowable SO_2 emissions at SJGS from approximately 0.18 lb/mmBtu annual average (i.e., current requirement is 90% and 72% annual average SO_2 control efficiency on Units 1, 3 and 4 and Unit 2, respectively) down to 0.15 lb/mmBtu on a 30-day rolling average. NMED requested that PNM submit a permit application to make the SO_2 reductions federally enforceable prior to the hearing in this proceeding. Accordingly, on April 19, 2011, PNM submitted a technical revision permit application to NMED to lower the allowable SO_2 emissions at the SJGS, which also includes an annual total SO_2 emission reduction of 3,670 ton/year. The technical revision procedures under the New Mexico air quality regulations require a 30-day public notice before the permit can be issued. The notice was published in the area newspaper on April 21, 2011 and the notice period will end on May 21, 2011. The notice ending date may allow NMED the opportunity to issue the permit revision before the EIB BART SIP Public Hearings.

BART COST EFFECTIVENESS ANALYSIS

The cost-effectiveness of each control technology was calculated from the total annualized cost to implement the technology and the amount of NOx reduced. The reduced emissions were estimated on a yearly basis according to the reduction from the existing emissions level shown in Table 6-1 of the B&V BART Report. The resultant cost effectiveness for NOx control technologies at SJGS is presented in Table 1 in the Revised SNCR BART

Analysis submitted to the NMED on February 11, 2011. The cost effectiveness was determined for the following NO_x control technologies:

- Selective Catalytic Reduction (SCR).
- Selective Non-Catalytic Reduction/Selective Catalytic Reduction (SNCR/SCR Hybrid).
- Rotating Opposed Fired Air (ROFA) and Rotamix (Mobotec).
- Rotamix (Mobotec).
- SNCR (Fuel Tech).
- ROFA (Mobotec).

Also presented in the Revised SNCR BART Analysis submitted on February 11, 2011 are "least cost curves" for NOx control technologies at each SJGS unit. The least cost curve defines the cost effectiveness of each NOx control technology as it shows the total annualized cost and annual emissions reduction attributed to each technology.

Cost effectiveness for visibility improvement was then determined for the SNCR technology. Air modeling results that describes the visibility improvements between the baseline scenario and each control technology was used. The cost effectiveness for visibility improvement was determined and is presented in Tables 4-6, 7-9, 10-12, and 13-15 of Attachment 6 in the Revised SNCR BART Analysis submitted to NMED on February 11, 2011. PNM Exhibit B&V-4 summarizes the cost effectiveness of the various control technologies applicable to San Juan.

The information provided above was submitted to assist the NMED in preparing its BART determination for San Juan. As noted above, additional information recently obtained by PNM suggests that SNCR is capable of achieving a NOx emission rate of 0.23 lb/mmBtu, based on the guarantee provided by Fuel Tech, which will result in an overall reduction in NOx emissions of 4,900 tons. Those NOx emission reductions will result in visibility improvements at each of the 16 Class I areas reviewed for this BART analysis.

DISCUSSION OF THE EPA PROPOSED FIP

In addition to supporting the BART determination prepared by NMED, PNM has asked B&V to generally comment on the differences between the B&V BART analysis and the proposed BART determination for SJGS recently issued by EPA Region 6. A detailed discussion of the Region 6's BART analysis is provided in PNM's comments on the proposed FIP which are attached as PNM Exhibit PJT-2 to the pre-filed testimony of Patrick J. Themig. A brief discussion of key points is included here.

A. EPA's Cost Analysis for SCR

The costs developed by the EPA's outside consultant results in significantly lower estimated SCR costs than those estimated by B&V. B&V believes that the estimate B&V developed appropriately reflects the true costs of SCR at San Juan. B&V's estimate is based on our real-world experience in the design and construction of both SCR and SNCR controls, as listed in attached PNM Exhibit B&V-3.

Table 4 below provides summary of those cost items excluded from the EPA analysis that B&V believes are needed to properly characterize the cost of SCR:

TABLE 4: Excluded Costs in EPA Region 6 SCR Cost Analysis

Excluded Capital Cost	**Impact to SCR Cost Estimate**			
	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**
Cost of additional auxiliary power equipment	$15,053,000	$15,943,000	$21,668,000	$20,511,000
Cost of protecting the air preheater from ABS	$1,451,000	$1,451,000	$6,898,000	$6,898,000
Cost of boiler stiffening and balanced draft	$11,950,000	$11,950,000	$15,909,000	$15,909,000
Lost generation cost associated with retrofit extended outage	$15,667,000	$15,667,000	$23,674,000	$23,674,000
Cost of 3 initial catalyst layers in SCR	$7,233,000	$7,576,000	$9,570,000	$9,177,0000
Costs of sorbent injection system	$2,900,000	$2,900,000	$3,159,000	$3,159,000
Additional steel needed due to site congestion	$5,482,000	$10,086,000	$12,499,000	$7,020,000
Cost of SCR bypass to protect SCR during startup	$30,660,000	$32,166,000	$32,997,000	$30,661,000
Use of appropriate escalation factors	$4,197,000	$4,165,000	$4,687,000	$4,934,000
Direct Installation Cost estimates	$8,408,000	$8,348,000	$9,437,000	$9,437,000
"Contingency" costs	$13,315,000	$14,302,000	$17,801,000	$16,560,000
Interest During Construction costs	$16,853,000	$18,318,000	$22,481,000	$20,648,000
Total Cost Impact Per Unit	**$133,169,000**	**$142,872,000**	**$180,780,000**	**$168,588,000**
Grand Total of Impact of Excluded Costs	**$625,409,000**			

The EPA's annual cost estimate is also significantly lower than B&V's estimate for SCR. This is because the EPA also omitted significant annual operating costs from its analysis. As with the capital cost estimate, B&V believes that our estimate appropriately captures the true cost of SCR at SJGS. Table 5 below shows the impact of cost items omitted by the EPA.

Table 5 –Excluded Annual Costs

Excluded Annual Cost	Impact to SCR Cost Estimate			
	Unit 1	**Unit 2**	**Unit 3**	**Unit 4**
Decrease in auxiliary power consumption rate and cost	$1,094,000	$1,101,000	$1,586,000	$1,607,000
Impact of underestimated capital costs on annual cost	$10,733,000	$11,515,000	$14,571,000	$13,588,000
Increase in SCR life-span from 20 to 30 years	$3,263,000	$3,525,000	$4,404,000	$4,076,000
Total Cost Impact Per Unit	**$15,118,000**	**$16,169,000**	**$20,597,000**	**$19,307,000**
Grand Total of Impact of Excluded Annual Costs	**$71,191,000**			

B. EPA's Visibility Analysis

The EPA's visibility analysis shows larger visibility improvements likely to result from installing and operating SCRs at San Juan as compared to B&V's analysis, in part due to out-dated modeling techniques, and in part due to its assumption that installing SCRs at San Juan will allow each unit to achieve a NOx emission rate of 0.05 lb/mmBtu. Using more advanced modeling techniques and a more appropriate expected NOx emission rate, B&V has confirmed that the installation of SCRs at San Juan will not result in meaningful visibility improvements.

C. EPA Compliance Deadline

The EPA's proposed FIP also greatly underestimates the amount of time it will take to permit, engineer, purchase, construct, and commission SCRs for all four units at San Juan. The EPA proposal would impose a compliance deadline of three years for what would be a massive retrofit at San Juan. B&V has significant concerns about the feasibility of installing four SCR's at San Juan in accordance with the EPA compliance schedule.

This concludes the testimony of B&V in this proceeding.

DIANE M. FISCHER

Air Quality Control Project Manager

Air Quality Control

Education
Bachelors, Mechanical Engineering, Iowa State University, 1992

Professional Registration
Professional Engineer, Missouri, 1996

Total Years Experience
19

Joined Black & Veatch
1992

Language Capabilities
English

Diane Fischer is a project manager, mainly involved with AQC compliance projects. Her duties include managing compliance studies, supporting detailed design of air quality control projects with technical and process support, and maintaining updated knowledge of the regulatory environment associated with air quality compliance.

Representative Project Experience

EPC Specification Development for La Cygne Station, Kansas City Power & Light, Kansas, 2010-2011
Air Quality Control Engineer. Responsible for specification, bid evaluation, and bid negotiation associated with the SCR portion of the EPC specification for new air quality control equipment at La Cgyne Units 1 and 2.

Asbury Environmental Retrofit Project Definition, Empire District Electric Company, Missouri, 2010
Air Quality Control Engineer. B&V performed a study to determine the recommended air quality control equipment for Asbury Station to comply with potential air emissions regulations. Ms. Fischer's was responsible for all process related activities for the project, including air quality equipment selection, development of cost estimates for AQC equipment, mass balances, and identification of redundancy and sizing requirements.

BART Analysis, Public Service of New Mexico, New Mexico, 2007-2011
Project Manager. Responsible for all work on a Best Available Retrofit Technology analysis for four coal fired power plants. The analysis examined BART alternatives for NO_x and particulate matter. This study was done in response to the Federal Regional Haze requirements. After completion of the BART analysis, B&V continues to support PNM in their discussions with the regulatory agencies.

NOx Reduction Project, Hovensa LLC, St. Croix, 2009
Air Quality Control Engineer. B&V is assisting Hovensa in developing a conceptual design for the retrofit of selective catalytic reduction systems on two refinery gas/No. 6 fuel oil fired boilers. The project includes obtaining budgetary estimates for all equipment, developing layout drawings, developing system descriptions and developing flow diagrams for the project. The project also includes developing a specification for purchase of the SCR system.

NO_x Reduction Study, Entergy, Louisiana, 2009
Project Manager. B&V performed a NO_x reduction study that examined NO_x reduction technologies for one PRB-fired power plant.

Preliminary Engineering for AQC Equipment, TransAlta Utilities, Alberta 2008-2009
Engineering Manager. B&V performed a preliminary engineering assessment to determine the feasibility, layout, and balance of plant impacts for retrofit of spray dryer absorber and fabric filter for six coal-fired units in Alberta, Canada. The project included obtaining budgetary estimates for all

equipment, developing layout drawings, developing system descriptions and developing flow diagrams for the project.

New Biomass Fired Boiler, Oglethorpe Power Corporation, Georgia 2007-2010
Air Quality Control Engineer. B&V is assisting OPC in permitting of two 100 MW biomass fired boilers in Georgia. Support of the permitting including emissions calculations and air quality control technology assessment. B&V continues to support OPC in the procurement of the boiler and SO2, NOx, and PM control equipment through development of the specifications and bid evaluation.

Mercury Reduction Project, Platte River Power Authority, Colorado 2007-2009
Project Manager. Responsible for the assessment of available mercury control technologies for a coal fired power plant. The study included identifying potential technologies, developing budgetary costs, and determining the recommended technology. Based on the results of the study, B&V developed a specification for purchase of the mercury control equipment. B&V assisted the Owner in bid evaluation and award of the mercury control equipment.

SCR Retrofit Project, Saint Johns River Power Park, Florida, 2006-2009
SCR Technical Manager. Responsible for the process design associated with installing selective catalytic reduction systems on two coal-fired boilers. Duties include oversight of development of catalyst specification, ductwork design, flow model testing, startup, and performance testing.

SCR Retrofit Project; Alabama Electric Cooperative, Alabama, 2005-2008
SCR Technical Manager. SCR technical manager responsible for the process design associated with installing selective catalytic reduction systems on two coal-fired boilers.

New Coal Fired Power Plant; Wisconsin Public Service Company, Wisconsin, 2003-2008
AQC Engineer. Responsible for providing process design support associated with installing a selective catalytic reduction system on a new coal fired boiler, including contract negotiations and design review.

Mercury Technology Assessment Study, Xcel Energy, Minnesota, 2007
Project Manager. Responsible for the assessment of available mercury control technologies for four coal fired power plants. The study included characterizing existing mercury emissions, identifying potential technologies, developing budgetary costs, and determining the recommended technology.

Multi-Pollutant Study, TransAlta Utilities, Alberta, Canada, 2006-2007
Project Manager. Responsible for the economic analysis of air quality control alternatives available for eight coal fired power plants. Study included assessment of available technologies for removing SO_2, NO_x, particulate matter, mercury, and CO2. From the results of the study, an Excel

spreadsheet was developed that allowed the owner to change control alternatives based on changes to regulations.

King Plant Rehabilitation Project; Xcel Energy, Minnesota, 2004-2007
AQC Engineer. Responsible for providing process design support associated with installing a selective catalytic reduction system as part of a rehabilitation of a 600 MW coal fired boiler, including contract negotiations and design review.

Flue Gas Conditioning Study; Allegheny Energy, Pennsylvania, 2004
Project Manager. Performed a cost comparison study of flue gas conditioning alternatives for three 555 MW units.

SCR Retrofit Projects; VECTREN; Indiana, 2000-2005
SCR Technical Manager. SCR technical manager responsible for the process design associated with installing selective catalytic reduction systems on four coal-fired boilers.

SCR Retrofit Projects; NIPSCO SCR Projects; Indiana, 1999-2005
Mechanical Engineer. SCR Technical Manager responsible for the process design associated with installing selective catalytic reduction systems for four coal-fired boilers.

SCR Retrofit; Dayton Power & Light; Ohio, 1999-2004
Mechanical Engineer. Mechanical engineer responsible for detailed design of air quality control system related equipment including catalyst, dampers, ash handling, flue gas conditioning and NO_x monitoring equipment for retrofit of SCR systems at five 600 MW coal-fired boilers.

NO_x and SO_2 Emissions Reduction Preliminary Engineering Study; Confidential Client, 2003
AQC Engineering Manager. Directed the process analysis and design work associated with the AQC process design. The preliminary engineering project included preliminary design of SCR systems and SO_2 reduction using sorbent injection.

SCR Retrofit Project; City of Springfield, IL; Illinois, 2001-2003
SCR Technical Manager. SCR technical manager responsible for the process design associated with installing selective catalytic reduction systems on three coal-fired boilers.

SO_2 Emissions Reduction Study; Confidential Client, 2002
AQC Engineer. Assisting in the feasibility study of SO_2 reduction alternatives, specifically dry sorbent injection.

NO_x Reduction Consulting Services; Confidential Client; Illinois and Indiana, 2001-2002
Project Manager. Project manager responsible for the overall project. Project consisted of providing technical support regarding NO_x reduction

technologies to the client as they considered power purchase agreements with several coal-fired power plants.

FGD Retrofit Study; Confidential Client; Ohio, 2001
Project Manager. Project manager responsible for overall conceptual design and the report. A conceptual design and cost estimate was developed for retrofitting FGD equipment on a 610 MW coal-fired boiler.

NO_x Compliance Study; NIPSCO; Indiana, 1998
Mechanical Engineer. Assisted in NO_x compliance study which examined NO_x reduction technologies for seven different units.

NO_x Compliance Study; City of Holland; Holland, Michigan, 1998
Mechanical Engineer. Assisted in NO_x compliance study which examined NO_x reduction alternatives and provide recommendations based on current regulatory environment.

Material Handling Study; Iowa State University; Ames, Iowa, 1998
Mechanical Engineer. Assisted with material handling study to determine improved material handling systems for the facility.

910 Project; Union Camp Corporation; Franklin, Virginia, 1996 – 1998
Mechanical Engineer. Assisted with startup and project closeout issues related to air quality control equipment, CEM equipment, and emissions testing.

West Java Power Plant; Ansaldo Energia s.p.a.; West Java, Indonesia 1997
Mechanical Engineer. Mechanical engineer responsible for design and specification of flue gas desulfurization and particulate removal systems, ash handling, and continuous emissions monitoring equipment for a 400 MW coal-fired boiler.

Southpoint Project; Calpine; Arizona, 1997
Mechanical Engineer. Assisted in permitting for a new natural gas fired combined cycle project. Project included detailed review of emerging NO_x reduction technologies.

Lightweight Aggregate Plant; Wisconsin Electric Power Company; Wisconsin, 1997
Mechanical Engineer. Assisted in examining causes of benzene and acrylonitrile emissions at a sludge incinerating facility and assisted in determining air quality control solutions.

NO_x Compliance Study Pennsylvania and West Virginia; Allegheny Power Systems, 1997
Mechanical Engineer. Assisted in NO_x compliance study which examined NO_x reduction technologies for 11 different units.

Big Cajun II; Cajun Electric Cooperative; New Roads, Louisiana 1995 – 1997
Mechanical Engineer. Involved with specification and design of economizer ash handling system.

Big Cajun II; Cajun Electric Cooperative; New Roads, Louisiana, 1996
Mechanical Engineer. Six week onsite construction management assignment for construction of economizer as handling systems on two units.

IPP Combined Cycle Project; Dongbu Engineering and Construction Co.; Korea, 1996
Mechanical Engineer. Assisted in developing mechanical portions of a proposal. Involvement included P&ID's, system descriptions, and bill of quantities.

Iatan 2; Iatan Power Partners; Missouri, 1995 – 1996
Mechanical Engineer. Assisted in permitting of new, pulverized coal fueled boiler.

Fisk Station, Waukegan Station; Commonwealth Edison Company Chicago, Illinois, 1994 – 1996
Mechanical Engineer. Specified, designed, and administered contracts for ash handling systems.

Joppa Station; Electric Energy Inc.; Joppa, Illinois, 1993 – 1995
Mechanical Engineer. Involved with specification and design of fly ash handling systems.

Silas Ray Repowering Project; City of Brownsville; Brownsville, Texas 1994
Mechanical Engineer. Assisted in permitting of a new natural gas and fuel oil fired combustion turbine.

Cheswick and Elrama Stations; Duquesne Light Company Pennsylvania 1993 – 1994
Mechanical Engineer. Developed quality control plans and audit plans for newly installed continuous emissions monitoring systems.

Cedar Bay Cogeneration Plant; Cedar Bay Generating Company; Jacksonville, Florida, 1993 – 1994
Mechanical Engineer. Coordinated air emissions testing activities for demonstration of compliance with air permit.

Boomer Lake Station; Stillwater Utilities Authority; Stillwater, Oklahoma 1992 – 1994
Mechanical Engineer. Development of predictive NO_x emissions monitoring system. Assisted in specification development, test procedure development, and permit compliance.

DIANE M. FISCHER

Muddy River Energy Project; Muddy River Limited Partnership; Nevada 1993
Mechanical Engineer. Assisted in permitting of a new natural gas fired combustion turbine.

Coke Oven Gas Boiler; Indianapolis Power and Light; Indiana, 1993
Mechanical Engineer. Assisted in permitting of new, coke oven gas fueled boiler.

Ponca City Steam Plant; Oklahoma Municipal Power Authority; Oklahoma, 1993
Mechanical Engineer. Assisted in permitting of natural gas and fuel oil fired combustion turbine.

CEM Specifications; Various, 1993
Mechanical Engineer. Assisted in development of several continuous emission monitoring equipment specifications in response to the 1990 Clean Air Act Amendments including Hastings Utilities, Washington Water Power, Cane Island, and Kissimmee.

Morgantown Units 1 and 2, Chalk Point Units 1 and 2, Dickerson Units 1 – 3; Potomac Electric Power Cooperative; Pennsylvania, 1993
Mechanical Engineer. Examination of SO_2 emission control alternatives for three power plants.

KYLE J. LUCAS

Air Quality Scientist

Air Permitting Manager, NSR/PSD Air Permit Preparation, Clean Air Act Compliance, Meteorological and Climatological Studies, Air & Odor Dispersion Modeling, Process Hazard Analysis (Team Leader), Risk Management Plans, Compliance Audits, Environmental Impact Assessments, Air Emissions Inventory, Class I Analyses, Accidental Chemical Release, Title V Permit Preparation

Education
BS, Atmospheric Science, 1993 University of Kansas

Professional Affiliations
American Meteorological Society
Air & Waste Management Association

Total Years Experience
16

Joined Black & Veatch
1994

Language Capabilities
English

Kyle Lucas is an Air Permitting Manager assigned to Black & Veatch's Environmental Services Section. The section is responsible for all permitting activities and environmental assessment studies related to electric power generating facilities, water and wastewater treatment plants, and various other new or modified major industrial developments.

His primary responsibilities include assisting clients in developing Clean Air Act compliance strategies and managing specific air permitting and licensing projects, particularly for traditional coal-fired power plants and gas/oil combustion turbine power plants. He has dealt with all aspects of the overall air quality licensing process including strategic planning, recommendation of controls and emission limits, overseeing the preparation of atmospheric air quality impact studies and preparation of permit applications, participating in client and agency meetings, and writing applicable sections of environmental impact statements as well as studies associated with stack exhaust gas, cooling towers, and fugitive source emissions.

Mr. Lucas has been involved with the Best Available Control Technology (BACT) analyses and Maximum Achievable Control Technology (MACT) determinations and emission control selection, negotiations with local, state, and federal agencies regarding source emission levels, appropriate modeling analyses, and decisions regarding site arrangement, construction activities and fugitive dust, building/stack height options, fuel assumptions, auxiliary equipment selections, and preparation of the permit application documents and associated analyses. Mr. Lucas' air permitting experience includes various Prevention of Significant Deterioration (PSD) Air Permit Applications and associated analyses for power generating and industrial facilities throughout the United States. He has participated in developing meteorological and pollutant monitoring stations for generating stations and performed air quality assessments for facilities in the countries of El Salvador, Puerto Rico, Columbia, Korea, and Mexico.

Project highlights (detailed below) that will serve this project include Mr. Lucas' extensive involvement with LG&E and KU over the past eight years including his facilitation of the Trimble County Unit 2 air permitting. Additionally, he has completed permits for combustion turbine facilities and conducted numerous other analyses for the PSD/NSR permitting process including BACT analyses, Class I and Class II modeling demonstrations, and netting analyses.

Additionally, Mr. Lucas has participated in determining how impacts from multi-pollutant legislation can potentially affect Asset Management for electric generating sources. He identified air quality regulatory drivers impacting the value of coal fired facilities and evaluated the potential economic impact of these drivers. Drivers considered included the multi-pollutant legislation proposals in Congress, new ozone ambient air quality standard, new fine particulate and other ambient air quality standards, yet-to-be proposed Utility MACT replacement for the Clean Air Mercury Rule (CAMR), and Clean Air Transport Rule (CATR) replacement for the Clean Air Interstate Rule (CAIR), new NSPS, Best Available Retrofit Technology (BART), etc.

Mr. Lucas has facilitated Process Hazard Analyses (PHA) and Risk Management Plan (RMP) compliance audits as a Team Leader for various power generation, water, and wastewater utilities pursuant to USEPA's Chemical Accidental Prevention Provisions regulations. Additionally, assisted numerous facilities in the development of their RMP compliance program.

Before joining Black & Veatch, Mr. Lucas attended the University of Kansas where he gained experience by analyzing and interpreting meteorological variables for the campus laboratory. He also revised old course material, created videos for visual aid instruction, and developed new laboratory exercises for an introductory level atmospheric science course.

Representative Project Experience

BART Modeling and Engineering Analyses, Public Service Company of New Mexico, San Juan Generating Station
2007-Present
Air Permitting Manager. Managed the BART modeling activities and assisted with the BART engineering activities for PNM's four BART applicable units at San Juan Station. Duties included initial BART applicability review and compliance strategy, oversight of the BART Modeling, and review of the BART engineering analyses and preparation documentation for agency submittal, agency and client contact.

Air Quality Control Assessment and Cost Analysis; LG&E and KU; Kentucky
2010- Present
Assistant Project Manager and Environmental Coordinator - Following a high level Phase I study to determine order of magnitude costs for retrofit AQC equipment, LG&E and KU retained B&V to develop project definitions consisting of a conceptual design and budgetary cost estimates for selected AQC technology improvement at three of its coal fired facilities (Mill Creek, Ghent, and E.W. Brown), also called Phase II. The project is designed to determine the capital and operations and maintenance (O&M) costs of specific AQC retrofits related to environmental scenario compliance planning for future regulatory requirements. Duties included overseeing the environmental, technical, and site related activities, client discussion, coordination of reports and analyses, and presentation of material.

Maximum Available Control Technology Compliance Planning and Technical and Environmental Services; Confidential Client; Southeastern United States
2010- Present
Air Permitting Manager – Provided compliance planning services for the yet-to-be proposed Utility MACT for three coal-fired units. Services included facilitating compliance and strategy development meetings, development of emissions testing specifications for a detailed emission testing program on all units, conducting pre-bid meetings with emission testing vendors, bid evaluations, contract negotiations, oversight and coordination of emissions testing programs, determination of required air quality control equipment, oversight of associated analysis, reports, and presentation of various information.

Fleet-wide Air Quality Control Assessment and Cost Analysis; LG&E and KU; Kentucky
2010
Assistant Project Manager and Environmental Coordinator - The purpose of this

Phase I study was to develop fleet-wide, high-level, capital and O&M costs for recommend air quality control equipment necessary to meet future environmental requirements at 18 coal-fired units located at 6 facilities (E.W. Brown, Ghent, Cane Run, Mill Creek, Trimble County, and Green River). Duties included overseeing the environmental, technical, and site related activities, client discussion, coordination of analyses and reports.

Technical and Environmental Due Diligence Services; Confidential Client; Eastern Midwest
2010
Air Permitting Manager – Provided additional due diligence assessment and various updates related to certain environmental and technical performance aspects of the study assets. This information was added as an addendum to the original due diligence report Black & Veatch issued in the Fall of 2009.

BART Analyses and Technical Support, Central Arizona Water Conservation District, Navajo Generating Station
2009-2010
Project Manager. Managed the BART review and technical support activities and assisted CAWCD in the development and preparation of public comments in response to an Advance Notice of Public Rulemaking (74 FR 44313) issued by the USEPA on August 28, 2009 specifically with regard to Navajo Generating Station. Duties included review of applicable NGS BART modeling and engineering studies, and review Arizona and EPA comments and technical discussions, development of responses to support CAWCD's ANPR submittal, and presentation of information to CAWCD Board.

Technical and Environmental Due Diligence Services; Confidential Client; Eastern Midwest
2009
Air Permitting Manager – Provided additional due diligence assessment and various updates related to certain environmental and technical performance aspects of the study assets. This information was added as an addendum to the original due diligence report Black & Veatch issued in the Fall of 2008.

Technical and Environmental Due Diligence Services; Confidential Client; Eastern Midwest
2008
Air Permitting Manager – Performed an air quality environmental due diligence review for 10 facilities consisting coal-fired units, hydro facilities, and combustion turbine installations as part of a larger technical due diligence. This activity consisted in review of available permits, internal operational and compliance documentation, agency determinations as compared to facility permitted levels, operating emission levels, and external public information. Duties also included discussion of potential compliance issues with the client.

NSR/PSD Air Permitting Services, Permit Appeal, and Litigation Support; LG&E; Trimble County Generating Station; Unit 2; Kentucky
2005-2007
Project Manager – Assisted LG&E in the Unit 2 air permit appeal process for the air application that was submitted in December 2004. Additionally, supported the litigation activities initiated by Sierra Club and other environmental Groups. Duties included responding to agency and public comments, developing strategy, review of

other similar permits and responses, conducting additional air analyses as required to support the application and response package, developing testimony, and providing deposition in support of the air permit application and Unit 2 project.

NSR/PSD Air Permitting Services and Optimization Studies; LG&E; Trimble County Generating Station; Unit 2; Kentucky
2006-2007
Project Manager - Tracked design modifications to the proposed 750 MW project during engineering design and construction which were not reflected in the 2004 air permit application or the resulting final air permit. The plant modifications were analyzed and included in an amended air permit application for the facility. Detailed emission calculations, regulatory review, and cumulative source modeling was completed. At the request of the KDAQ air agency, a draft permit and Statement of Basis was developed which reflected the amended application document. Reviewed public and agency comments on the application and draft air permit and drafted responses to comments.

NSR/PSD Air Permitting Services; LG&E; E.W. Brown Generating Station; Unit 3; Kentucky
2009
Project Manager - Performed a Best Available Control Technology (BACT) review for H_2SO_4 to support KU's submittal of PSD/Title V Permit Modification for the addition of SCR for E.W. Brown Unit 3 submitted to KDAQ in July 2009. This was a complex BACT as technology review and the associated emission levels Unit 3 need to consider a retrofit verses installation of a new unit. Other duties included strategy development, client consultation, review of associated data for particulate emissions and opacity, client and agency discussion, and development of several post submittal responses to agency Notice of Deficiency requests.

NSR/PSD Air Permitting Services; LG&E; Ghent Generating Station; Units 1-4; Kentucky
2010
Project Manager - Performed a Best Available Control Technology (BACT) review for H_2SO_4 to support the response effort to the 2009 Notice of Violation (NOV) issued by EPA on March 19, 2009. The NOV indicated coincidental increases of sulfuric acid mist (H_2SO_4), exceeded the New Source Review (NSR) Prevention of Significant Deterioration (PSD) Significant Emission Rates (SERs) and were not quantified in the application process for the Unit 1, 3, and 4 SCRs. The BACT scenario reflected operating scenarios consistent with operations and installation of air quality control equipment in 2013. Additionally, detailed emission calculations were conducted for the BACT process, as well as, for three other scenarios which defined Unit operations during various phases of air quality control installations (i.e., Pre-2005, 2005, and current operations). Furthermore a H_2SO_4 white paper was developed reviewing the complexities of testing and potential errors in the testing methods. Other duties included strategy development, client consultation, review of associated data for particulate emissions and opacity, and client discussions.

Title V Air Permitting Services; LG&E; Trimble County Generating Station; Kentucky
Title V Update
2008
Project Manager - Oversaw the preparation of the Title V operating permit renewal application for the generating station. A seven-step approach was followed which

included pre-inventory review, emissions inventory compilation, regulatory characterization, development of alternate operating scenarios, source characterization/ status, determination of source compliance, prepare compliance assurance monitoring (CAM) plan.

Rick Management Plan Services; LG&E; Trimble County Generating Station; Unit 1; Kentucky
RMP Compliance Audit
2005
Project Manager - Conducted Risk Management Plan (RMP) 3-year compliance audit for their power generating station. The audit was conducted as part of the requirement under 40 CFR Part 68.

NSR/PSD Air Permitting Services; LG&E; Trimble County Generating Station; Unit 2 Auxiliary Boiler; Kentucky
BACT Update
2008
Project Manager - During the review of the Title V renewal application in December 2007, KDAQ determined that the vacatur of the Industrial Boiler MACT justified a review of the auxiliary boiler's BACT requirements. Although BACT reevaluation analyses are not required as part of a Title V renewal application and the aforementioned Trimble County Unit 2 Project auxiliary boiler had already been constructed an updated BACT review to demonstrate that the auxiliary boiler as installed represents BACT. The project consisted of conducting a regulatory review, performing a BACT and Industrial Boiler MACT analysis, emission calculations, agency discussions, development of an application document, and agency discussions.

Air Permitting Services, Confidential Client, Southeastern United States
2009
Air Permitting Manager. Managed the air related feasibility and permitting studies for a proposed 1,000 MW coal fired generation a greenfield location. Additionally, work consisted of Class I & II analyses using both CALPUFF and AERMOD while other duties included reviewing the generation of engineering design and performance information for use in the analysis, review of BACT emissions limits, air quality control technology assessment, emission calculations, and development of permitting strategy.

Due Diligence, Various Confidential Clients, Various Confidential Locations
On-going
Air Permitting Manager – Performed due diligence reviews of air permits including construction, operation, and acid rain, as well as compliance histories of numerous facilities located throughout the United States. These studies were part of a larger economic and environmental due diligence study for financing entities. These environmental due diligence reviews were requested for various purposes including potential sale/purchase of facilities, internal compliance audits, and/or refinancing of loans. Duties included client (bank), operator, and corporate office personnel contact, and review of pertinent air permit and environmental documents, and agency determinations as compared to facility permitted levels and operating emission levels. Verbal and written summary reports were also reviewed and compared to applicable documents. Summary reports were prepared and included with the overall project findings for the financial review.

PSD Air Permitting Services, Interstate Power and Light Co., Sutherland Generating Station
2007
Air Permitting Manager. Assisted with the feasibility analyses and air permitting activities for a proposed 600 MW supercritical pulverized coal-fired unit addition the existing Sutherland Generating Station in Central Iowa. Duties included assessing Class II criteria pollutant impacts, emissions and visibility calculations, preparation of the BACT analysis, permitting strategy, supervision of air dispersion modeling, review of engineering design and performance information, and preparation of PSD air permit application document. Also, responsible for contact and coordination of activities with the client and state permitting agencies.

BART Modeling Analyses, Louisville Gas & Electric, Cane Run, Mill Creek, Ghent, and E.W. Brown Generating Stations
2006-2007
Air Permitting Manager. Managed the BART modeling and engineering activities for LG&E's 10 BART applicable units at four generating stations. The project was able to exempt three facilities and six units from BART requirements and conducted engineering and modeling studies for four units at the Mill Creek Generating Station. Duties included initial BART applicability modeling and BART permitting strategy, review of the VISTAS BART protocols and associated analyses, gathering of appropriate source information, and preparation documentation for agency submittal, agency and client contact.

PSD Air Permitting Services, LG&E, Trimble County Generating Station
2003-2005
Project Manager. Managed the feasibility analyses and air permitting activities for a proposed 750 MW supercritical pulverized coal-fired unit addition the existing Trimble County Generating Station in Northern Kentucky. Duties included assessing Class II criteria pollutant impacts as well as conducting class I analyses, netting analyses, emissions and visibility calculations, preparation of the MACT and BACT analysis, permitting strategy, supervision of air dispersion modeling, review of engineering design and performance information, and preparation of PSD air permit and combined Title V application document. Also, responsible for contact and coordination of activities with the client, subcontractors, state and federal permitting agencies, and US National Park Service. Post submittal activities included drafting both the air construction and operating permit, agency negotiation, response to public and agency comments, and support through litigation with the Sierra Club including response to interrogatories, depositions and expert testimony. Additionally, oversaw the air permitting activities for design optimizations during construction activities and follow-up activities with the state agency including drafting both the air construction and operating permit.

BART Modeling and Engineering Analyses; Basin Electric Power Cooperative; Laramie River Generating Station; Wyoming
2006-2009
Air Permitting Manager. Managed the BART modeling activities and assisted with the BART engineering activities for Basin's three BART applicable units at Laramie River Station. Duties included initial BART applicability review and

compliance strategy, oversight of the BART Modeling, and review of the BART engineering analyses and preparation documentation for agency submittal, agency and client contact.

BART Modeling Analyses, Alabama Electric Cooperative, Inc., Charles R. Lowman Generating Station
Air Permitting Manager. Managed the BART modeling activities for AEC's three BART applicable units. Duties included initial BART applicability modeling and BART permitting strategy, review of the VISTAS BART protocols and associated analyses, gathering of appropriate source information, and preparation documentation for agency submittal, agency and client contact.

New Source Review Modification and Emissions Netting Analysis, Basin Electric Power Cooperative, Leland Olds Station
Air Permitting Manager. Managed the NSR modification and emissions netting feasibility activities for proposed facility modifications. Duties included developing a plant historical emissions database, determination of NSR/PSD modification applicability, netting calculations, and permitting strategy.

Air Permitting Services, Confidential Client, Southeast
Air Permitting Manager. Managed the air siting and feasibility studies for a proposed 1,000 MW coal fired or Integrated Gasification Combined Cycle (IGCC) generation addition and 480 MW of simple cycle combustion turbine generation at multiple new Greenfield and existing facility locations. The coal fired addition included four fuel options and three boiler technologies and associated air quality control equipment while the turbine study focused on four fast-start turbine models. Additionally, the siting study consisted of Class I & II analyses using both CALPUFF and AERMOD, a proximity scoring system to appropriately rank each proposed site. The study focused on 10 coal/IGCC and 13 simple cycle candidate sites. Other duties included reviewing the generation of engineering design and performance information for use in the analysis, review of BACT emissions limits, air quality control technology assessment, emission calculations, and development of permitting strategy.

PSD Air Permitting Services, Tri-State Generation & Transmission Inc. and Sunflower Electric Power Corporation, Holcomb Generating Station
Air Permitting Manager. Black & Veatch was retained as Owner's Engineer for the proposed 2,100 MW (3 x 700 MW) coal fired addition. Duties included review of emission calculations, BACT analysis, air modeling and other associated analysis and documents for the air permit activities. Details from the air permitting were applied to associated project equipment and vendor contracts and specifications. Additionally, assisted in post submittal activities which included response to public (Sierra Club) and agency comments.

PSD Air Permitting Services, Alabama Electric Cooperative, Inc., Charles R. Lowman Generating Station
Air Permitting Manager. Managed the air permitting activities for AEC's air pollution control project at their coal-fired plant. The project will be permitted under the Alabama PSD air rules under provisions for "Environmentally Beneficial Activities". Duties included initial feasibility studies and permitting

strategy, preparation of an air permit application, as well as development of representative operating scenarios and modeling parameters, agency and client contact, and supervision of complex air dispersion modeling analyses.

Multi-Pollutant Legislation Impacts on Asset Management, Confidential Client, Southeast
Air Permitting Manager. Identified air quality regulatory drivers impacting the value of coal fired facility and evaluated the economic impact of these drivers. Drivers considered include the multi-pollutant legislation proposals in Congress, new ozone ambient air quality standard, new fine particulate ambient air quality standard, mercury Maximum Achievable Control Technology (MACT) standards, and Clean Air Interstate Rule (CAIR).

Multi-Pollutant Legislation Impacts on Asset Management and NSR Violation Compliance, Confidential Client, Midwest
Air Permitting Manager. Identified air quality regulatory drivers impacting the value of coal fired utility portfolio and evaluated the economic impact of these drivers. Drivers considered include local metropolitan air quality issues, the multi-pollutant legislation proposals in Congress, new ozone ambient air quality standard, new fine particulate ambient air quality standard, mercury Maximum Achievable Control Technology (MACT) standards, and Interstate Air Quality Rule (IAQR). Additionally, worked with the client to developed compliance strategy options using results from the aforementioned analysis that could satisfy EPA with regard to identified NSR violations (NSR 114 letter).

Due Diligence Air Permitting Assessment, NRG Corporation, St. Paul Minnesota
Air Permitting Manager. Due diligence air quality review for multiple NRG coal, oil, and gas facilities located in the northeastern US. This study was part of a larger economic and environmental due diligence study for a financing entity. Duties included client (bank), operator, and corporate office personnel contact, and review of pertinent air permit documents, and agency determinations as compared to facility permitted levels and operating emission levels. Verbal and written summary reports were also reviewed and compared to applicable documents. Summary reports were prepared and included with the overall project findings for the financial review.

New Source Review Modification and Emissions Netting Analysis, Westar Energy
Senior Air Quality Scientist. Performed the NSR modification and emissions netting calculations for proposed facility modifications at three coal fired facilities. Duties included developing a plant historical emissions database, determination of NSR/PSD modification applicability, netting calculations, and permitting strategy.

Multi-Pollutant Legislation Impacts on Asset Management, Confidential Client, Eastern Midwest
Senior Air Quality Scientist. Assisted in identifying air quality regulatory drivers impacting the value of coal-oil-gas fired utility portfolio and evaluated the

economic impact of these drivers. Drivers considered include the multi-pollutant legislation proposals in Congress, new ozone ambient air quality standard, new fine particulate ambient air quality standard, and mercury Maximum Achievable Control Technology (MACT) standards.

Multi-Pollutant Legislation Impacts on Asset Management, Confidential Client, Northern Midwest
Senior Air Quality Scientist. Assisted in identifying air quality regulatory drivers impacting the value of coal-oil-gas fired utility portfolio and evaluated the economic impact of these drivers. Drivers considered include the multi-pollutant legislation proposals in Congress, new ozone ambient air quality standard, new fine particulate ambient air quality standard, and mercury Maximum Achievable Control Technology (MACT) standards.

PSD Air Permitting Services, City Utilities of Springfield Missouri and Tenaska Corporation, Southwest Power Station
Air Permitting Manager. Conducted a due diligence review of the air permit application document and associated analyses for a coal fired boiler addition to the Southwest Power Station as well as an associated and competing coal fired power project proposed by Tenaska Corporation of Omaha, Nebraska. Tasks included review and comparison of the Best Available Control Technology (BACT) analysis, the PSD Air Permit Application, representative coal (fuel) analysis and facility operating parameters (boiler, material handling, air quality control systems), calculation of worst case operating scenarios, emissions and visibility calculations, air dispersion modeling, and Class I regional haze analyses for several Class I areas. Duties also included contact with owners, state and federal air permitting agencies, two consultant/engineering companies, and the federal land managers.

PSD Air Permitting Services, Peabody Energy, Prairie State Generating Station
Air Permitting Manager. Managed associated feasibility studies and air permitting activities for a 1,500 MW mine-mouth pulverized coal-fired power plant. Duties included assessing Class II criteria pollutant impacts as well as conducting class I analyses, supervising the generation of engineering design and performance information for use in air permitting (boiler, material handling, air quality control systems, etc.), emissions and visibility calculations, preparation of the MACT and BACT analysis, permitting strategy, supervision of air dispersion modeling, and preparation of PSD air permit application document for submittal of initial air permit application. Also responsible for contact and coordination of activities with the client, subcontractors, and state and federal permitting agencies.

PSD Air Permitting Services, Peabody Energy, Mustang Generation Station
Air Permitting Manager. Managed associated feasibility studies and the air permitting activities for a proposed 300 MW mine-mouth pulverized coal-fired power plant. Duties included assessing Class II criteria pollutant impacts as well as conducting class I analyses simultaneously at seven Federal PSD Class I areas, determination of the project's associated relationship to a proposed coal mine (i.e., support facility or secondary emissions source), supervising the generation of engineering design and performance information for use in air permitting (boiler,

material handling, air quality control systems, etc.), complex regional haze modeling, emissions and visibility calculations, preparation of the MACT and BACT analysis, permitting strategy, supervision of air dispersion modeling, assisted in the development and siting of a meteorological monitoring system, and preparation of PSD air permit application document for submittal of initial air permit application.. Also responsible for contact and coordination of activities with the client, subcontractors, the state permitting agency, USEPA - Region VI, the US National Park Service and US Forest Service.

PSD Air Permitting Services, Peabody Energy, Southwestern United States
Air Permitting Manager. Managed the preparation of a complex feasibility study for a proposed 1,000 MW mine-mouth pulverized coal-fired power plant. The study included assessing Class II criteria pollutant impacts as well as conducting Class I regional haze analyses simultaneously at six Federal PSD Class I areas. Duties included supervising the generation of engineering design and performance information for use in air permitting (boiler, material handling, air quality control systems, etc.), determination of the project's associated relationship to a proposed coal mine, complex mitigation of impacts for on-site public receptors, oversight of preliminary BACT and MACT analyses, permitting strategy, supervision of air dispersion modeling. Also responsible for contact and coordination of activities with the client, subcontractors, and state and federal permitting agencies.

PSD Air Permitting Services, Peabody Energy, Thoroughbred Generating Station
Air Permitting Manager. Assisted with associated air permitting activities for a 1,500 MW mine-mouth pulverized coal-fired power plant. Duties included review of engineering performance and air quality control data, review of Class I analyses, emissions calculations, permitting strategy, and interaction with permitting authorities and consultants.

PSD Air Permitting Services, Public Service Company of Colorado, Colorado
Air Quality Scientist. Performed an ambient air quality impact analysis for a coal-fired power plant at the Hayden Station Power Station in Hayden, Colorado. Duties included calculation of worst-case operation scenarios using the current and future pollution control equipment, fugitive emission inventory and emission calculations, and preparation of the impact assessment report. An analysis was performed to determine if the existing stack configurations at the facility could be used in the pollution control project. Additionally, on-site meteorological data from a nearby station was processed using MPRM and used in air dispersion modeling to assess impacts in the class II area as well as at Mount Zirkel.

PSD Air Permitting Services Morgan Stanley Dean Witter, Alabama Facility, New York
Air Permitting Manager. Managed the air permitting activities for two phases of a combustion turbine power project in Northeastern Alabama. Phase I consisted of three simple cycle combustion turbines (500 MW), while Phase II (the final phase) consisted of six combined cycle combustion turbines (1,500 MW). Duties included gathering of representative operating scenarios and parameters, agency and client contact, supervision of air dispersion modeling, MACT and BACT analyses, and preparation of the PSD air permit application document.

Air Permitting Services – Jacksonville Electric Authority (JEA), Brandy Branch Facility, Jacksonville, Florida
Air Permitting Manager. As part of a site and technology evaluation study air permitting analyses were conducted for up to 500 MW of peaking power at three sites, 250 MW of base load power at two sites, and analyzed repowering an existing steam turbine. Project analyzed potential technology and operating scenarios which regard to air quality regulations. The project also conducted refined Class II and Class I analyses to aid in differentiating potential sites and technologies.

PSD Air Permitting Services, Orlando Utility Commission (OUC) in cooperation with Kissimmee Utility Authority (KUA) and Florida Municipal Power Authority (FMPA), Stanton Energy Center, Florida
Air Permitting Manager. Managed the preparation of a PSD Air Permit Application for two combined cycle combustion turbines, as well as air quality and environmental impact analyses in support of the project's Site Certification Application (SCA) under Florida's Electrical Power Plant Siting Act. Duties included the gathering of representative operating parameters (manufacturer's guarantees), agency and client contact, calculation of worst-case operating scenarios, oversight of the BACT analysis, permitting strategy, supervision of air dispersion modeling and preparation of air impact assessment report, and conducting Class I analyses. Additionally, presented expert testimony for air quality related issues for the PSD application at the State of Florida's SCA public hearing.

Chlorine Risk Management Plan, City of Lakeland Florida, C. W. Combee Water Treatment Plant, Florida
Senior Air Quality Scientist. The C. W. Combee Water Treatment Plant is a new water treatment facility that uses chlorine for disinfection as part of the water treatment process. Black & Veatch's responsibilities included developing the draft chlorine Risk Management Plan for compliance with known federal and state requirements, and conducting a Hazard Review of the chlorine unloading, storage, and transfer system, in accordance with 40 CFR, Part 68.

PSD Air Permitting Services – Jacksonville Electric Authority (JEA), Brandy Branch Facility, Jacksonville, Florida
Air Permitting Manager. Analyzed and permitted the fuel oil operating scenarios which allowed the facility greater operation flexibility while still remaining in compliance with applicable air quality standards. Preparation of the complete Air Permit Application for fuel oil flexibility one simple cycle and two combined combustion turbines, which included a refined Class I analyses using CALPUFF and permit application forms.

PSD Air Permitting Services – Abbott/Upjohn Pharmaceutical, Pharmacia Cogen – Central Utilities Project (CUP), Puerto Rico
Air Quality Scientist. Conducted several air quality impact analysis study for proposed simple and combined cycle combustion turbines located centrally to several pharmaceutical facilities. Duties included calculation of worst-case operation scenarios using manufacturer's operating parameters, agency contact, client meetings and site investigation in Puerto Rico, air dispersion modeling analyses, and preparation of the air impact assessment report.

PSD Air Permitting Services – Kissimmee Utility Authority (KUA), Cane Island Unit 3, Kissimmee, Florida
Air Quality Scientist. Preparation of a PSD Air Permit Application for one combined cycle combustion turbine, as well as air quality and environmental impact analyses in support of the project's site certification application (SCA) under Florida's Electrical Power Plant Siting Act. Project also required refined Class I analyses using CALPUFF.

PSD Air Permitting Services – Florida Power and Light Company, Wiscasset (Mason Station) and Cousins Island (Wyman Station), Maine
Air Quality Scientist. Preparation of a PSD and NAAQS Air Permit Application for combined cycle combustion turbine new power additions at each plant--four CCCT/HRSGs at Mason Station and seven CCCT/HRSGs at Wyman Station. Additionally these project required visibility and regional haze analyses.

Title III Risk Management Program Development and Compliance Audits
Project Manager. Facilitated over 40 Process Hazard Analyses (PHA) and Risk Management Plan compliance audits as a Team Leader for various power generation, water, and wastewater utilities pursuant to USEPA's Chemical Accidental Prevention Provisions regulations.

Title V Air Permitting Services, Electric Utilities
Air Quality Scientist. Preparation of Title V operating permit applications for several fossil- fueled power generating facilities located in Kansas and Missouri. Additionally, he has also assisted in the completion of Title V operating permit applications for similar type facilities located in Montana, North Dakota, South Dakota, and Wyoming. This assistance has included site inspections/audits, development of emission inventory computer spreadsheets, completion of application forms, and preparation of drawings and other supporting documentation required for the permit application.

PNM EXHIBIT B&V-3

B&V has substantial experience with the design and construction of NO_x reduction systems on coal-fired electrical generating units. B&V has designed and built many SCRs. Below is a list of some of the SCR projects that have been designed and built by B&V.

Client	Unit	Capacity (MW)	Combustion Process / Fuel	Year In Service
NIPSCO	Bailly Unit 7	175	Cyclone/Coal	2008
SJRPP	St. John River Power Park	2 x 670	PC/Coal Pet Coke	2008
Alabama Electric Cooperative, Inc.	Lowman Units 2 & 3	2x250	PC/Coal	2007
IPL	Harding Street Station Unit 7	460	PC/Coal	2005
Vectren	A. B. Brown Units 1 & 2	2 x 265	PC/Coal	2004 / 2005
NIPSCO	Bailly Unit 8	360	Cyclone/Coal	2004
ALCOA	Warrick Unit 4	320	PC/Coal	2004
Dayton Power & Light	J. M. Stuart Station Units 1-4	4x600	PC/Coal	2003 – 2004
Dayton Power & Light	Killen Station Unit 2	600	PC/Coal	2003
NIPSCO	Schahfer Unit 14	431	Cyclone/Coal	2003
Vectren	Culley Unit 3	255	PC/Coal	2003
City of Springfield, IL	Dallman Units 21 & 32	80 (each)	Cylcone/Coal	2003
City of Springfield, IL	Dallman Unit 33	190	PC/Coal	2003
NIPSCO	Michigan City Unit 12	470	Cyclone/Coal	2002
Associated Electric Cooperative, Inc.	New Madrid Station Unit 1 & 2	638 (each)	Cyclone/Coal	2000 / 2001

PNM EXHIBIT B&V-3

Below is a list of B&V's experience with SNCR.

Client	Unit	Capacity (New MW)	Combustion Process / Fuel	Year In Service
Jacksonville Electric Authority	Northside Units 1 and 2	2 x 275	CFB/Coal and Pet Coke	2002
CMS Generation	Genesee Power Station	35	Stoker/Wood	1996
CMS Generation	Grayling Generating Station	40	Stoker/Wood	1993
IPL	Harding Street Station Unit 5	110	PC/Coal	2003
IPL	Harding Street Station Unit 5	110	PC/Coal	2004
AES Barbers Point	Barbers Point Cogeneration Plant	180 (2 CFBs)	CFB/Coal	1992
Michigan State University	T. B. Simon Boiler 4	45	CFB/Coal	1992
Kerr McGee	Argus Cogeneration Project	100	CFB/Coal	1990

NM EXHIBIT B&V-4

PNM SJGS BART Analysis - Cost Analysis (Draft)

Technology: Selective Non-Catalytic Reduction - SJGS Unit 1 & 2

Date: 1/24/2011

Cost Item	$	Remarks/Cost Basis				
CAPITAL COST						
Direct Costs						
Purchased equipment costs						
SNCR system scope:	*$4,962,000*	*From vendor quote (FuelTech), escalated by 16 percent, per email from Fuel Tech dated 1/23/2011*				
Reagent delivery system						
Wall injectors and multiple nozzle lances						
Automatic injector and lance retract system						
Flue gas temperature monitors						
Reagent storage tank	$100,000	B&V cost estimate				
NOx monitoring system	$220,000	B&V cost estimate				
Electrical system upgrades	$189,000	B&V cost estimate				
Instrumentation and control system	$279,000	B&V cost estimate				
Subtotal capital cost (CC)	$5,750,000					
Gross Receipt Tax	$355,781	(CC) X	6.2%			
Freight	$287,500	(CC) X	5.0%			
Total purchased equipment cost (PEC)	$6,393,000					
Direct installation costs						
Foundation & supports	$639,000	(PEC) X	10.0%			
Handling & erection	$1,918,000	(PEC) X	30.0%			
Electrical	$639,000	(PEC) X	10.0%			
Piping	$160,000	(PEC) X	2.5%			
Insulation	$0	(PEC) X	0.0%			
Painting	$0	(PEC) X	0.0%			
Demolition	$320,000	(PEC) X	5.0%			
Relocation	$128,000	(PEC) X	2.0%			
Total direct installation costs (DIC)	$3,804,000					
Air preheater modifications	$1,071,000	B&V cost estimate				
Site preparation	$0	N/A				
Buildings	$0	N/A				
Total direct costs (DC) = (PEC) + (DIC)	$11,268,000					
Indirect Costs						
Engineering	$789,000	(DC) X	7.0%			
Owner's cost	$563,000	(DC) X	5.0%			
Construction management	$1,127,000	(DC) X	10.0%			
Start-up and spare parts	$338,000	(DC) X	3.0%			
Performance test	$100,000	(DC) X	Engineering estimate			
Contingencies	$2,254,000	(DC) X	20.0%			
Total indirect costs (IC)	$5,171,000					
Interest During Construction (IDC)	$609,000	[(DC)+(IC)] X	7.41%		1 years (project time length X 1/2)	
Total Capital Investment (TCI) = (DC) + (IC) + (IDC)	$17,048,000					
ANNUAL COST						
Direct Annual Costs						
Fixed annual costs						
Operating labor	$125,000		1 FTE and	124,862 $/year		Estimated manpower level
Maintenance labor and materials	$338,000	(DC) X	3.0%			
Total fixed annual costs	$463,000					
Variable annual costs						
Reagent	$1,417,000		906 lb/hr and	420 $/ton		Engineering estimate
Auxiliary and ID fan power	$36,000		80 kW and	0.061 $/kWh		Estimate in vendor quote
Water	$6,000		39 gpm and	0.33 $/1,000 gal		Engineering estimate
Total variable annual costs	$1,459,000					
Total direct annual costs (DAC)	$1,922,000					
Indirect Annual Costs						
Cost for capital recovery	$1,660,000	(TCI) X	9.74%	CRF at 7.41% interest & 20 year life		
Total indirect annual costs (IDAC)	$1,660,000					
Total Annual Cost (TAC) = (DAC) + (IDAC)	$3,582,000					

PNM SJGS BART Analysis - Cost Analysis (Draft)

Technology: Selective Non-Catalytic Reduction - SJGS Unit 3 & 4 **Date:** 1/24/2011

Cost Item	$	Remarks/Cost Basis				
CAPITAL COST						
Direct Costs						
Purchased equipment costs						
SNCR system scope:	*$6,462,000*	*From vendor quote (FuelTech), escalated by 15 percent, per email from Fuel Tech dated 1/23/2011*				
Reagent delivery system						
Wall injectors and multiple nozzle lances						
Automatic injector and lance retract system						
Flue gas temperature monitors						
Reagent storage tank	$100,000	B&V cost estimate				
NOx monitoring system	$220,000	B&V cost estimate				
Electrical system upgrades	$242,000	B&V cost estimate				
Instrumentation and control system	$291,000	B&V cost estimate				
Subtotal capital cost (CC)	$7,315,000					
Gross Receipt Tax	$452,616	(CC) X	6.2%			
Freight	$365,750	(CC) X	5.0%			
Total purchased equipment cost (PEC)	$8,133,000					
Direct installation costs						
Foundation & supports	$813,000	(PEC) X	10.0%			
Handling & erection	$2,440,000	(PEC) X	30.0%			
Electrical	$813,000	(PEC) X	10.0%			
Piping	$203,000	(PEC) X	2.5%			
Insulation	$0	(PEC) X	0.0%			
Painting	$0	(PEC) X	0.0%			
Demolition	$407,000	(PEC) X	5.0%			
Relocation	$163,000	(PEC) X	2.0%			
Total direct installation costs (DIC)	$4,839,000					
Air preheater modifications	$1,071,000	B&V cost estimate				
Site preparation	$0	N/A				
Buildings	$0	N/A				
Total direct costs (DC) = (PEC) + (DIC)	$14,043,000					
Indirect Costs						
Engineering	$983,000	(DC) X	7.0%			
Owner's cost	$702,000	(DC) X	5.0%			
Construction management	$1,404,000	(DC) X	10.0%			
Start-up and spare parts	$421,000	(DC) X	3.0%			
Performance test	$100,000	(DC) X	Engineering estimate			
Contingencies	$2,809,000	(DC) X	20.0%			
Total indirect costs (IC)	$6,419,000					
Interest During Construction (IDC)	$758,000	[(DC)+(IC)] X	7.41%	1 years (project time length X 1/2)		
Total Capital Investment (TCI) = (DC) + (IC) + (IDC)	$21,220,000					
ANNUAL COST						
Direct Annual Costs						
Fixed annual costs						
Operating labor	$125,000		1 FTE and	124,862 $/year		Estimated manpower level
Maintenance labor and materials	$421,000	(DC) X	3.0%			
Total fixed annual costs	$546,000					
Variable annual costs						
Reagent	$2,201,000		1,408 lb/hr and	420 $/ton		Engineering estimate
Auxiliary and ID fan power	$36,000		80 kW and	0.061 $/kWh		Estimate in vendor quote
Water	$9,000		60 gpm and	0.33 $/1,000 gal		Engineering estimate
Total variable annual costs	$2,246,000					
Total direct annual costs (DAC)	$2,792,000					
Indirect Annual Costs						
Cost for capital recovery	$2,067,000	(TCI) X	9.74%	CRF at 7.41% interest & 20 year life		
Total indirect annual costs (IDAC)	$2,067,000					
Total Annual Cost (TAC) = (DAC) + (IDAC)	$4,859,000					

PNM EXHIBIT "D"
TO NOTICE OF INTENT

Gradient
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Peter A. Valberg, Ph.D., Fellow ATS
Principal
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Areas of Expertise

Public health, inhalation toxicology, epidemiology, human health risk assessment, risk communication, indoor / outdoor air quality, comparative toxicology, modeling of human exposure and retained dose, health effects of ionizing and non-ionizing radiation.

Education

M.S., Human Physiology and Inhalation Toxicology, Harvard School of Public Health.

Ph.D., Physics, Harvard University, Graduate School of Arts and Sciences.

M.A., Physics, Harvard University.

A.B., Physics and Mathematics, *summa cum laude*, Taylor University.

Professional Experience

2001 – Present (and 1990 – 1998) GRADIENT, Cambridge, MA
Principal. Environmental consulting practice includes inhalation toxicology, environmental health, human health risk assessment, use of epidemiology in public health decisions, health effects of airborne gases and particles, and health effects of ionizing and non-ionizing radiation.

1998 – 2000 CAMBRIDGE ENVIRONMENTAL, INC., Cambridge, MA
Senior Scientist.

1985 – 2000 HARVARD SCHOOL OF PUBLIC HEALTH, Boston, MA
Associate Professor of Human Physiology. (Adjunct, after 1990) Research work included: (1) human health effects of air toxics, (2) lung macrophage function measured with magnetic particles, and (3) lung deposition and clearance of radioactive tracer particles.

1987 INSTITUTE OF OCCUPATIONAL HEALTH, Helsinki, Finland
Visiting Researcher. Developed a magnetometric assay to be used for studying pulmonary macrophage function for lung cells lavaged from human subjects.

1984 INHALATION TOXICOLOGY RESEARCH INSTITUTE, Albuquerque, NM
Visiting Scientist. Examined the effect of exercise and hypercapnia on deposition, lung clearance, and lung distribution of inhaled radioactive aerosol.

1976 – 1985 HARVARD SCHOOL OF PUBLIC HEALTH, Boston, MA
Assistant Professor of Respiratory Physiology.

1970 – 1976 AMHERST COLLEGE, Amherst, MA
Assistant Professor of Physics.

Professional Activities

- National Academy of Sciences and National Research Council, Evaluating Health-Risk-Reduction Benefits of US EPA Regulations (2001 – 2003).
- Harvard School of Public Health: Research Advisory Committee Member for NIH-Sponsored Research on "Mechanisms of mortality/morbidity due to air particulate" (1997 – 2005).
- Member of the Committee on Man and Radiation (COMAR) (1999 – 2006).
- Health Effects Institute, Cambridge, MA, *ad hoc* reviewer (1984 – 1994).
- National Research Council, Commission on Life Sciences: Committee on Passive Smoking (1986 – 1988).
- Editorial Board, *Journal of Aerosol Medicine* (1987 – 2000).
- Center for Indoor Air Research, grant-application reviewer (1989 – present).
- NIOSH: Environmental Center Grants, Site Visit Delegation (1990).
- NIH Reviewer: Cardiovascular and Pulmonary Study Section, Radiation Study Section, and Health of the Population Study Section.
- DOE: Office of Health and Environmental Research, reviewer.
- Harvard Center for Risk Analysis: Review of Cellular Telephones (1994 – 1999).
- Physical and Biological Sciences Study Committee, Town of Needham Planning Board.

Professional Affiliations

Fellow of the Academy of Toxicological Sciences • Society of Toxicology (full member) • International Society for Environmental Epidemiology • Society for Risk Analysis • Health Physics Society (full member) • Sigma Xi • American Association for the Advancement of Science • American Conference of Governmental Industrial Hygienists (associate member)

Projects *(abbreviated)*

Carbon Black Manufacturers: Evaluated the toxicology and epidemiology of carbon black inhalation and ingestion.

Charter School in Washington, DC: Prepared a health risk assessment for the school board on the health risks of handling asbestos-containing materials that might release fibers.

City of Newton Health Department: Measured RF levels from a local transmitting antenna, reviewed RF field calculations, and provided scientific literature critique on RF health effects.

Confidential Client: Prepared a risk assessment for a Massachusetts landfill containing both chemical and radioactive waste and including multiple pathways of contaminant uptake by a trespasser.

Confidential Client: Prepared a model predictive of asbestos fiber drift and inhalation health hazard applicable to industrial processes where asbestos-containing materials are used.

Confidential Clients: Prepared an analysis of relative risks of TCE in drinking water *versus* health hazards from background levels of chemicals in air, water, and soil, as well as other routine risks to life and health.

Electric-Power Generating Companies: Prepared and delivered expert reports and public testimony on the potential health effects of airborne emissions from coal fired, gas-fired, oil-fired, and wood-fired electric utility power generating plants.

Electric Power Research Institute: Reviewed and analyzed the mechanisms by which biological systems may be affected by environmental electric and magnetic fields (EMFs). Organized a public workshop on the causes and characteristics of childhood leukemia.

Engine Manufacturers Association: Evaluated US EPA and California EPA health assessment documents on the potential carcinogenicity of diesel exhaust and ambient air particulate matter.

Harvard School of Public Health: Continuing Education for Professionals: Prepared material on special topics on inhalation toxicology for graduate students and health professionals. Presented lectures on risk assessment and risk communication.

Health Effects Institute: Prepared an analysis entitled "Ozone Molecular Dosimetry and Interaction with Biological Macromolecules."

Health Effects Institute: Organized, supervised, and documented a feasibility study for the Health Effects Institute initiating a national research program on the health effects of electric and magnetic fields.

Manufacturing Company: Analyzed multi-pathway human health risk for a site contaminated with polychlorinated biphenyls (PCBs) and chlorinated organic solvents. Analyzed experimental data to derive a fraction of PCBs that are picked up from concrete when touching the concrete.

Manufacturing Company/FUSRAP Site: Prepared a radionuclide health risk assessment and site management plan for site contaminated by nearby storage of uranium ore.

Massachusetts Department of Public Health: Prepared a public communications essays on what citizens can do to support improved air quality.

Medical Product Manufacturer: Prepared a risk assessment for air toxics produced during malfunction of a medical device used to assist breathing.

Michigan Occupational and Environmental Medical Association (MOEMA): Prepared and delivered a risk assessment tutorial for MOEMA's Continuing Education program.

Mining Company: Evaluated the epidemiological basis for the toxicity of arsenic in soils. Evaluated metals toxicity factors and site-specific bioavailability of metals.

National Institute of Environmental Health Sciences – Division of Research Grants: Reviewed grant applications for the Radiation Study Section Panel on Health-Effects Research.

National Institute of Environmental Health Sciences / Environmental Protection Agency: Asbestos Workshop, assisted in the review of the summary publication, "A Science-Based Examination of Asbestos and Related Mineral Fibers".

Navy Occupational Health and Preventive Medicine Program: Prepared and delivered seminars and workshops to US Navy medical personnel on the current research on EMFs.

New Mexico Environmental Department: Prepared a health risk assessment for measured and modeled concentrations of 80 airborne chemicals in Albuquerque, NM.

Refineries in US and Canada: Prepared a multi-pathway human health risk assessment for air emissions from petroleum refineries. The risk assessment process was monitored by task forces composed of regulators, educators, union members, and local officials.

School District on Long Island: Assessed possible environmental, occupational, and lifestyle risk factors for early-term miscarriage.

University of Denver: Analyzed the potential health impact of uranium disposal from munitions testing ("depleted uranium") as it was practiced in the 1960s and 1970s.

Uranium Mill: Evaluated the health implications of radioactive substance migration as predicted by different US EPA and DOE models.

US Department of Energy: Prepared a risk communication strategy for a nuclear test site where detonation of underground atomic devices had the potential to contaminate groundwater.

US Department of Justice: Prepared an analysis of the health hazards of the Love Canal Superfund site (Niagara Falls, NY).

US Department of Justice: Prepared a report and provided expert testimony on human toxicology with regard to soil contamination at a RCRA site.

US Department of Justice: Prepared reports and provided expert testimony in several different cases on asbestos, sulfuric acid, and airborne particulate inhalation toxicology.

US Environmental Protection Agency: Provided US EPA with a peer review (scientific critique) of the agency's draft guidance on risk assessment for VOC's present in household water..

US Environmental Protection Agency: Provided US EPA with a peer review (scientific critique) of the agency's draft reference concentration (RfC) methodology for risk assessment.

US Environmental Protection Agency: Analyzed the health risks of a remediation alternative at the Bloody Run Creek section of the Hyde Park Landfill superfund site (Niagara Falls, NY).

US Environmental Protection Agency, Health Effects Research Laboratory: Assisted in preparing a database of non-cancer health effects for 189 Hazardous Air Pollutants.

US Environmental Protection Agency, Environmental Criteria and Assessment Office: Evaluated research proposals on "Indoor and Ambient Air Risk Assessment Methodologies."

Utility: Analyzed the relationship between inhaled carbon monoxide concentration and blood carboxyhemoglobin. Performed sensitivity analysis on all the variables involved.

Waste Management Company: Evaluated health risks for a medical waste incinerator, including a multiple-pathway (ingestion, inhalation, dermal, mothers' milk) health risk assessment.

World Health Organization: Helped prepare a WHO research report on EMF health effects. Presented a lecture on EMF health effects at a WHO workshop in Geneva, Switzerland. Published review article on RF health effects.

Academic Research Projects *(abbreviated)*

National Heart, Lung, and Blood Inst.:	"Physical Determinants of Lung Function and Dysfunction."
National Heart, Lung, and Blood Inst.:	"Pulmonary SCOR: Chronic Diseases of the Airways."
National Cancer Institute:	"Magnetic Field Effects on Macrophages."
National Inst. of Environ. Health Sci.:	"Inhaled Particle Retention in Normal and Diseased Lungs."
National Heart, Lung, and Blood Inst.:	"Particle Location and Ingestion by Lung Macrophages."
National Inst. of Environ. Health Sci.:	"Factors Influencing Deposition of Inhaled Aerosols."

Publications – *Articles*

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Valberg, PA; Long, CM. 2011. "Do brain cancer rates correlate with ambient exposure levels of criteria air pollutants or hazardous air pollutants (HAPs)?" *Air Quality, Atmosphere and Health.* DOI: 10.1007/s11869-010-0122-3. (In press).

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Long, CM; Valberg, PA. 2007. Comment on "An Assessment of Risk from Particulate Released from Outdoor Wood Boiler by Brown *et al.*" *Human and Ecological Risk Assessment* 13:681-685.

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Abstracts & Reports *(list available on request)*

Invited Lectures *(past 10 years)*

6/14/10 "Portals of Entry for Workplace Chemicals / Lung Deposition and Clearance of Inhaled Particles." Presented in the course "*Comprehensive Industrial Hygiene: The Applications of Basic Principles*" Harvard School of Public Health, Boston, MA.

3/24/10 "Do Brain Cancer Rates Correlate with Ambient PM-Levels or with Hazardous Air Pollutant (HAP) Concentrations ?" Presented at the AAAR Specialty Conference "*Air Pollution and Health: Bridging the Gap from Sources to Health Outcomes*," San Diego, CA.

6/23/08 "Routes of Entry into the Body: Pulmonary Deposition and Clearance of Particles." Presented in the course "Comprehensive Industrial Hygiene: Practical Applications of Basic Principles," Harvard School of Public Health, Boston, MA.

6/25/07 "Routes of Entry into the Body: Pulmonary Deposition and Clearance of Particles." Presented in the course "Comprehensive Industrial Hygiene: Practical Applications of Basic Principles," Harvard School of Public Health, Boston, MA.

3/29/07 "Non-linear Exposure-Response Relationships between Ambient PM_{10} and Daily Mortality." Presentation with Dr. T. Bowers at the Society of Toxicology Annual Meeting, Charlotte, NC. This presentation was selected as one of the *Top 12 Risk Assessment Abstracts at the SOT Meeting.*

11/7/06 "What is EMF? How EMF Interacts with Organisms." Presented at the Cyprus International Institute for the Environment and Public Health symposium on "Electromagnetic Fields: Sources, Health Effects, and Regulations, Nicosia, Cyprus.

6/19/06 "Pulmonary Deposition and Clearance of Particles." Presented in the course "Comprehensive Industrial Hygiene: Practical Applications of Basic Principles," Harvard School of Public Health, Boston, MA.

5/18/06 "Health Hazards of Nanoparticles." Presented at "A Mock Hearing: Environment, Health & Safety" at the NanoBusiness Alliance Meeting, New York City, NY.

4/25/06 "Inhalation Risk Assessment: Extrapolating from Macro-materials to Nano-materials." Overcoming Obstacles to Effective Research Design in Nanotoxicology, Cambridge, MA.

10/6/05 Panelist for: "A Reevaluation of the Association Between Diesel Exhaust Exposure and Lung Cancer." Air & Waste Management Association (AWMA) Specialty Workshop on "Diesel Exhaust," Chicago, IL.

6/20/05 "The Respiratory Tract as a Portal of Entry for Airborne Chemicals in the Work Environment." Lecture at the Harvard School of Public Health course on "Comprehensive Industrial Hygiene," Boston, MA.

6/16/05 "Electromagnetic Fields, Base Stations, and Wireless Networks: Exposures & Health Consequences." WHO Workshop, 15-16 June 2005, at the World Health Organization, Geneva, Switzerland.

2/11/05 "Generation of Charged Aerosols by High-Voltage Electric-Power Lines." American Association for Aerosol Research, Specialty Conference on Particulate Matter, Atlanta, GA.

2/4/05 "Magnetic Microparticles Detect and Probe Cytoplasmic Motions." Bioelectromagnetics Society Winter Workshop, Phoenix, AZ.

6/21/04 "Pulmonary Deposition and Clearance of Particles." Harvard School of Public Health Continuing Education course on "Fundamentals of Industrial Hygiene," Boston, MA.

1/27/04 "Quantitative and Qualitative Factors that Determine Health Risk: Explaining Risk to Judges, Juries, and Communities." Mealey's Water Contamination Conference, Pasadena, CA.

9/14/02 "Health Effects of Air Pollutants." Annual Scientific Meeting of the Michigan Occupational and Environmental Medicine Association "Current Topics in Occupational and Environmental Medicine," Frankenmuth, MI.

6/18/01 "Pulmonary Physiology, and Lung Deposition and Clearance of Particles." Harvard School of Public Health Continuing Education course on "Fundamentals of Industrial Hygiene," Boston, MA.

11/14/00 "Effects of Air Pollution on the Human Lung." Lecture in Tufts University course CEE 136, "Air Pollution," Medford, MA.

7/26/00 "Review of Ambient Air Quality as it Relates to Proposed Emission Standards for Massachusetts Power Plants." Testimony before the Massachusetts Department of Environmental Protection, Boston, MA.

1/10/00 "Useful Concepts in the Physics of RF." RF Safety: Science, Compliance and Communication, Electromagnetic Energy Association and the University of Texas Health Science Center, San Antonio, TX.

Manuscript Peer Reviewer for the Following Research Journals

American Industrial Hygiene Journal; American Journal of Physics; American Journal of Respiratory Cell and Molecular Biology; American Review of Respiratory Disease; Atmospheric Environment; Bioelectromagnetics; Biophysical Journal; Biorheology; Cell Biophysics; Critical Reviews in Toxicology; Environmental Geochemistry and Health; Environmental Health Perspectives; Environment International; Environmental Science & Technology; Epidemiology; Experimental Lung Research; Fundamental and Applied Toxicology; Hepatology; Human and Ecological Risk Assessment; Human and Experimental Toxicology; IEEE Biomedical Engineering; IEEE Transactions on Plasma Science; International Journal of Radiation Biology; Journal of Aerosol Medicine and Pulmonary Drug Delivery; Journal of Applied Physiology; Journal of Applied Toxicology; Journal of Occupational and Environmental Hygiene; Journal of Occupational and Environmental Medicine; Journal of Occupational Medicine and Toxicology; Journal of the Royal Society Interface; Journal of Toxicology and Environmental Health; Nature; Nonlinearity in Biology, Toxicology, and Medicine; Radiation Research; Risk Analysis: An International Journal; Regulatory Toxicology & Pharmacology; Science; Tissue & Cell; Toxicology and Applied Pharmacology; Toxicological Sciences; USGS Environmental Geochemistry of Mineral Deposits (Reviews in Economic Geology series).