

GAS CURTAILMENT RISK STUDY

BUSINESS PROPOSAL

The Electric Reliability Council of Texas

19 AUGUST 2011



BLACK & VEATCH
Building a **world** of difference.®

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19 August 2011

Mr. Jimmy Ramirez
ERCOT
2705 West Lake Drive
Taylor, Texas 76574

Dear Mr. Ramirez:

Black & Veatch Corporation ("Black & Veatch") is pleased to respond to the Request for Proposal for Gas Curtailment Risk Study Request of The Electric Reliability Council of Texas, Inc. ("ERCOT") to evaluate the risk of natural gas supply disruptions to electric generating stations within the ERCOT administered portion of Texas. We believe that a review of our proposal will reveal the depth and breadth of our project team's technical qualifications and expertise, an approach and analysis plan that addresses ERCOT's key questions, and the analytical methodologies required to provide substantive insights as well as the relevant experience and consulting capacity of our firm.

We are confident that Black & Veatch can satisfy ERCOT's expected needs through a combined strong understanding and hands-on knowledge of the gas supply market serving ERCOT and a deep understanding of the regional power generation market.

Our staff offers outstanding depth and breadth of experience in the areas required to complete the scope of work outlined in the Request for Proposal for ERCOT. Highlights of Black & Veatch's experience include the following:

Expertise in the Natural Gas, Liquids and Electric Markets - Black & Veatch professionals have deep industry expertise in the North American gas market, built on experience as consultants and leaders of energy companies. Our senior natural gas team members each have over 20 years of combined industry and consulting experience, and receive the support of industry leading analytical tools and extensive proprietary and contracted data bases.

Pipeline Level Market & Hydraulic Analysis Capabilities - Black & Veatch has deep expertise in the analysis of natural gas market fundamentals on a pipeline segment level as well as providing analysis of infrastructure reliability using hydraulic models. Black & Veatch produces an integrated and comprehensive outlook on North American energy issues in its Energy Market Perspective. Black & Veatch staff has years of natural gas infrastructure planning, modeling and reliability evaluation experience and recently served in an advisory role to the California Energy Commission (CEC) to recommend a means to evaluate the effect on electric reliability of from 150-200 miles of main being taken out of service in California for replacement, re-testing or repairs by PG&E after the San Bruno incident.

Experience with Electric Markets & ERCOT - As one of the world's largest builders of power plants, Black & Veatch has a deep understanding of the functioning of power generators and the electric market. Black & Veatch has extensive experience working with ERCOT for over 10

years. More than 50 Black & Veatch professionals have provided services to ERCOT including Subject Matter Expertise: EMS, MMS, Markets, Network Design, Commercial Operations, and Operational Support: Commercial Operations, Network Modeling.

Statistical and Strategic Analysis Capabilities - Black & Veatch not only provides in-depth analysis but also supports our clients' planning for a wide range of operating, technical and commercial strategies. We are respected by the industry for providing well grounded advice. Our recommendations and implementation strategies are based on our understanding of the client's market presence, business objectives and regulatory environment.

In summary, Black & Veatch staff brings extensive expertise and perspective to meet ERCOT's objectives and provide exceptional analysis of gas supply curtailment risks. As you will see in our detailed scope of work, we have detailed specific data and analysis methodologies to pursue to create a credible report for use in broader policy related discussion.

Please find below the information requested to be conveyed in the transmittal letter.

REQUIREMENTS OF TRANSMITTAL LETTER	BLACK & VEATCH RESPONSE
Disclosure of all pending, resolved, or completed litigation, mediation, arbitration, or other alternate dispute resolution procedures involving the respondent (including subcontractors,) and its client(s) within the past 24 months.	See Attachment A
Disclosure of all affiliations with or ownership relationships with any ERCOT Market Participant or its affiliates.	Black & Veatch has no ownership relationship with any ERCOT Market Participant or its affiliates.
A description of any personal or business interest that may present an actual, potential or apparent conflict of interest with the performance of the contract and an explanation of how the respondent can assure ERCOT that these relationships will not create an actual conflict of interest.	Black & Veatch is not aware of any personal or business interest that may present an actual, potential or apparent conflict of interest with the performance of the contract.
A list of key personnel previously employed by ERCOT in accordance with the requirements of Section 1.5.2.	None of the Black & Veatch's key personnel on this project were previously employed by ERCOT.

REQUIREMENTS OF TRANSMITTAL LETTER	BLACK & VEATCH RESPONSE
A complete list of all exceptions, reservations and limitations to the terms and conditions of the RFP and the Master Agreement.	Black & Veatch and ERCOT successfully executed a contract dated October 23, 2007 "Professional Services Agreement" and as amended to extend the End Date to October 23, 2011. If Black & Veatch is the successful bidder, we propose to create a new task order under the 2007 Agreement or as a model for developing a new contract. Black & Veatch is confident that a mutual agreement can be reached in a timely fashion to meet the needs of the current scope of services identified in your RFP. It is understood that, upon your acceptance of this proposal from Black & Veatch, both parties agree to use reasonable diligence, to negotiate a mutually acceptable definitive written contract with respect to the work described in this proposal. However, until we receive a fully executed, mutually acceptable definitive written contract, Black & Veatch will not perform any work on behalf of ERCOT related to the scope of work proposed herein.

It is our sincere hope that this proposal conveys to you Black & Veatch's commitment to provide ERCOT the credible, fact based analysis being sought. If you should have any questions concerning our relevant experience and capabilities, or require any further detail concerning how we intend to undertake the scope of work, please do not hesitate to contact Scott Smith at (713) 590-2270 or me at (415) 860-0474.

Very truly yours,
BLACK & VEATCH CORPORATION



Mark A. Gabriel
Senior Vice President and Executive Director, Strategy

2.0 Executive Summary

Black & Veatch Corporation (Black & Veatch) is uniquely qualified to support the Electric Reliability Council of Texas (ERCOT) Gas Curtailment Risk Study because we bring together the industry experience, analytical capabilities, and strategic planning skills required for this assessment.

2.1 BLACK & VEATCH VALUE PROPOSITION

Key attributes that we believe provide differential value to ERCOT are as follows:

BLACK & VEATCH VALUE	ERCOT BENEFIT
<p>Expertise in the Natural Gas, Liquids and Electric Markets</p> <p>Black & Veatch professionals have deep industry expertise in the North American gas market, built on experience as consultants and leaders of energy companies. Our senior natural gas team members each have over 20 years of combined industry and consulting experience, and receive the support of industry leading analytical tools and extensive proprietary and contracted data bases. We continuously monitor developments in the evolving gas market and have undertaken in-depth analysis on critical issues relevant to the future development of the natural gas market and infrastructure: gas demand from the power sector and the resulting volatility in gas usage patterns, gas demand to back up wind generation capacity, transition from traditional pipeline flow patterns to accommodate unconventional gas supplies.</p>	<ul style="list-style-type: none"> ■ Project leadership from experienced industry professionals to help ensure results are on point and create the most informational value for ERCOT ■ Ability to understand in detail the capabilities and constraints of the natural gas infrastructure for serving demand from electric generators in ERCOT ■ Well known and respected professionals will author the study, which adds to the credibility of ERCOT's assessment of the risk of gas curtailment to power generators
<p>Pipeline Level Market & Hydraulic Analysis Capabilities</p> <p>Black & Veatch has deep expertise in the analysis of natural gas market fundamentals on a pipeline segment level as well as providing analysis of infrastructure reliability using hydraulic models. Black & Veatch produces an integrated and comprehensive outlook on North American energy issues in its Energy Market Perspective, a bi-annual long term forecast for North American natural gas, liquids, electricity and coal markets. We have supported a wide range of clients across the natural gas industry spectrum - producers, pipeline and storage owners and developers, marketing companies, investors and potential customers in evaluating the opportunities and value propositions presented by various fundamental changes in the natural gas market. We take pride in our ability to quickly respond to clients' specific needs as new opportunities emerge.</p> <p>Black & Veatch staff has years of natural gas infrastructure planning, modeling and reliability evaluation experience and recently served in an advisory role to the California Energy Commission (CEC) to recommend a means to evaluate the effect on electric reliability of from 150-200 miles of main being taken out of service in California for replacement, re-testing or repairs by PG&E after the San Bruno incident.</p>	<ul style="list-style-type: none"> ■ An existing natural gas market model and view that allows for a fast response to ERCOT's needs and helps ensure deadlines are met ■ Ability to understand pipeline impacts, flows, etc at the segment level to provide a detailed review of curtailment risks to power generators ■ Increased credibility for ERCOT's study due to an integrated understanding of the natural gas market fundamentals and its drivers as well as the natural gas infrastructure

BLACK & VEATCH VALUE	ERCOT BENEFIT
<p>Experience with Electric Markets & ERCOT</p> <p>As one of the world’s largest builders of power plants, Black & Veatch has a deep understanding of the functioning of power generators and the electric market.</p> <p>Black & Veatch has extensive experience working with ERCOT for over 10 years. More than 50 Black & Veatch professionals have provided services to ERCOT including Subject Matter Expertise: EMS, MMS, Markets, Network Design, Commercial Operations, and Operational Support: Commercial Operations, Network Modeling.</p>	<ul style="list-style-type: none"> ■ Black & Veatch’s in-depth experience in both the electric and gas markets provides ERCOT with a unique and hands-on understanding of the issues involved in creating a successful interplay between the two markets. ■ Black & Veatch’s experience with and understanding of the culture and key drivers of success within ERCOT help enhance project interface and the results obtained for ERCOT. ■ Higher productivity and greater likelihood of success for ERCOT due to demonstrated success working closely with ERCOT on complex engagements
<p>Strategic Analysis Capabilities</p> <p>Black & Veatch not only provides in-depth analysis but also supports our clients’ planning for a wide range of operating, technical and commercial strategies. We are respected by the industry for providing well grounded advice. Our recommendations and implementation strategies are based on our understanding of the client’s market presence, business objectives and regulatory environment. We integrate that external view with internal assessments of each client’s unique assets and organizational capabilities. In each engagement, we strive to provide practical insights to support key strategic decisions.</p>	<ul style="list-style-type: none"> ■ The ability to help ensure that ERCOT understands in detail the risk of gas curtailment as well as alternatives to manage these risks in a cost effective and practical manner ■ Helps ensure that our results incorporate current and anticipated strategic issues, and not just historical trends

2.2 ORGANIZATION OF BLACK & VEATCH PROPOSAL

Black & Veatch proposes to provide risk analysis services to the Electric Reliability Council of Texas Inc., (ERCOT) in response to its Gas Curtailment Risk Study RFP. Our proposal is organized as follows:

Section 3: Corporate Background and Experience - Introducing Black & Veatch, relevant project experience and key personnel for the project

Section 4: Methodology and Services Approach - Approach to the scope of work, including data sources that will be relied upon, time schedule for work, project deliverables, and how we will approach each of ERCOT’s required deliverables

Section 5: Assumptions – List of key assumptions underlying Black & Veatch’s proposal

Section 6: Appendices – Black & Veatch experience matrix and full resumes of key personnel, pertinent project experience

Section 7: Vendor Information and Nondisclosure Statement

2.3 SUMMARY OF METHODOLOGY & APPROACH PHASE 1

Black & Veatch will approach Phase 1 as a combined economic and quantitative analysis with the final objective being presentation of risk-based likelihoods of natural gas curtailments that could affect gas-fired generation for scenarios that are specific to ERCOT. The aim will be to fulfill the information required for box 3D in Figure 4 shown below.

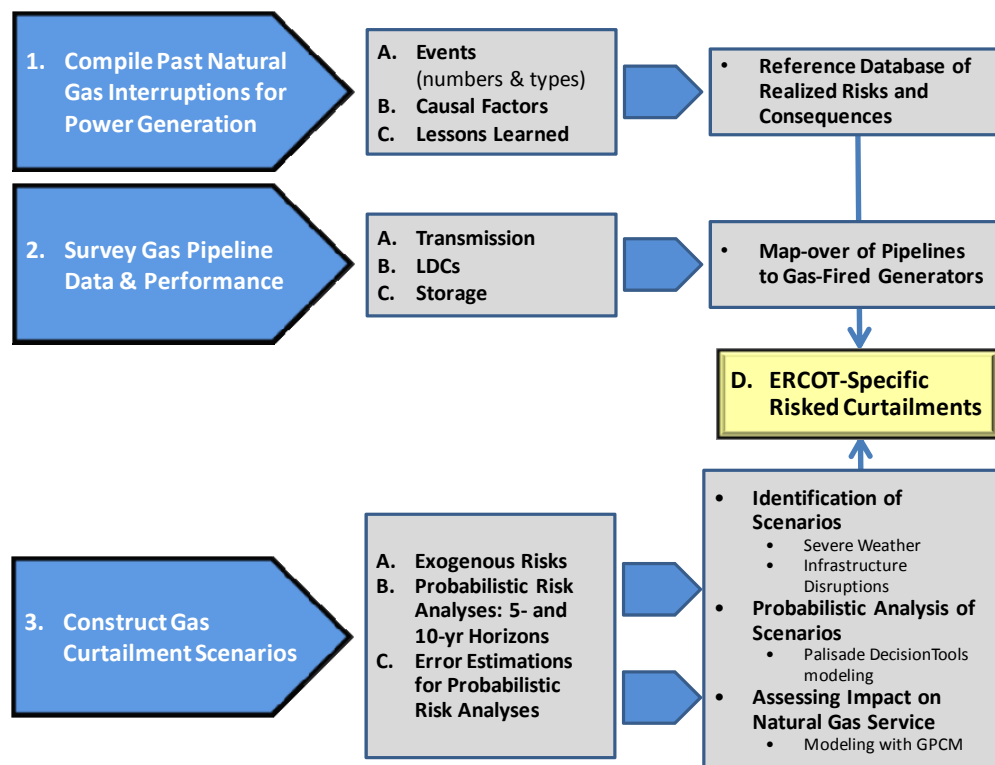


Figure 4. Black & Veatch Approach to Delivery of Phase-1 Study.

A detailed review of Black & Veatch's proposed methodology and deliverables is discussed in Section 4 of this proposal. The Black & Veatch work plan for Phase 1 is summarized in Table 1.

Table 1. Black & Veatch Work Plan for Phase 1 (Analyze Risk)

PHASE-1 DELIVERABLE	REQUIRED CONTENT	B&V TASK
Project Kick off Meeting	Align Black & Veatch and ERCOT prior to start of work efforts.	1. Team member introduction 2. Scope review & clarification (as required) 3. Confirmation of deliverables and timing 4. Expected outcomes 5. Definition of a successful / unsuccessful project
1. Review past natural gas interruptions impacting electric generation for insights.	A. List interruption events and number of occurrences sufficient to indicate risk factors to natural gas supply in	1. Review and digest ERCOT Operations Monthly Reports, dating from Year 2004 (online) or earlier (if available). 2. Review and digest NERC System Disturbances

PHASE-1 DELIVERABLE	REQUIRED CONTENT	B&V TASK
	the ERCOT region.	<p>reports dating from Year 1992 (online).</p> <ol style="list-style-type: none"> Review FERC Form No. 576 (Report of Service Interruptions) filings by natural gas pipeline companies that serve electric-power generators in ERCOT. Review additional information to be determined if appropriate to supplement data gathering The data gathered on past natural gas interruptions impacting electric generation will be summarized in the form of an Excel dataset as a deliverable to ERCOT.
	B. Describe causal factors leading to events.	<ol style="list-style-type: none"> Categorize events according to the causal agent as weather, pipeline outages, financial-performance issues or other factors. Use simple FMEA fishbone diagrams to describe interrelationships among causes and effects. Write narrative summaries of key events that are instructive as “lessons learned.”
	C. List “lessons learned” for ERCOT from these past events.	<ol style="list-style-type: none"> Identify important causes of historical interruption events and digest as operational examples to be avoided or emulated. This deliverable will be provided to ERCOT in the form of a PowerPoint presentation summary of the lessons learned from the past events studied. Black & Veatch will schedule a conference call with ERCOT to provide a walk-through of the PowerPoint presentation to ERCOT.
<p>2. For pipeline systems that serve generation review public information, databases, and surveys to understand pipeline physical limitations to providing natural gas to electric generation in ERCOT. This would likely include data gathering.</p> <p>Report these capabilities and limitations on the following basis:</p>	A. By individual pipeline systems.	<ol style="list-style-type: none"> Confirm with ERCOT the locations of all gas-fired electric-power generation facilities. Review RRC data, including annual reports and regulatory dockets for gas service providers. Review system data posted on pipeline company websites such as pipeline index of customers, pipeline operationally available capacities, as well as data from third-party vendors such as Lippman Consulting for which Black & Veatch has a current subscription. Survey of delivery capacity by pipeline as required and utilizing publically available information.

PHASE-1 DELIVERABLE	REQUIRED CONTENT	B&V TASK
		5. Augment information gathered using experience with similar infrastructure reliability/planning studies.
	B. For LDC systems.	<ol style="list-style-type: none"> 1. In collaboration with ERCOT, develop a list of the electric generators that are served by utilities 2. Review system data posted on LDC websites and make data requests to determine the physical capacity of the gas utility to serve electric generation plants with capacity higher than 100 MW
	C. For storage facilities.	<ol style="list-style-type: none"> 1. Review FERC jurisdictional facility data , and other data sources as available, for capacity and deliverability. 2. Black & Veatch maintains and utilizes a detailed database of natural gas storage facilities as a result of its years of work involving natural gas market analysis which will also be relied upon to determine and report the capabilities and limitations of storage facilities within ERCOT's region.
Define how this information will be used to model/analyze the delivery problem.		<ol style="list-style-type: none"> 1. Confirm map-over of gas-supply network (pipelines, storage facilities and LDCs) to electric-power generation facilities. 2. Collaborate with ERCOT to establish gas demand by gas-fired power generators by facility (preferred) or by ERCOT Weather Zone (minimum requirements). Black & Veatch will also share with ERCOT its proprietary view on the electric demand by gas-fired electric generators within ERCOT in the 5 year and 10 year time horizon. 3. The pipeline, LDC and storage facilities capacities available to provide natural gas to electric generators in ERCOT will be incorporated in the GPCM model along with demand projections from these electric generation facilities to determine where constraints, if any, arise within the natural gas infrastructure in serving the electric generation facilities. 4. Black & Veatch will summarize the capacities of the pipeline systems, LDCs and storage facilities to provide natural gas to electric generating facilities within ERCOT in the form

PHASE-1 DELIVERABLE	REQUIRED CONTENT	B&V TASK
		of an Excel data file with accompanying maps highlighting the natural gas infrastructure in relation to the electric generating facilities.
3. Review scenarios in which ERCOT natural gas supply to electric generating stations could be significantly limited, including conditions of severe cold temperature combined with high wind speeds.	A. Develop risk analysis scenarios that consider 1) severe cold weather with wind; 2) flood; 3) hurricane; and 4) heavy demand from interstate pipelines	<ol style="list-style-type: none"> 1. Identify a representative weather station in each of the 8 ERCOT Weather Zones and, for each weather station, obtain official daily weather data from NCDC for the years 1950-2011. 2. Obtain official tropical-cyclone (TC) historical data from NHC for all TCs affecting Texas. 3. For each Weather Zone station, compute probabilities of extreme cold temperatures (32 F and lower) during Dec-Feb. 4. For each Weather Zone station, compute probabilities of extreme winds (20 mph and higher) during Dec-Feb. 5. For each Weather Zone station, compute probabilities of extreme high temperatures (100 F and higher) during Jun-Aug. 6. For each Weather Zone station, compute probabilities of excessive rainfall (exceedance of regional flash flood guidance thresholds) for each month of the year. 7. For the Coast and Southern Weather Zones, compute probabilities for hurricane landfalls and extreme winds (50 mph or higher) during Jun-Nov. 8. For each scenario, develop estimate of (a) natural gas demand for power generation as well as for residential, commercial, industrial demand that could compete with electric generators for natural gas, (b) natural gas supply deliveries into interstate, intrastate and gas distribution facilities, and (c) availability of pipeline and storage capacity/deliverability. 9. Incorporate the demand supply and infrastructure availability scenarios into the GPCM model to determine where constraints, if any, arise within the natural gas infrastructure in serving the electric generation facilities. 10. Black & Veatch will summarize and review the scenarios with ERCOT in the form of a PowerPoint presentation to be presented by

PHASE-1 DELIVERABLE	REQUIRED CONTENT	B&V TASK
		<p>Black & Veatch in a conference call to ERCOT personnel (or meeting location in Houston)</p> <p>11. For each interstate pipeline, compile historical flow data by month and unique daily scenarios to compute probabilities of flow failing to meet expectations of nominal performance.</p>
	B. Calculate the risk (assess probability) of such events in the near (5 year) and mid (5 to 10 year) timeframe. Discussion of both physical (hydraulic) and market liquidity issues are required.	<p>1. Use individual probabilistic analyses to derive 5 and 10-year thresholds for occurrence of each specified hazard.</p> <p>2. Construct reference charts for each specified hazard that can be used by ERCOT planners to anticipate probabilities on 1-, 5- and 10-year intervals.</p> <p>3. Prepare narratives that explain each probabilistic model, its reference charts and the operational fundamentals underlying each specific hazard.</p>
	C. Quantify the expected error range in these estimates.	<p>1. For each probabilistic analysis, provide a measure of uncertainty as the equivalent of 1 standard deviation around each predictive metric.</p> <p>2. Prepare narratives that describe how the uncertainties were calculated.</p>
	D. Consider the ERCOT energy market mechanisms and timelines that result in natural gas procurement for electrical generation in combination with these scenarios to assess probability of curtailment scenarios. Scenarios should include the possibility of electrical interruption to pumping stations.	<p>1. Prepare a risk matrix that shows severity of impact vs. likelihood of occurrence of each specific hazard in the context of potential gas curtailments.</p> <p>2. For each cell in the risk matrix, identify specific effects that could be expected relative to gas supply for power generation.</p> <p>3. Prepare a selection of narrative scenarios that describe the hypothetical sequence of events and effects for the most likely and the potentially most severe hazards.</p>
4. Prepare a final comprehensive report describing the results of all analysis required in Phase 1 Requirements, including any vendor proposed alternatives.		<p>1. Prepare a written report in electronic format, including internal and external hyperlinks that can be accessed under Adobe Portable Document Format (PDF).</p> <p>2. Provide key analytical results as Microsoft Excel spreadsheet files.</p> <p>3. Black & Veatch will summarize the findings and review with ERCOT in the form of a PowerPoint presentation to be presented by</p>

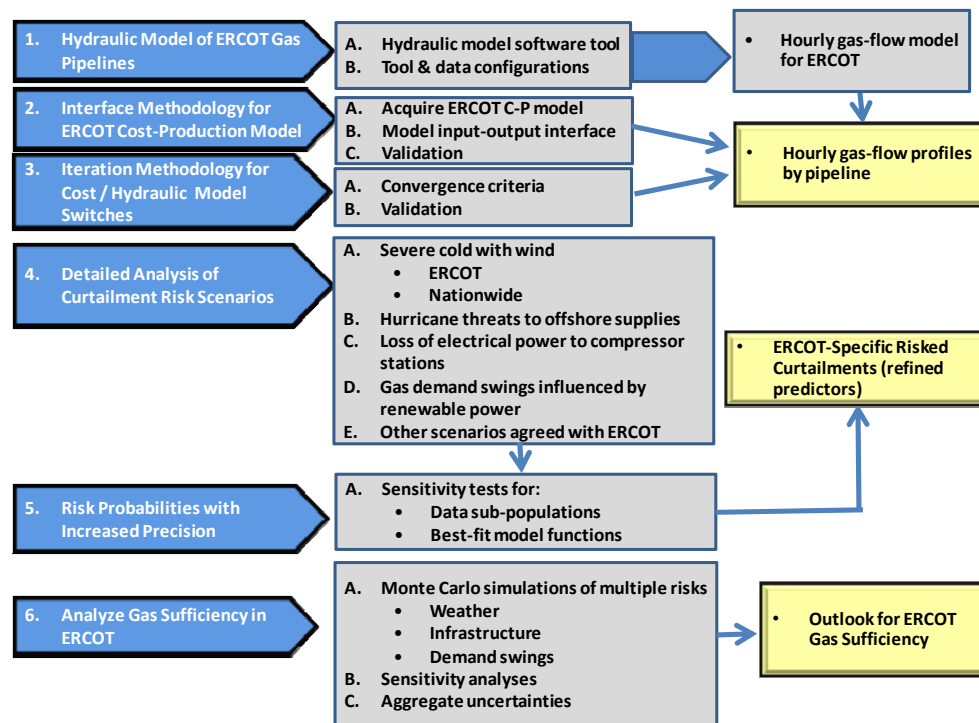
PHASE-1 DELIVERABLE	REQUIRED CONTENT	B&V TASK
		Black & Veatch personnel at a location in Texas (assume ERCOT office in Austin or Taylor, Texas).

2.4 SUMMARY OF METHODOLOGY & APPROACH - OPTIONAL PHASE 2

In order to provide high-value risk analysis to ERCOT to meet the objectives of Phase 2, Black & Veatch proposes to bring together:

- Our specialized experience modeling pipeline hydraulic systems,
- The Geographic Information Systems (GIS) expertise housed within Black & Veatch's Enspira Solutions group, and
- The premier natural gas hydraulic modeling software¹ of GL Noble Denton, a technical service provider for the oil and gas industry.

We propose the following Project Approach to meet the objectives and deliverables of Phase 2 and to provide interaction with ERCOT staff during the project:



¹ GL Noble Denton's Stoner Pipeline Simulator is the worldwide leader in transient flow simulation for liquid and gas pipelines.

A detailed review of Black & Veatch's proposed methodology and deliverables for Phase 2 is discussed in Section 4 of this proposal. The Black & Veatch work plan for Phase 2 is summarized in Table 2.

Table 2. Black & Veatch Work Plan for Phase 1 (Analyze Risk).

PHASE-2 DELIVERABLE	REQUIRED CONTENT	B&V TASK
1. Gather data for, and utilize a commercially available gas pipeline modeling system to create a detailed hydraulic model of ERCOT gas pipeline infrastructure suitable for hourly analysis of gas consumption under scenarios.	<p>A. Hydraulic model software tool</p> <p>B. Tool & data configurations</p>	<p>1. Assemble background data, including import of data from Phase 1 and data request to ERCOT:</p> <ul style="list-style-type: none"> ■ Maps & data for natural gas pipeline infrastructure serving ERCOT ■ Locations and gas requirements for the natural gas power plants above 100 MW generation capacity ■ Local Distribution Company (LDC) tap locations and 3 years of flow/load history ■ Other large gas loads connected to the pipelines directly and not downstream of the LDCs. ■ ERCOT Electric Model Data ■ Data concerning Project Drivers i.e. past curtailments, scenarios, previous studies, etc. <p>2. Project Kick-Off Meeting with ERCOT to discuss and confirm scope, schedule, roles and responsibilities and approach.</p> <p>3. Build the geographical information system (GIS) database required to support the hydraulic model analyses</p> <p>4. Collaborate with GL Denton Noble to integrate GIS database into Stoner Pipeline Simulator (SPS) model software system</p> <p>5. Integrate load data from ERCOT electrical model into the SPS model</p> <p>6. Develop modeling scenarios, including import of results from Phase 1 and coordination with probabilistic risk analyses and ERCOT feedback:</p> <ul style="list-style-type: none"> a. Severe cold weather with wind b. Hurricane threat eliminating supply from offshore and other effects c. Loss of electric power to local natural gas compression stations d. High swings in renewable power, reflected in high swings in natural gas demand e. Other scenarios to be determined in

PHASE-2 DELIVERABLE	REQUIRED CONTENT	B&V TASK
		<p>consultation with ERCOT</p> <ol style="list-style-type: none"> Run modeling scenarios in collaboration with GL Noble Denton using the SPS software tool Analyze initial reports to establish model sufficiency and calibrations with focus on: <ol style="list-style-type: none"> Effects of transient power loads on an intra-day basis and over a multi-day period Cumulative effects. A pipeline may be able to accommodate heavy intra-day swings, but such swings, if repeated over several days, can diminish flexibility faster than a pipeline can “repack” overnight. Swing effects from wind generation. Cumulative impacts can also result from overnight wind de-ratings that shift loads onto pipelines at the time when the system linepack is typically restored. Review model results with ERCOT to agree on sufficiency or need for additional runs
2. Create a methodology for using production cost model study results as input to the hydraulic model to create hourly gas flow profiles for each pipeline	<ol style="list-style-type: none"> Acquire ERCOT Cost-Production (C-P) model Model input-output interface Validation 	<ol style="list-style-type: none"> Acquire ERCOT C-P model or arrange with ERCOT to obtain output from specific scenarios Model input-output interface Vet interface assumptions and approach through collaboration with hydraulic model team Test & validate interface through collaboration with hydraulic model team Review interface design and test results with ERCOT
3. Create a methodology for allowing iteration between production cost model results and hydraulic model results.	<ol style="list-style-type: none"> Convergence criteria Validation 	<ol style="list-style-type: none"> Develop convergence criteria, including criteria for recognizing and arresting model overflow conditions Vet iteration assumptions and approach through collaboration with hydraulic model team Test & validate iterative analyses through collaboration with hydraulic model team Review iterative design and test results with ERCOT
4. Analyze scenarios defined in Phase 1	A. Severe cold weather with	<ol style="list-style-type: none"> For each ERCOT station, sub-divide

PHASE-2 DELIVERABLE	REQUIRED CONTENT	B&V TASK
and additional scenarios needed to accurately assess risk. At this point ERCOT staff expects these scenarios to include:	wind and nationwide cold weather.	<p>weather data into successive Climate Normal periods and calculate risks for each period.</p> <p>2. For nation, simulate synoptic cold patterns using stations outside ERCOT that could pull gas to the West, North or South (for example, Phoenix, Chicago, Atlanta, New York) and calculate probabilistic risks.</p>
	B. Hurricane threat eliminating supply from offshore and other effects.	<p>1. Calibrate Gulf of Mexico supply interruptions vs. curtailment events (Phase 1) to produce an event filter.</p> <p>2. Compile historical tropical-cyclone tracks across to Texas and Louisiana coasts and calculate probabilities for occurrence 1, 5 and 10-year horizons and pass through the event filter.</p>
	C. Hurricane threat eliminating supply from offshore and other effects.	<p>1. Calibrate Gulf of Mexico supply interruptions vs. curtailment events (Phase 1) to produce an event filter.</p> <p>2. Compile historical tropical-cyclone tracks across to Texas and Louisiana coasts and calculate probabilities for occurrence 1, 5 and 10-year horizons and pass through the event filter.</p>
	D. High swings in renewable power available to ERCOT, reflected in high swings in natural gas demand.	<p>1. Use B&V EMP to create time-variable profiles for renewable-energy capacity factors.</p> <p>2. Create gas-demand variability profile by decrementing in sync with renewable capacity-factor profiles.</p>
	E. Other scenarios to be determined in consultation with the vendor and regulatory authority.	<p>1. Outage of major transmission pipeline as a result of rupture or other major failure</p> <p>2. Collaborate with ERCOT to identify and agree upon other scenarios</p>
5. Calculate with higher accuracy and precision than the Phase 1 study, the risk of natural gas curtailments due to both physical risk to gathering and transport, and to commercial risks (lack of firm contractual arrangements during stress conditions).	<p>A. Sensitivity tests for:</p> <ul style="list-style-type: none"> ■ Data sub-populations ■ Best-fit model functions 	<p>1. Use Phase-1 risk results as the starting point.</p> <p>2. Calculate sensitivities to sub-population assumptions (for example, 30-year vs. 60-year lengths of record).</p> <p>3. Calculate sensitivities to risk model assumptions (for example, Weibull vs. Log-Logistic probability distribution functions).</p>
6. Analyze sufficiency of the natural gas infrastructure within ERCOT to support the next 5 years with an expected loss	<p>A. Monte Carlo simulations of multiple risks</p> <ul style="list-style-type: none"> ■ Weather 	<p>1. Use tornado-plot analyses to identify the top-ranked variables with regard to curtailment probability.</p>

PHASE-2 DELIVERABLE	REQUIRED CONTENT	B&V TASK
of load expectation of less than 1 day in 10 years.	<ul style="list-style-type: none"> ■ Infrastructure ■ Demand swings B. Sensitivity analyses C. Aggregate uncertainties D. Review & integrate Deliverables 1-5 results	2. Create a linked network/tree model that connects top-ranked variables and perform Monte Carlo analyses on the network/tree. 3. From Monte Carlo results, extract daily risk probabilities at 1, 5 and 10-year milestones and by season (summer vs. winter). 4. Analyze and compile overall uncertainties for linked risks 5. Synthesize all hydraulic model, cost-production interface/iteration and refined risk analyses 6. Review preliminary findings with ERCOT
7. Report	A. Draft report B. Final report	1. Provide draft report to ERCOT 2. Assimilate feedback from ERCOT 3. Deliver final report 4. Present seminar to review and discuss the final report

Given that Phase 2 is an optional service at this juncture and that more due diligence (and progress on Phase 1) may be required before finalizing the requirements for Phase 2, Black & Veatch proposes to work collaboratively with ERCOT to define the final scope of services for Phase 2. We will remain flexible in modifying the approach proposed here and its associated timeline and budget to design the best solution for ERCOT.

2.5 KEY PROJECT MEMBERS

Black & Veatch believes that the industry and technical leadership of its experts and professionals in the relevant disciplines is an essential element of value in our proposal to ERCOT. Black & Veatch commits the following highly qualified consultants, whose short biographies are included in this section and whose full resumes are included in Section 5.

CONSULTANT	TITLE	FIELD OF SPECIALIZATION/ PROJECT ROLE
Scott Smith	Vice President & Executive Director	Project Lead & Client Executive
Greg Hopper	Managing Director	Natural Gas Market Specialist
Deepa Poduval	Principal Consultant	Market Economist & Project Manager
Dr. James Gooding	Manager	Geoscientist & Weather Risk Analysis Specialist
Joseph Peters	Manager	ERCOT Market Specialist
Denny Yeung	Manager	Strategic Analysis & Modeling
John (Rod) Walker	Principal Consultant	Infrastructure Reliability/Planning Specialist, Pipeline Hydraulic Modeling Lead

Scott Smith – Vice President with Black & Veatch Management Consulting. He is the Executive-in-Charge for Industry Verticals, comprising Oil & Gas, Electric Power and Public client sectors. He has over 25 years of energy industry experience. The Black & Veatch consulting practice focuses on providing regulatory support, financial analysis, market analysis, asset planning and transaction support, strategic advice, energy efficiency, policy advice and sustainability services to the electric, oil & gas, and water industries in North America. His consulting focus and expertise includes energy market analysis, risk management, energy asset valuation, energy asset optimization, business strategy development, and energy decision analysis. He has led several projects in Alaska for the Department of Natural Resources, Department of Revenue, the Governor's office, and Chugach Electric Association, including leading Black & Veatch's support of the AGIA Pipeline. As Project Lead and Client Executive, Scott will be responsible for overseeing the project and maintaining communication with the ERCOT project leads on all important project-related issues.

Greg. W. Hopper - Managing Director with Black & Veatch. He advises clients in the natural gas and electric generation industries, providing strategy, asset valuation, and market analysis expertise. Prior to joining Black & Veatch, Mr. Hopper was with Williams Gas Pipelines where he led natural gas investments in pipelines, storage, LNG facilities and joint venture companies. Mr. Hopper began his energy career as in the Natural Resources investment-banking group at Kidder, Peabody & Co. He was also a financial analyst in the oil field service sector and is a licensed CPA in the state of Texas.

Deepa Poduval - Principal Consultant with Black & Veatch. She is responsible for business strategy and project management and is an economist and engineer by training. Ms. Poduval's responsibilities extend over a range of activities including the valuation of energy industry assets; analysis of oil & gas marketing strategies; evaluation of asset portfolios; research of industry networks & structures; and analysis & utilization of the natural gas industry structural models. She has worked on extensive projects, including projects for large natural gas & oil producers, for the Minerals Management Service of the U.S. Department of Interior, and the State of Alaska. Prior to joining Black & Veatch, Ms. Poduval obtained a Masters in Engineering Management from Dartmouth College.

Dr. James Gooding – Industry Specialist with Black & Veatch. He is a geoscientist and energy market analyst with extensive technical, supervisory and management experience in government and industry. He is responsible for coordinating research, analysis and delivery of services for clients focused on energy issues. He directs work performed by analysts and defines and develops new services and capabilities with emphasis on natural gas and other carbon-based enterprises. Before joining Black & Veatch he was an independent consultant in geology and meteorology and a trainer of industry professionals as

an instructor at San Jacinto College; Keller Graduate School of Management (DeVry University); and the University of Houston. He has consulted on weather and climate risk management both for onshore and offshore energy projects. He earned a Ph. D. degree (with Distinction) in Earth & Planetary Science from The University of New Mexico, Albuquerque.

Joseph Peters – Manager with Black & Veatch. He is responsible for fundamental market analysis, independent engineering support, and business strategy/planning support. He provides expertise in the analysis of the technical, market, and financial factors that drive and enable the power generation industry. He has plant operational and engineering experience as a nuclear-trained naval officer and, through his experience in power generation technology application engineering with a major original equipment manufacturer, is well-versed in the typical technical, regulatory, and financial issues that bear on energy asset development, valuation, and management.

Denny Yeung – Manager with Black & Veatch. He brings expertise in natural gas fundamental market analysis. He is responsible for modeling detailed fundamentals factors in the North America natural gas market, and assessing the impact on price, basis on proposed pipeline and storage infrastructure. He has accumulated extensive knowledge on market fundamentals and storage valuation in his experience with B&V. Mr. Yeung graduated from Rice University and holds an MBA from the University of Texas at Austin.

Rod Walker – Principal Consultant with Black & Veatch. He is a 25 year veteran of the natural gas industry having spent nineteen years working in a variety of Operations, Management and Engineering (OME) positions for a large investor-owned gas utility and two municipal gas utilities. As a consultant, he has had extensive experience providing solutions to domestic and international clients on issues they face from a management consulting and engineering perspective. He is recognized as an OME risk-based audit expert from the dozens of audits and due diligence projects he has been involved with in his career. Over his career as a utility engineer and consultant, he has been involved with infrastructure planning/reliability analysis for natural gas systems including review of State of California natural gas infrastructure's ability to support electric generation.

3.0 Corporate Background & Experience

3.1 SUMMARY OF BLACK & VEATCH BACKGROUND

BACKGROUND INFORMATION REQUESTED	BLACK & VEATCH INFORMATION
Respondent's full organization, company or corporate name	Black & Veatch Corporation
Headquarter address	11401 Lamar Avenue Overland Park, KS 66211
Type of ownership (e.g. partnership, corporation)	Corporation
If respondent is a subsidiary or affiliate, the name of parent organization	Not applicable
State where the respondent is incorporated or otherwise organized to do business	Black & Veatch Corporation was incorporated in Delaware on 11-16-1998.
Federal taxpayer identification	43-1833073
Name and title of person who will sign the contract	Scott R. Smith, Vice President and Executive Director, Industry Verticals Black & Veatch Management Consulting
Name and title of person responsible for responding to questions regarding the proposal, with telephone number, facsimile number and email address	Scott R. Smith, Vice President and Executive Director, Industry Verticals Black & Veatch Management Consulting Telephone number: 713-590-2270 Facsimile number: 713-961-1100 Email address: smithsr@bv.com

Business Organization Statement

Black & Veatch Corporation is a corporation within the Black & Veatch family of companies that is directly or indirectly owned by the Parent, Black & Veatch Holding Company. Black & Veatch Holding Company is a privately held corporation with majority ownership by an ESOP (employee stock ownership program). Black & Veatch Corporation was incorporated in Delaware on 11-16-1998.

Black & Veatch began as a two-person partnership in 1915, between Ernest Bateman Black and N.T. Veatch with 12 employees in Kansas City, Missouri. With \$2.3 billion in revenue, Black & Veatch now employs a total staff of more than 8,100, has more than 100 offices worldwide, and has completed projects in more than 100 countries on six continents.

Black & Veatch is a leading global engineering, consulting and construction company specializing in infrastructure development in energy, water, telecommunications, management consulting, federal and environmental markets. Black & Veatch develops tailored infrastructure solutions that meet clients' needs and provide sustainable benefits. Solutions are provided from the broad line of service expertise available within Black & Veatch, including conceptual and preliminary engineering services, engineering design,

procurement, construction, financial management, asset management, program management, construction management, environmental, security design and consulting, management consulting and infrastructure planning.

We have built our quality reputation by providing our clients with high-quality and responsive services. We take pride in building strong relationships with our clients; many have retained our services continually for more than 40 years. Our goal is to provide our clients with services meeting their specific needs using innovative processes and techniques.

Black & Veatch Management Consulting

Black & Veatch Management Consulting is the consulting division of Black & Veatch with over 300 consultants. We deliver value through the application of first-hand industry expertise, exceptional program and project execution, thought leadership, proven methodologies and processes, and ethical business practices. Our proven capability to deliver is local, national and international. We are a dynamic organization that strives to change as our clients' needs evolve.

We combine experience with a strong focus on project execution and value. Our engagements can draw on experienced senior executives, economists, senior policy experts and regulatory officials, engineers and internationally respected subject-matter experts.

Because Black & Veatch provides diverse consulting services that span financial, process, and technology solutions, many of our experienced professionals possess cross functional skills that include asset management, cost of service/rate design, business process / work flow analysis, and implementation services. Below is a summary of the wide-range of services offered by Black & Veatch Management Consulting professionals.

B&V Management Consulting Services

Business Processes

- Enterprise Strategy Development
- Energy Asset Strategy
- Energy Market Perspective/Market Analysis
- Demand Side Management/Energy Efficiency
- Utility Regulatory and Litigation Support
- Municipal Financial Planning and Ratemaking
- Municipal Formation and Organizational Transformation
- Sustainability/Smart Grid

Infrastructure Consulting and Engineering

- Transaction Support
- Technical Due Diligence
- Benchmarking
- Integrated Resource Planning
- Construction Monitoring
- Development Support
- Operations Review
- Asset Valuations

Business & Operating Technology Services

- Project / Program Management
- Technology Planning
- Software Vendor Selection Services
- Full Lifecycle System Integration Services
- Delivery Assurance Services
- Organizational Optimization
- Business Intelligence & Performance Management
- SAP Services Partner
- Oracle Partner Network Member
- HP Software & Solutions Services Provider

Business Philosophy

Black & Veatch maintains high standards for all of our engagements and commits to providing the highest level of service to the client. We are able to make this commitment due to our clients' confidence in our technical and managerial capabilities and our successful performance on previous projects.

Black & Veatch Management Consulting staff members are held to the highest professional standards. Professionals are continually evaluated with emphasis on:

- Client satisfaction
- Financial performance
- Engagement/special assignments
- Capability and professionalism
- Safety
- Consultant administration
- Attributes and value behavior

Description of Project Team Qualifications

Key members of the project team selected for this engagement were originally part of Lukens Energy Group, a preeminent management consulting group serving senior management in the oil and gas industry in strategy, risk mitigation, valuation and regulatory matters. Lukens Energy Group brought together professionals with commercial leadership experience and quantitative skills to provide strategic business advice, market analysis, valuation and regulatory support services, with a primary focus on the natural gas market. Lukens Energy Group was acquired by Black & Veatch Corporation in 2005.

Black & Veatch has provided natural gas market analysis and research for the last 13 years. During this time, we have provided market analysis services to numerous North American and international energy companies, state governmental and regulatory bodies as well as utilities, producers, and gas pipeline and storage companies.

Natural Gas Services

Black & Veatch has extensive experience and knowledge of the North America infrastructure, including the interstate pipeline grid, storage facilities, unregulated markets, risk management, gas price and basis forecasting, pipeline cost of service and rate design and regulatory affairs. Such knowledge has been developed as a result of senior manager industry experience and consulting engagements on behalf of leading industry companies.

Power Services

Black & Veatch brings a team of experienced senior executives, economists, policy and regulatory experts, engineers and technology advisors in the electric generation industry. Our services will build upon capabilities in market analysis

and power generation technology design and construction. We believe these complementary capabilities, and the associated tools and professionals that underlie them, make Black & Veatch uniquely qualified.

Specifically, we would like to highlight the following:

- Our **industry experts** provide ERCOT with the benefit of their decades of leadership experience in the energy industry. Having led large energy companies prior to consulting, these experts bring a practical, commercial perspective to help ERCOT identify workable information and insights to make better-informed decisions.
- Black & Veatch has multiple years of **modeling the natural gas infrastructure** for numerous North American and international energy companies, state governmental and regulatory bodies as well as utilities, producers, and gas pipeline and storage companies. ERCOT will benefit from our experience and in-depth understanding of the natural gas infrastructure as well as the **detailed natural gas database** that we have assembled over the years on the various pipelines, LDCs, storage facilities, production regions and processing plants as a result of our work.
- As the number one design firm for power plants in the U.S. Black & Veatch brings to ERCOT a **unique understanding of the power market** that is unmatched by our competitors. Black & Veatch's deep understanding of the power markets through our pre-eminent position as one of the top power plant design and construction firms in North America combined with our power and natural gas market analysis capabilities has helped us build unique and comprehensive expertise in the key drivers of the U.S. natural gas market and infrastructure going forward.
- Our professionals have extensive experience on projects of complex size and scope throughout the world. Black & Veatch's **industry-recognized project management skills**, combined with our proven business consulting services ensure long-term value on our clients' most challenging projects. We will apply Black & Veatch's well-developed project management practices to provide efficient and cost effective delivery of solutions to ERCOT.

3.2 RELEVANT PROJECT EXPERIENCE

Black & Veatch has considerable experience with various companies concerning North American natural gas infrastructure and markets. Listed below is a summary of projects that we have completed to support clients concerning natural gas markets and infrastructure.

Pipeline Capacity and Fundamental Analysis

Confidential Client – Large Integrated Producer

Gulf Coast Study

Black & Veatch examined the projected growth in new supplies and the resulting utilization of pipeline capacity in the region, and the impacts on future basis differentials. The study placed an emphasis on South Texas in particular, where LNG imports and new Eagle Ford shale production have the potential to create bottlenecks on gas pipelines delivering into the HSC and to interstate markets in Louisiana and beyond. Black & Veatch provided U.S. and regional supply and demand analysis, studied scenarios based results by primary development sources, and provided pricing and economic analysis.

Confidential Client – Large Investor Owned Electric Utility

Mid-Continent Express Pipeline Study

Black & Veatch provided fifteen-year forecasts of future natural gas flows and prices across the proposed Kinder Morgan Mid-Continent Express Pipeline. The monthly forecasts were made using a microeconomic model of the North American natural gas market and a combination of public and proprietary data regarding future gas supply and demand and transportation capacities and costs. The forecasts were completed for a number of scenarios regarding future pipeline expansions, shale production levels, and demand growth rates across the South Atlantic. The market analysis results were used by the company to make capital investment decisions regarding new pipeline development and potential acquisitions.

State of Alaska

Long-Term Natural Gas Price Analysis:

Black & Veatch was engaged by the State of Alaska (the State) to provide an assessment of the long-term natural gas prices in North America during the period 2011-2044. Particular focus placed was on drivers of price uncertainty at the Henry Hub in Louisiana and the AECO (NIT) hub in Alberta, Canada. In addition, the report presents price levels at the regional markets of Malin, Chicago and New York. This study was intended to clarify the nature and extent of future price uncertainty, especially as it is influenced by the availability of and the costs associated with shale gas supply. The impact of the uncertainty in key demand variables, such as gas demand for power generation, was also assessed.

State of Alaska

Alaska Gasline Inducement Act Support:

B&V was engaged as a consultant to assist in the evaluation of proposals related to the Alaska Gasline Inducement Act and its economic impact on the State. Black & Veatch developed a comprehensive economic model evaluating the economic benefits to the different stakeholders of the Alaska Gas Pipeline during the initial 25-year period of operation of the pipeline incorporating detailed

assumptions on factors such as production profiles, fiscal structures, market prices and pipeline tariffs during the analysis period. The effort included numerous public presentations and testimony to the State of Alaska Legislature in 2008. Key project activities were natural gas price forecasts, integration of 3rd party oil and LNG forecasts into the economic analysis, economic model development, Monte Carlo based risk analysis, and an assessment of strategic implications. This work required that Black & Veatch develop a probability distribution of future natural gas prices at the AECO hub in Alberta from 2010 through 2040. Using a microeconomic model of the North American gas market, Black & Veatch identified the key drivers of future gas prices. Black & Veatch then developed probability distributions and correlation estimates for each of these drivers and used the parameters to estimate the probability distributions of future gas prices at key locations in North America, including the AECO hub.

Confidential Client – Large Integrated Producer

Natural Gas Production Outlook:

A consulting team of Black & Veatch and ARI International collaborated to provide a market assessment and natural gas production outlook for the eastern U.S. Our review reported on market demand, gas transportation alternatives and the relative impacts of new supplies on regional gas market prices. Black & Veatch's report and other associated deliverables underscored the producer's acquisition of extensive interests in the Marcellus Shale regions of the Appalachian Gas Basin.

Confidential Client – Rockies Producer

Rockies Production Outlook:

Black & Veatch examined the production outlook for Rockies production and the pipeline outlets to reach Eastern and Western markets. In the study, we examined the impact of the Ruby pipeline and the likelihood of success for newly proposed pipelines to Midwest and Eastern markets. Black & Veatch worked with the client's staff and developed several scenarios around the levels of production from the Green River and Powder River basins in the Rockies and the timing of new pipelines outlets. Black & Veatch's report was used for potential investment interests in the Rockies.

Confidential Client – Large Integrated Producer

Short-term Price Forecasts

Black & Veatch worked with the client to develop a quarterly Henry Hub natural gas price forecast model. The econometric model was developed in conjuncture with client's staff and their views on the North American market. Major drivers in the econometric model included NBP prices, Lower 48 weather patterns, North American marketed production, storage inventory, market sentiment and NYMEX futures expectations. After developing the initial model, Black & Veatch was asked to update the model every quarter and develop a brief summary presentation.

Confidential Client - Interstate Pipeline Company & Gas/Electric Utility

Regional Market Hub Study:

Black & Veatch provided detailed market and economic analysis to evaluate the feasibility of developing a large regional market hub using its natural gas transportation and storage assets. Key services provided included long and short term natural gas supply and demand fundamental analysis, natural gas transportation and storage asset valuation, strategy development and negotiation support,

Confidential Client – Integrated Northeast Gas Company

Implications of Marcellus Shale

B&V prepared a study and report on the implications of the development of the Marcellus Shale on Client's exploration and production, natural gas pipeline and storage, natural gas distribution and natural gas trading and marketing business units. Analysis focused on the near-term (3-5 years) and long-term (10 years) implications of the projected development of Marcellus Shale on the client's market. The study incorporated the uncertainties surrounding this shale play including environmental and water-use concerns, market access, demand projections, finding and development costs, and the impact that these uncertainties had on natural gas production, natural gas prices and pipeline utilization in the region.

Confidential Client - Integrated Northeast Gas Company

NY and NJ Market Study

Black & Veatch supported client's due diligence efforts related to developing new pipeline capacity into the northern NJ and NY city market. The study focused on understanding the potential impact that regional gas demand and new pipeline capacity extending from the client's system will have on pipeline flows and prices in the region. Black & Veatch reviewed historical gas flows and operations on interstate pipeline and LDCs serving the market, summarized projections for gas demand growth in the region and associated demand for natural gas capacity, developed forward projections of gas basis prices and flows, and provided comparative assessments of client strategies with competitors proposed for the region.

Confidential Client - Global Financial Services Firm

REX Study

Black & Veatch analyzed the current REX Index of customers and the aging of firm transportation contracts. Analysis also included the pipeline capacity demand/supply balance in the Northeast US to forecast the need for REX capacity to meet supply needs. Black & Veatch assessed the pipeline take-away capacity out of the Rockies relative to regional production expectations and declines in Western Canadian production. Qualitative summary of market drivers that will affect the REX was provided to the client including studies for

production costs comparison between Rockies and Emerging Shales, new capacity to reach Western Markets, and potential Mid-West markets.

Confidential Client - Integrated Regulated Energy Company

Long-term View of the Natural Gas Market

Black & Veatch performed detailed market analysis for the client to develop a long-term view of the natural gas market. The market analysis involved developing supply and demand forecast for the region east of the Mississippi and specifically in the areas within the client's footprint. In addition to the Black & Veatch market view, the analysis also utilized existing studies from multiple industry sources to identify alternative market scenarios. Black & Veatch utilized a fundamental economic model to represent in detail, the client's transportation and storage assets as well as the interaction of these assets with other components of the natural gas infrastructure in the Mid-Atlantic and Northeast regions. Among the key issues analyzed was the impact of increased LNG imports on the client's assets; especially in the Gulf and East coasts. The analysis also factored in key variables such as new pipeline projects from Canada and the Rocky Mountain Region, reasonable expectations for industrial gas demand at high gas prices, and consumption for power generation. A competitive analysis was performed to assess the impact of these and other factors on competitor assets vis-à-vis the client. Black & Veatch's market analysis was utilized to develop a five-year growth strategy for the client.

Confidential Client – International Exploration & Production Company

Forecasts of Natural Gas Flows and Prices

Black & Veatch provided seven-year forecasts of future natural gas flows and prices for pipelines connected to or near a proposed gas storage facility in Louisiana. The monthly forecasts were made using a microeconomic model of the North American natural gas market and a combination of public and proprietary data regarding future gas supply and demand and transportation capacities and costs. The forecasts were completed for several scenarios regarding Gulf Coast LNG imports. The basis differential and gas flow forecasts were used to quantify the likely profitability of the proposed gas storage facility.

American Gas Foundation

Direct Use of Natural Gas Study

Black & Veatch was retained by the American Gas Foundation (AGF) to develop a comprehensive study titled, "Direct Use of Natural Gas: Implications for Power Generation, Energy Efficiency, and Carbon Emissions." The study was published in April, 2008 and provided a quantitative assessment of the impact on shifting electric load at the R&C level to direct gas. The results of the study showed that increasing the use of natural gas by 50% of the switchable load, produced a decrease in U.S. energy consumption; reduced the overall cost of energy, and reduced CO2 emissions. In addition, the study provided an in depth review of the natural gas and power markets in the U.S.

Natural Gas Storage Analysis

Confidential Client – Independent Storage Developer & Operator

Gas Storage Valuation and Market Power Study

B&V was engaged to complete a market assessment and valuation of an existing storage facility at the HSC/Katy market. B&V's approach included examining projections of regional market fundamentals, interstate and intrastate pipeline flows and price/basis movements at nearby trading hubs. B&V utilized its Storage Valuation Advisor™ model to understand storage service values and contract rates. B&V was asked to assess the storage market conditions and its impact on re-contracting storage rates.

B&V was also engaged to perform a gas storage market power study in West Texas that conforms to the Federal Energy Regulatory Commission's (FERC) guidelines for market power studies, as prescribed in its policy statement on alternatives to cost-of-service rate making. B&V's market power study considered decisions in recent certificate orders issued to similarly situated applicants and evaluated market concentration using the Herfindahl-Hirschman Index (HHI), as applied to the relevant geographic and product markets.

Confidential Client – Large Investment Fund

Falcon Gas Storage

An energy investment fund retained B&V/LEG to assist in the valuation and acquisition due diligence of Falcon Gas Storage. The project required valuing the services from Falcon Gas' existing storage facility, Hill Lake, located in Texas. B&V/LEG utilized its Storage Valuation Advisor™ model to understand how storage service values will change as Falcon Gas expands this facility. B&V/LEG was also asked to evaluate the storage development projects that Falcon Gas owns to understand their commercial viability and key risks associated with development. In addition, B&V/LEG provided advice on the acquisition structure to mitigate risks for the buyer.

LNG Analysis

Confidential Client – LNG Import Terminal Developer

Gulf Coast LNG Market:

Black & Veatch provided six-year forecasts of future natural gas flows and prices for approximately ten pricing points in the Gulf Coast region near existing and proposed LNG receiving terminals. The monthly forecasts were made using a microeconomic model of the North American natural gas market and a combination of public and proprietary data regarding future gas supply and demand and transportation capacities and costs. The forecasts were completed for several scenarios regarding the amount and timing of new LNG receiving terminal development. The results of the analysis were used by the client in their discussions with potential customers searching for new LNG import capacity.

Confidential Client – Texas LNG Import Terminal Developer

Texas LNG Study:

Black & Veatch was engaged by client to assess the value that natural gas transportation alternatives can contribute to its proposed LNG import terminal in Texas. B&V analyzed the impact that having access to multiple pipeline interconnects could provide to customers of the proposed LNG terminal by undertaking a historical and forward looking market analysis of region. In addition, real-options based valuation using B&V's proprietary Transportation Valuation Advisor (TVA) software of the arbitrage opportunities between different market centers linked by the pipeline network will be completed for the proposed project. B&V's assessment of value supported the LNG developer's marketing efforts for their LNG import terminal and header pipeline capacity.

Confidential Client – International Oil & Gas Exploration and Production Company

NY and NJ Market Analysis for LNG Import

Black & Veatch provided the client with an overview of the NY and NJ gas systems focused on intra-regional flows and natural gas consumption, as well as the projected growth in gas consumption supporting regional demand that could be served by the client's proposed LNG project. The study examined alternatives for providing incremental capacity and supply to the regional market. Black & Veatch also reviewed environmental and regulatory issues that emerged for other proposed regional LNG import projects, provided initial assessment of project's constraints and compared the client's proposed LNG project to its competitive alternatives.

Confidential Client – LNG Producer / Trader

Cove Point Analysis

Black & Veatch assisted the client in the evaluation and recommendation of strategic choices for marketing Cove Point LNG in the eastern US market. Major engagement components included detailed fundamental analyses of the eastern North American gas market and opportunities for increased gas consumption in regional electricity markets. Black & Veatch's deliverables to the client included recommendations for future capital investments in selected energy industry segments to leverage the value of Cove Point LNG imports, competitor threat and opportunity assessments, and identification of potential joint venture partners.

Electricity Market Related Analysis

Confidential Client - Fuel Supply Plan and Portfolio Development

ERCOT Electric G&T Cooperative

B&V was retained by the G&T Cooperative to develop a fuel supply plan for an ERCOT generation facility. The fuel supply plan was utilized as a basis for negotiating transportation and supply agreements and obtaining financing

approval for the G&T Cooperative through the RUS. Specific project tasks in developing the supply plan included identification of the key decision criteria for a fuel supply plan, incorporation of plant operating characteristics and associated uncertainty, identification of supply alternatives including transportation and storage, estimation of the cost of each alternative, development of a prioritized supply plan that maximizes value for the company relative to the key decision criteria and negotiating key commercial agreements.

ERCOT

Wind Effective Load Carrying Capability Study

Black & Veatch Enterprise Management Solutions professionals conducted a study for, and in conjunction with, ERCOT to determine the Loss of Load Probability on the ERCOT system and also to determine the Effective Load Carrying Capability (ELCC) of wind on the ERCOT system.

Confidential Client – Renewable Generation Developer

Texas Wind Farm Curtailment Analysis

B&V assisted a potential buyer of several West Texas wind farm in the due diligence phase by analyzing causes of past congestion-related curtailment, and in forecasting when and if ERCOT CREZ-related transmission improvements would reduce or eliminate the reasons for curtailment. Using detailed knowledge of transmission projects from nodal and zonal modeling work in ERCOT, and experience gained from monitoring of the day-to-day operation of the ERCOT grid, B&V identified the crucial projects in the transmission planning queue that would provide relief, and interpreted the timing of their implementation given updated developments among regulatory and transmission service provider stakeholders.

Confidential Client – Renewable Generation Developer

Nodal Analysis in ERCOT for Wind Project

B&V was engaged to study the impact on ERCOT nodal prices of the massive topological change associated with the Texas Public Utility Commission's plan for transmission infrastructure to support export of wind power from Western Competitive Renewable Energy Zones (CREZ). Starting with basic elements such as generation, fuel price, emissions price, and demand drawn from Black & Veatch's Energy Market Perspective product, we applied solved power flow cases to reorganize the topology from zonal to nodal. Full nodal analysis was done before and after CREZ in order to establish the expected price levels for a wind farm in the West region of ERCOT.

Confidential Client – Renewable Generation Developer

Renewable Energy Market Analysis

B&V designed and completed the evaluation of a biomass-fueled power project in the ERCOT region. We conducted the analysis by applying Black & Veatch's Energy Market Perspective to establish the fundamental industry model, and

conducted dispatch analysis over a 25-year period. In an industry where the stakeholders may be more familiar with the roles of traditional coal, nuclear, and gas-fired generation, such analytical work is important to establish the expected position in the industry structure of an increasing amount of renewable generation.

3.3 REFERENCES

1. Electric Reliability Council of Texas (ERCOT)

Black & Veatch and its team members have been long time partners of Texas ISO, providing services since 2001.

Over 50 different Black & Veatch professionals have provided services to ERCOT. Services have included:

- Project Management
- IT Development
- Market & System Test Management, Execution and Coordination
- Nodal Market Readiness and Coordination
- Subject Matter Expertise: EMS, MMS, Markets, Network Design, Commercial Operations
- Operational Support: Commercial Operations, Network Modeling

Black & Veatch has provided support for the ERCOT Nodal Project, providing project management, testing, and subject matter expertise. In addition to Program Management support Black & Veatch led the grid control testing, process, and training efforts. Black & Veatch professionals led the first successful full market load frequency test of the ERCOT grid under the NODAL program. Black & Veatch continues to provide operational support in Commercial Operations and Network Modeling areas.

Black & Veatch Professionals helped ERCOT define the initial market and commercial system requirements in 2001. Team members then designed and built the original configuration. Since that time, Black & Veatch has been consistently involved in the development of the ERCOT Market and the systems that support it. Black & Veatch consultants work side by side with ERCOT employees evolving the Wholesale and Retail solutions to help create one of the most successful deregulated energy markets in the world.

Reference:

Mr. Matt Mereness

Manager

ERCOT ISO

Address: 2705 West Lake Drive, Taylor, Texas 76574

Phone: (512) 248-3089

Email: matt.mereness@ercot.com

Scope of Project: ERCOT Nodal Project support

Duration of Contract: 2005-2011

2. State of Alaska

Alaska Gasline Inducement Act Support and Various Engagements

B&V was engaged as a consultant to assist in the evaluation of proposals related to the Alaska Gasline Inducement Act and its economic impact on the State. Black & Veatch developed a comprehensive economic model evaluating the economic benefits to the different stakeholders of the Alaska Gas Pipeline during the initial 25-year period of operation of the pipeline incorporating detailed assumptions on factors such as production profiles, fiscal structures, market prices and pipeline tariffs during the analysis period. The effort included numerous public presentations and testimony to the State of Alaska Legislature in 2008. Key project activities were natural gas price forecasts, integration of 3rd party oil and LNG forecasts into the economic analysis, economic model development, Monte Carlo based risk analysis, and an assessment of strategic implications. This work required that Black & Veatch develop a probability distribution of future natural gas prices at the AECO hub in Alberta from 2010 through 2040. Using a microeconomic model of the North American gas market, Black & Veatch identified the key drivers of future gas prices. Black & Veatch then developed probability distributions and correlation estimates for each of these drivers and used the parameters to estimate the probability distributions of future gas prices at key locations in North America, including the AECO hub.

Reference:

Dr. Antony Scott

Commercial Analyst

Division of Oil & Gas, Department of Natural Resources

Address: 550 W 7th Ave Ste 800, Anchorage, AK 99501-3560

Phone: (907) 269-8530

Email: antony.scott@alaska.gov

Scope of Project: Analytical, regulatory and strategic support related to natural gas pipeline from Alaska.

Duration of Contract: 2005-2011

3. Atmos Pipeline - Texas

Texas Intrastate Pipeline Capacity Study

Black & Veatch prepared a market outlook and market power study for the client to support a potential filing for market-based rates before the FERC. Specifically, Black & Veatch provided a long-term outlook of natural gas supply and demand through 2025 which focused on the implications of emerging developing supply sources such as LNG and shale gas in addition to potential infrastructure development in markets served by the client. . Preliminary testimony which summarized Black & Veatch's market power study was also provided.

Reference:

Mr. Charles R. Yarbrough, II
Vice President
Rates and Regulatory Affairs
Address: 5420 LBJ Freeway, Suite 1557, Dallas, TX 75240
Phone: (214) 206-2809
Email: Charles.Yarbrough@atmosenergy.com

Scope of Project: Texas Intrastate Pipeline Capacity Study

Duration of Contract: 2010

4. Enbridge Energy Company Inc.

East Texas Shale - Gas Flows & Prices Forecast:

Black & Veatch analyzed the market for Client's LaCrosse Pipeline and advised the client on projections for utilization, transportation values, and potential strategic modifications. We forecasted gas demand for power generation driven from baseline projections in Fall 2009 Energy Market Perspective, provided twenty year forecasts of future natural gas production and consumption in the markets including Louisiana, the southeast US, northeast and Midwest US regions, and integrated projections into the projected demand for LaCrosse and other pipeline transportation capacity in the region. We used a fundamental microeconomic model to perform the analysis and the market analysis results were used by the company to make capital investment decisions regarding new pipeline development.

Reference:

John Loiacono

Vice President

Commercial Activities

Address: 1100 Louisiana St., Suite 3300, Houston, TX 77002

Phone: (713) 821-2068

Email: John.Loiacono@enbridge.com

Scope of Project: East Texas Shale – Prices and Gas Flows Forecast

Duration of contract: 2010

3.4 ADDITIONAL INFORMATION

Background information on Black & Veatch's Enspira Solutions group and GL Noble Denton (which is proposed to be utilized as a subcontractor for Phase 2 – Optional Service) are included as Appendix 6.3 and Appendix 6.4, respectively.

4.0 Methodology & Services Approach

4.1 OUR UNDERSTANDING OF ERCOT'S OBJECTIVES

Per the Gas Curtailment Risk Study RFP issued, ERCOT is seeking “services to quantify the risk of natural gas limitations within Texas limiting/curtailing the supply of natural gas to electricity generation resources within the service area of the Electric Reliability Council of Texas Inc. It is intended that the risks quantified include both physical, commercial, and if applicable, regulatory barriers to natural gas delivery to electric generating stations.”

Understanding Risks from Distributed Electricity Demand

ERCOT sub-divides itself into eight (8) Weather Zones² although the three most populous Zones together account for about 80% of the total electricity demand (Fig. 1). Demand peaks occur in January and August with relative demand minima in April and November (Fig. 1). Therefore, two obvious issues are to fully understand interruption risks associated with the three heavy-demand Weather Zones (North Central, South Central, Coast) as well as the risks associated with seasonal peaks in summer and winter.

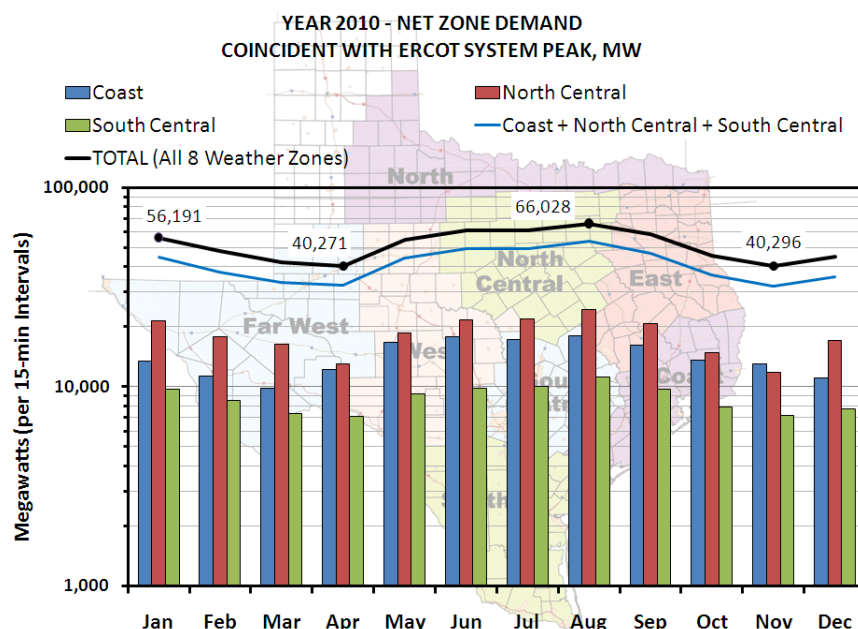


Figure 1. Annual profile of electricity demand for ERCOT, including the three highest-load Weather Zones. Data re-calculated from ERCOT (2011a)³.

² ERCOT (2010). *Report on Existing and Potential Electric System Constraints and Needs*. Electric Reliability Council of Texas, December 2010, 125 p.
<http://www.ercot.com/content/news/presentations/2011/2010%20Constraints%20and%20Needs%20Report.pdf>

³ ERCOT (2011a). Data file: 2010 Demand and Energy.xls.
<http://www.ercot.com/content/news/presentations/2011/2010%20Demand%20and%20Energy.xls>

Understanding Risks from Gas-Fired Generation Disruption

By fuel type, about 38% of ERCOT's annual average generation is accomplished with natural gas⁴ and large concentrations of gas-fired facilities occur in the heavy-demand North Central, South Central and Coast Weather Zones (Fig. 2)⁵. Therefore, an important priority is to understand risks of gas interruptions in the three aforementioned Zones.

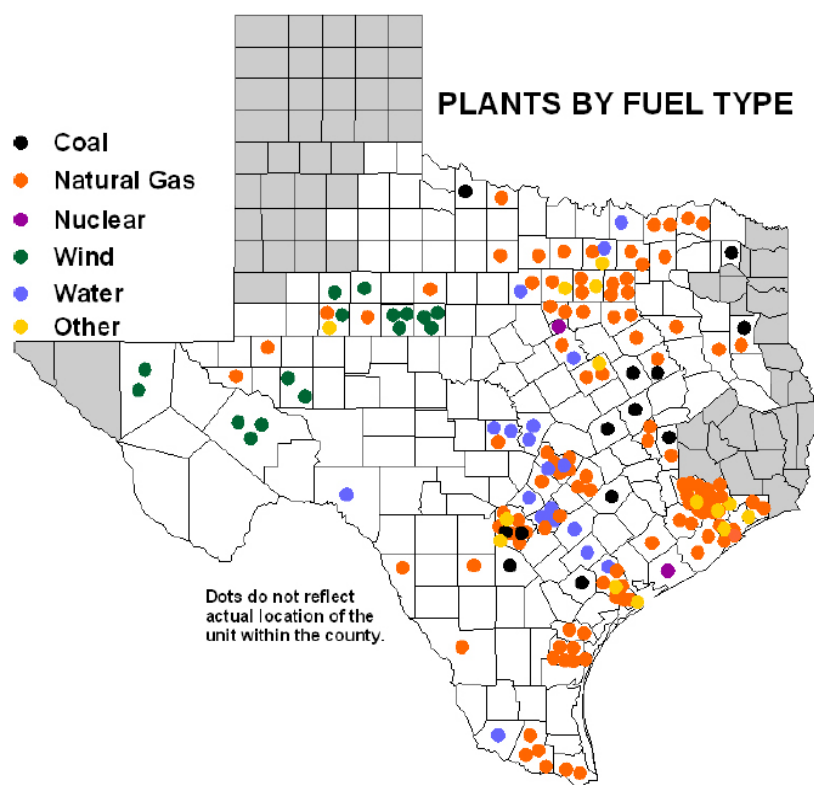


Figure 2. Locations of ERCOT electric-power generation facilities by fuel type as of 2006 (ERCOT, 2006).

Understanding Risks Associated with Natural Gas Delivery Infrastructure

Texas is served by 21,055 miles of interstate natural gas transmission pipelines and 103,014 miles of intrastate gas distribution pipelines⁶. As of 2009, there were 109 intrastate transmission utilities, 31 Investor-owned distribution utilities and 86 municipally-owned distribution utilities involved in the

⁴ ERCOT (2011b) Data file: GenerationByFuelType_2002-2010.xls.

http://www.ercot.com/content/news/presentations/2011/GenerationByFuelType_2002-2010.xls.

⁵ ERCOT (2006). Report on Existing and Potential Electric System Constraints and Needs. Electric Reliability Council of Texas, December 2006, 127 p.

http://www.ercot.com/news/presentations/2006/2006_ERCOT_Reports_Transmission_Constraints_and_Needs.pdf

⁶ RRC (2010). Table 2: Texas Pipeline System Mileage. Railroad Commission of Texas, October 28, 2010. <http://www.rrc.state.tx.us/data/gasservices/vitalstats/mileage.php>

intrastate transportation of 15,617 Bcf of gas⁷. In addition, there are 35 natural gas storage facilities with 505 Bcf of capacity located in Texas. The most dense concentrations of gas pipelines also occur in the metropolitan areas near the respective centers of the ERCOT North Central and Coast Weather Zones with far fewer in the South Central Weather Zone(Fig. 4)⁸. Therefore, pipeline and storage service risks clearly are important issues for North Central and Coast; special concerns might apply to South Central.

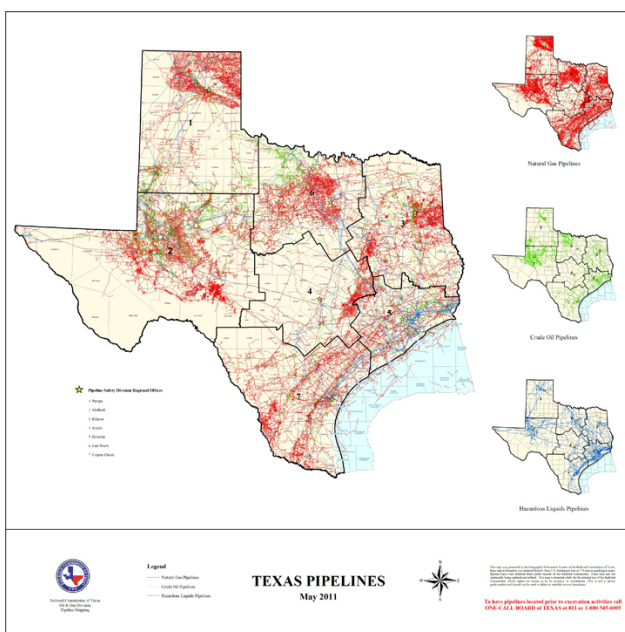


Figure 3. Texas Pipelines Map (RRC, 2011c).

4.2 TOOLS AND SOFTWARE

Black & Veatch will utilize several comprehensive models to analyze natural gas markets and infrastructure related to ERCOT's Gas Curtailment Risk Study.

Natural Gas Infrastructure Analysis

Black & Veatch will utilize RBAC's GPCM™ model to analyze the ERCOT and surrounding regions natural gas market infrastructure. The GPCM™ model operates using an advanced, proven algorithm to solve for optimal equilibrium price and quantities by balancing multiple demand and supply nodes in the market. As a network model, GPCM™ nodes represent production regions, pipelines, storage facilities, and end-use customer groups. Black & Veatch supports GPCM™ with a detailed data base of proprietary and public sources that can be modified to support ERCOT's assumptions and scenarios. Black &

⁷ RRC (2011a). Industry Statistics at a Glance. Gas Services Division, Railroad Commission of Texas, March 3, 2011, 1 p.

<http://www.rrc.state.tx.us/data/gasservices/annualrpt/AnnualIndustryStatistics30311.pdf>

⁸ RRC (2011b). Texas Pipelines. Railroad Commission of Texas, May 2011.

<http://www.rrc.state.tx.us/forms/maps/specialmaps/images/OGM0034.jpg>

Veatch professionals can customize and drill down from regional hubs to pipeline meter specific analysis.

The GPCM™ model balances supply and demand from all the regions to find an equilibrium solution that maximizes producer profit and minimizes consumer cost. Based on Nobel Prize winning economist Paul Samuelson's theory, the economically efficient, market clearing solution will dispatch lower cost supplies before more expensive ones and customers willing to pay more will be served before those willing to pay less. As shown in Figure 1, supplies from the supply region will continue to be transported to the consumption regions until either the price differentials between the two regions drops below the transportation cost or the transportation capacity between the two regions is exhausted. The resulting prices, consumption and production quantities will represent market equilibrium.

Black & Veatch professionals combine deep understanding of the economic theory that serves as the foundation of the GPCM™ model with extensive practical knowledge of the power and natural gas industries, and are therefore able to confirm that the model provides rigorous and practical business insights.

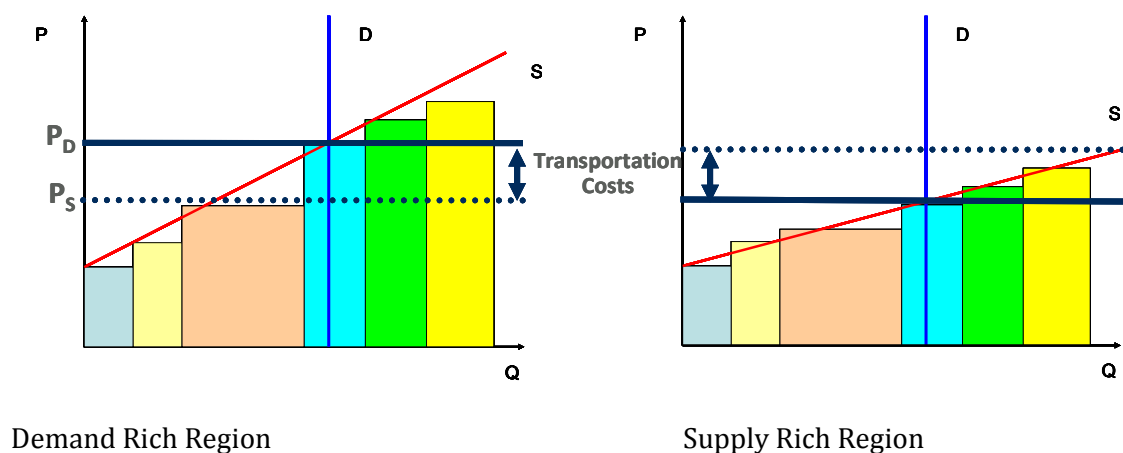


Figure 5 Supply-Demand Fundamentals. In the left-hand snapshot, quantity (Q) supplied to market grows as price (P) rises from point of production (P_S) to point of consumption (P_D). In the right-hand snapshot, the cost of transportation exceeds market price and supply retracts.

One of the challenges of understanding the risk of gas curtailment to electric generators within ERCOT is to determine the demand placed on the pipelines serving these electric generators by other sources – residential, commercial, and industrial demand within ERCOT's region as well as residential, commercial, industrial and electric demand from outside ERCOT's region that are served by the same pipelines. The GPCM™ model offers an efficient and effective methodology to model the impact of the total demand on each pipeline from other sources within and outside of ERCOT's region. The GPCM™ model achieves this by representing the entire natural gas infrastructure within North America.

The North American integrated model encompasses over a hundred different supply nodes with detailed production profiles and costs for each. For each customer group, demand nodes in GPCM™ are disaggregated from a state level all the way down to the local distribution level for all North American utilities. Over 160 interstate and intrastate natural gas pipelines are modeled and calibrated with current pipeline electronic bulletin board data and quarterly filed pipeline tariff rates. GPCM™ individually models all storage fields that report weekly to the Department of Energy EIA storage report, and all associated pipeline interconnects.

Black & Veatch will utilize GPCM™ to assess the constraints on the natural gas infrastructure in responding to demand from the electric generation sector within ERCOT under the different defined scenarios. For each scenario, a corresponding estimate of demand as well as any applicable scenario-specific infrastructure constraints (such as pipeline or production outages) will be defined. The GPCM™ model analysis will indicate the location and extent of any resulting infrastructure constraints in meeting the total, regional and location-specific demand.

Integrated Market Modeling

As part of its ever-growing Enterprise Management Solutions activities, Black & Veatch has developed an Integrated Market Modeling (IMM) process which is used to prepare its integrated long term view on energy markets, Energy Market Perspective (EMP). In order to arrive at this market view, Black & Veatch draws on a number of commercial data sources and supplements them with our own view on several of key market drivers, for example, power plant capital costs, environmental and regulatory policy, fuel basin exploration and development costs, and gas pipeline expansion.

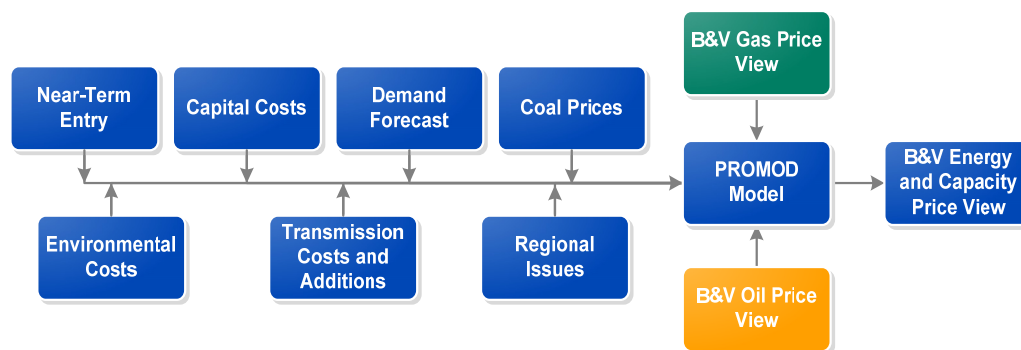


Figure 6 Black & Veatch Integrated Market Modeling Process

EMP is an integrated view of natural gas and power markets across North America, and the northern portion of Baja California, Mexico, that is electrically interconnected to the U.S. Black & Veatch's current fundamental view of natural gas, economic load growth, renewable resource penetration, and carbon allowance prices can be customized to reflect any number of input scenarios.

The proposed study period of 10 years is marked by expectations of significant growth in the use of natural gas for electric generation in North America driven by environmental policies and resulting coal retirements and the cost competitiveness of natural gas technology with other fuel sources on a fixed and variable cost basis. By providing a careful consideration of the multiplicity of factors impacting today's energy markets, the Black & Veatch

EMP uses an integrated market analysis process to arrive at a comprehensive view of how the energy world can evolve from today's starting point, providing a sound framework for decision making. Critical elements of the Energy Market Perspective include:

- A thoughtful, transparent and internally consistent approach to analysis of the energy markets and the government policies that influence them.
- A view of the markets for generation fuel sources.
- A view of the electric power markets.

The EMP is designed to capture both the broad policy level assumptions and detailed structural market representations to arrive at a consistent market view. From a "top down" perspective, Black & Veatch assesses the current state of energy and environmental policies at both a US and global level to determine their impact on North American energy markets and prices. Black & Veatch also analyzes likely future conditions in world oil and LNG markets, as these markets are becoming increasingly linked to US market conditions.

Concurrently, Black & Veatch addresses North American commodity markets with a very detailed "bottom up" approach using sophisticated structural market models to simulate market participant behavior in terms of rent extraction and new resource development, utilizing model inputs as diverse as power plant capital costs, environmental and regulatory policy, fuel basin exploration and development costs, and projected gas pipeline expansion.

In addition to a well-defined view, Black & Veatch provides ERCOT with proven expertise in integrating and iterating between natural gas structural models and electric production cost models to extract practical insights.

Probabilistic Risk Modeling

Black & Veatch utilizes Palisade DecisionTools Professional 5.0 which includes: @Risk: Stochastic simulation through Monte Carlo and Latin Hypercube algorithms; PrecisionTree: Graphical decision-tree constructor for building and solving multiple-gate optimization problems; TopRank: Automated analyzer and reporter of the most critical attributes in an Excel-based numerical model (a tornado-diagram monitor); NeuralTools: Neural-net-based algorithms for learning relationships among variables to enable predictions; StatTools: Mathematical functions for performing statistical analyses and forecasts of data

in timeseries; Evolver: Genetic algorithm for optimizing solutions for non-linear modeling of data.

For the ERCOT study, we expect that the most heavily used tools will be @Risk and PrecisionTree. The @Risk tool will be used to create probability distribution functions from event data while the PrecisionTree tool will be used to connect multiple curtailment-event variables into Monte Carlo analyses of overall curtailment risks.

Pipeline Hydraulic Modeling

Black & Veatch will rely upon GL Noble Denton's Stoner Pipeline Simulator (SPS) for hydraulic modeling of the natural gas infrastructure supporting electric generators in the ERCOT region. GL Noble Denton's Stoner Pipeline Simulator is the worldwide leader in transient flow simulation for liquid and gas pipelines. The GL Noble Denton pipeline simulation suite provides a complete range of simulation solutions from the design and planning desktop through operator training and qualification, and into online systems including leak detection and predictive simulation. SPS easily handles any combination of scenarios including control system analysis, equipment performance analysis or pressure flow capacity analysis with user-defined levels of complexity.

SPS can simulate all existing equipment, including pipes, centrifugal and reciprocating compressors and station yard piping, regulators, valves, headers and heat exchangers, exactly as it is configured in the field. The SPS idealized controls can be utilized for more simplified simulations. For example, SPS can model compressors simply, or in complete detail. SPS also tracks gas composition throughout the pipeline network with proven accuracy. With GL Noble Denton as a subcontractor, Black & Veatch will work closely with this proven tool to model the natural gas infrastructure serving electric generators in the ERCOT region and to capture the scenarios required to produce the most informational risk analysis for ERCOT.

4.3 METHODOLOGY & APPROACH – PHASE 1: ANALYZE RISK

4.3.1 Project Kick-off Meeting & Scope Confirmation

Black & Veatch will initiate a meeting at the commencement of the engagement to facilitate team introductions, alignment of goals and to establish communication plans for the duration of the study process. The key agenda items addressed at the initial kick-off meeting are anticipated to be:

- Team member introduction
- Scope review & clarification (as required)
 - Includes Black & Veatch walk through of data sources, EMP, etc
 - Level of detail to be available in ERCOT-provided documentation
- Confirmation of deliverable and timing
- Expected outcomes

- Definition of a successful / unsuccessful project
- ERCOT office location in either Austin or Taylor (or conference call with first deliverable presented in a face-to-face meeting)

4.3.2 Phase 1 – Deliverable 1

Black & Veatch will conduct research, using publicly-available information sources, to gather facts about historical cases of natural gas delivery interruptions within Texas that have impacted gas-fired electric power generation.

Black & Veatch will work with members of the ERCOT Reliability and Operations Subcommittee (ROS) and various Supporting Groups as appropriate to locate event data provided in the meeting records of these groups that is relevant to natural gas supply reliability. Historical ERCOT Monthly Operations Reports⁹, NERC System Disturbance Reports¹⁰, various FERC issued reports and historical pipeline operational information are expected to be key sources of timeline information. This information will be reviewed to compile chronological timelines for events involving curtailments or other disturbances of natural gas supplies to generation facilities. Although focus will be on the ERCOT region, gas-related incidents elsewhere will be included to the extent that they offer insights into issues relevant to ERCOT. Additional data sources such as pipeline operational flow orders (OFOs) that will be relied upon to identify natural gas interruptions are listed in Table 1. In addition, Black & Veatch will seek and incorporate information that ERCOT is able to obtain from the electric generators on natural gas interruptions that they may have experienced.

For each occurrence of natural gas interruption that is identified, Black & Veatch will examine the causal factors leading to the gas interruption. Potential causal factors that could be investigated include:

- Severe weather conditions in ERCOT
- Severe weather conditions in regions of competing demand
- Operational interruptions caused by pipeline outages
- Natural gas fuel supply driven interruptions
- Financially-driven interruptions
- Other

FMEA Fishbone or Cause and Effect diagrams will be employed to summarize and structure the causes of the natural gas interruptions identified. Figure 7 is an example of a Fishbone diagram that may be presented to ERCOT as part of Phase 1 - Deliverable 1 to examine the cause of the occurrence of a historical natural gas interruption to an electric generator.

⁹ ERCOT Operations Monthly Reports. <http://www.ercot.com/mktinfo/reports/omr/>

¹⁰ NERC System Disturbance Reports. <http://www.nerc.com/page.php?cid=5166>

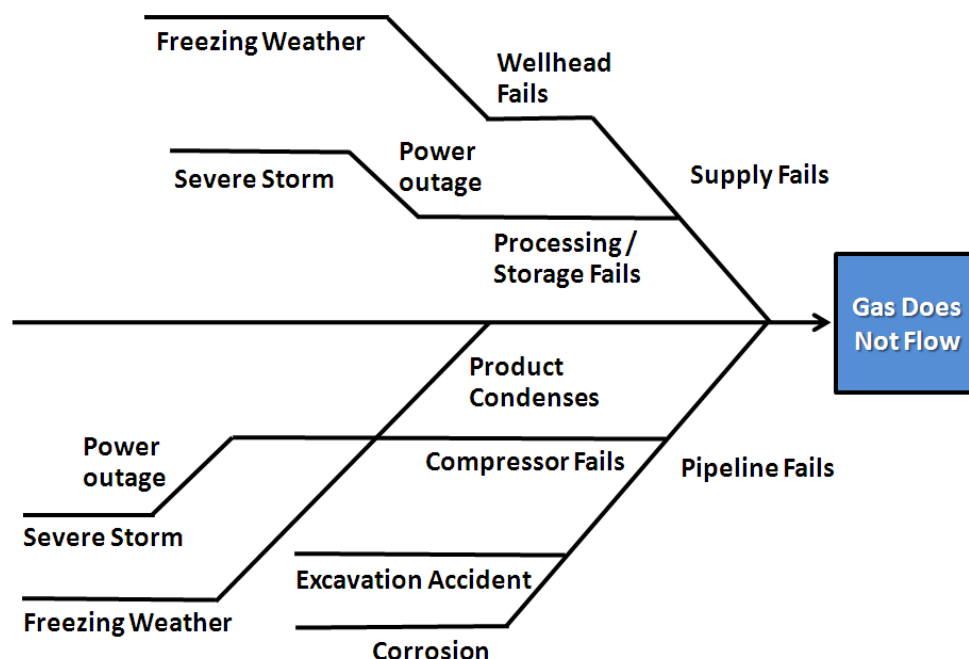


Figure 7. Example of Failure Modes and Effects Analysis (FMEA) as an Approach to Classifying Gas-Curtailment Events through Use of a “Fishbone” Diagram.

Black & Veatch will examine the common threads linking the instances of natural gas interruption identified and their causes to identify lessons that can be learned by ERCOT from these historic experiences. Common triggers and sequences of events leading to natural gas interruptions as well as any best practices that emerge will be sought and summarized to ERCOT as part of this deliverable.

Deliverables to ERCOT:

1. Excel data file listing natural gas interruptions to electric generators within ERCOT during the time period 1989-2011
2. Fishbone diagrams and /or Excel data files, as appropriate with commentary summarizing causes of identified natural gas interruptions
3. Lessons learned summarized in a PowerPoint format
4. Review with ERCOT on a conference call or a meeting in Houston

4.3.3 Phase 1 – Deliverable 2

For Phase 1 – Deliverable 2, Black & Veatch will rely on a number of data sources including the proprietary database underlying our large body of work in natural gas market analysis. Over the course of several years and multiple engagements, Black & Veatch has built an in-depth database of natural gas pipeline and storage infrastructure among various other data required for the EMP exercise. Our database lists the capacities of major natural gas pipeline systems by segment and includes the working gas capacity and deliverability of

major natural gas storage facilities. Our hands-on experience working with and providing market analysis to numerous North American and international energy companies, state governmental and regulatory bodies as well as utilities, producers, and gas pipeline and storage companies has given us an in-depth and practical understanding of the capabilities and limitations of the natural gas infrastructure in ERCOT as well as throughout North America.

In addition to our database, Black & Veatch will rely on various data sources to obtain additional detail and information on gas pipeline systems, LDCs and storage facilities.

As an initial step, Black & Veatch will work collaboratively with ERCOT to confirm the list of electric generators and their sources of natural gas supply – i.e., pipeline systems, LDC systems and storage facilities.

For gas pipeline systems, reference will be made to data maintained by the Railroad Commission of Texas (RRC)¹¹, including the online GIS-based pipeline maps¹². Additional relevant information will be sought from online documents available from PHMSA¹³ and FERC¹⁴. FERC data also will be valuable in documenting capacity and deliverability for each pertinent natural gas storage facility.

For LDCs, Black & Veatch will review system data posted on LDC websites and make data requests, as needed, to determine the physical capacity of the gas utility to serve electric generation plants with capacity higher than 100 MW.

For storage facilities, Black & Veatch will review FERC jurisdictional facility data and other public sources for capacity and deliverability. Black & Veatch maintains and utilizes a detailed database of natural gas storage facilities which will also be relied upon to determine and report the capabilities and limitations of storage facilities within ERCOT's region.

Deliverables to ERCOT:

1. Excel data file summarizing the electric generator facilities and the capacities of the natural gas pipeline systems, LDC systems and storage facilities which serve them
2. Review with ERCOT on a conference call or meeting in Houston

¹¹ Natural Gas Services, Railroad Commission of Texas.

<http://www.rrc.state.tx.us/data/gasservices/index.php>

¹² RRC Public GIS Map Viewer. <http://gis2.rrc.state.tx.us/public/startit.htm>

¹³ Data & Statistics, US Department of Transportation (DOT) Pipeline and Hazardous Material Safety Administration (PHMSA). <http://phmsa.dot.gov/pipeline/library/data-stats>

¹⁴ eLibrary, Federal Energy Regulatory Commission (FERC). <http://www.ferc.gov/docs-filing/elibrary.asp>

4.3.4 Phase 1 - Deliverable 3

Our work effort for Deliverable 3 will be focused on three main analytical efforts:

- A. Identification of Scenarios
- B. Probabilistic Analysis of Scenarios
- C. Assessing Impact of Scenarios on Natural Gas Service to Electric Generators

A. Identification of Scenarios

Black & Veatch will work collaboratively to identify and define a discrete set of scenarios that capture events likely to cause curtailment of gas supply to electric generators within ERCOT's region. These scenarios will be guided by results from Deliverable 1 and are expected to be primarily weather-driven or infrastructure-driven. Scenarios suggested by ERCOT within its RFP such as 1) severe cold weather with wind; 2) flood; 3) hurricane; 4) heavy demand from interstate pipelines (driven by weather conditions elsewhere in North America) 5) gas supply curtailments; 6) natural gas infrastructure outages will be considered for the final list of scenarios identified. Black & Veatch will include additional scenarios for consideration including rupture of major gas transmission pipelines ("trunklines") that feed multiple distribution systems. Black & Veatch will work closely with ERCOT in short-listing the most impactful and insightful scenarios for further study.

B. Probabilistic Analysis of Scenarios

The next analytical step is the probabilistic analysis of each of the scenarios to determine the risk associated with their occurrence. The probabilistic (stochastic) methodology will employ the following sequence of actions:

- Compile event data for each scenario
- Differentiate the event data into populations according to types of curtailments and causal relationships (for example, temperature, flood, pipeline failure)
- For each population, employ statistical-analysis software to derive a best-fit probability distribution function (*PDF*) that describes frequency of occurrence in the sample
- For a single-variable risk (for example, temperature) employ the *PDF* directly to derive probabilities of occurrence of the subject hazard (curtailment event) at selected timeline thresholds (for example, 5- and 10-year).
- For multiple-variable risks (for example temperature plus wind speed), perform Monte Carlo analyses using linked *PDFs*, as appropriate, to produce profiles of likelihood for curtailment events at selected timeline thresholds (for example, 5 and 10-year).

- Map-over probabilities of occurrence onto selected curtailment thresholds (for example 100 MW or higher generation outages) to establish planning guidance for ERCOT.

As an example of how probabilistic analyses would be applied to potential hazards, Figure 8 shows such an analysis for a single variable, namely, extreme low temperatures during winter. Those results can be used to place in context the extreme cold event that disturbed ERCOT in early February 2011. During the latter event, low temperatures in the Dallas-Ft. Worth area dipped to 13° F which, according to Figure 8, was an event with a winter-time daily probability of only 0.6%. Nonetheless, reality indicates that the ERCOT planning should provide for temperatures at least that low. And as further shown in Figure 8, there are small but finite probabilities for daily temperatures of 0° F or lower. The task for ERCOT is to employ results such as Figure 8 to objectively assess the costs and benefits of planning operations for successively lower temperatures. Because power generation facilities typically have upper limits for temperature also, a comparable analysis can and should be done for high temperatures during summer. For ERCOT's consideration, we will provide selected examples of high-temperature risks as part of Deliverable 3.

Table 2 identifies the weather stations that will be used to analyze weather-related risks in ERCOT comprising temperature, flooding precipitation and wind speeds from official records maintained by the US National Climatic Data Center (NCDC). Additional data pertaining to hurricane-related threats will be mined from the HURDAT database maintained by the US National Hurricane Center (NHC).

Table 2. Stations for Weather-Related Risk Analyses.

ERCOT WEATHER ZONE	WEATHER STATION		COMMENTS	
	NAME	WMO / WBAN ID	PHASE 1	PHASE 2
Coast	Houston Intl Airport	72243 / 12960	Daily data for Years 1950-2011 treated as a single population	Daily data differentiated into trend analyses for 30-year Climate Normal windows: 1951-1980 1961-1990 1971-2000 1981-2010 2011 as test
East	Tyler Pounds Field	(None) / 13972		
Far West	Midland Intl Airport	72265 / 23023		
North Central	Dallas Ft Worth Airport	72259 / 03927		
North	Wichita Falls Municipal Airport	72351 / 13966		
South Central	San Antonio Intl Airport	72253 / 12921		
South	Corpus Christi Intl Airport	72251 / 12924		
West	Abilene Rgnl Airport	72266 / 13962		

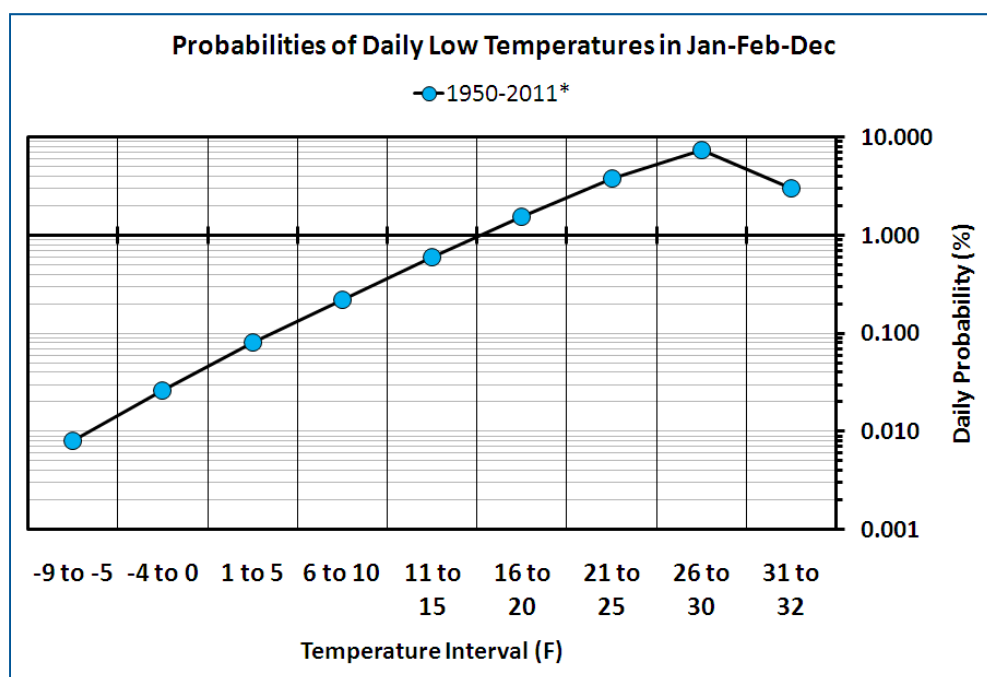
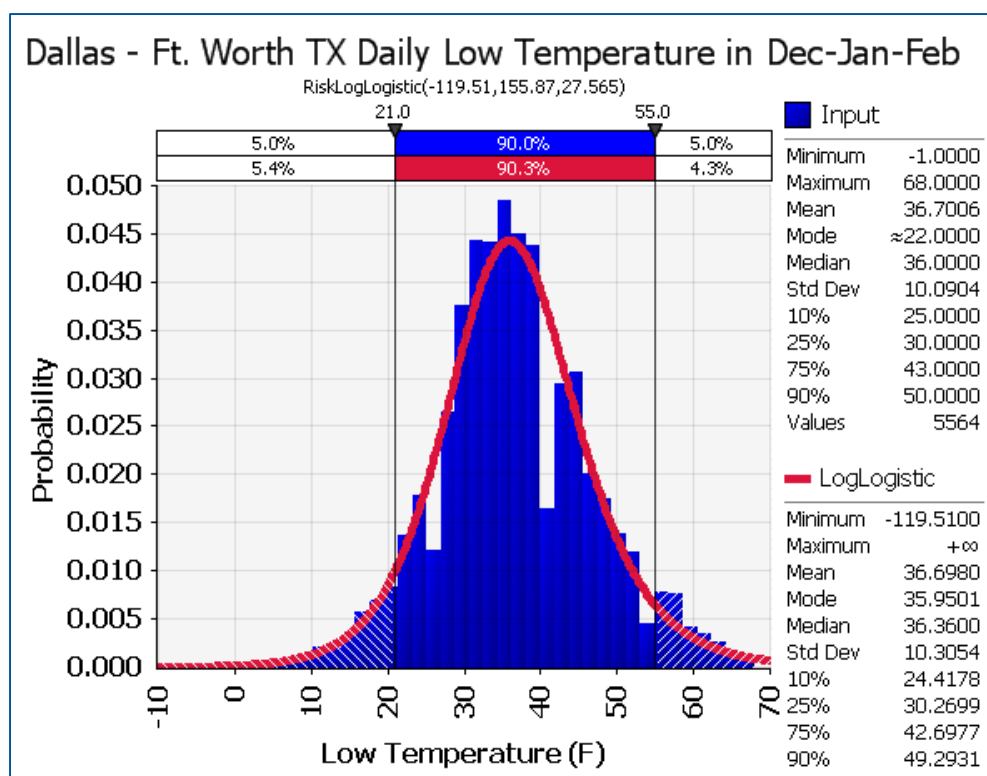


Figure 8. Example of Probabilistic Analysis of Extreme Low Temperatures That Might Occur in ERCOT, based on 1950-2011 data for Dallas-Ft. Worth, Texas. Upper chart is the statistical best-fit Log-Logistic model (red curve) for daily low temperatures during winter. The lower chart shows probabilities of occurrence (integration under the red curve) of selected temperature intervals.

C. Assessing Impact of Scenarios on Natural Gas Service

For each scenario identified, Black & Veatch will use the GPCM model to determine the impact on natural gas service to electric generators in the ERCOT region. This analytical approach is aligned with Alternative 1 proposed by ERCOT in its RFP in that it will incorporate the physical capabilities of the natural gas infrastructure in serving electric generators (as identified under Phase 1-Deliverable 2) rather than considering contractual obligations on the natural gas facilities. We believe this approach is more effective in meeting ERCOT objectives because the natural gas delivery to electric generators is ultimately driven by physical not contractual constraints, especially during extreme weather scenarios. Although there may be financial implications to procuring the gas supply needed, natural gas service will be available to electric generators subject to the physical constraints of the system. In addition, procuring all the bi-lateral contracts required to comprehensively capture the contractual obligations within ERCOT is a significant, if not impossible, undertaking that is, complicated by the lack of publicly available information.

Black & Veatch will determine the natural gas demand or supply implications associated with each of the scenarios and use these modified demand and supply assumptions as inputs to the GPCM model. The analysis will then identify any constraints within the system (caused either through increased demand or decreased supply) that impacts the availability of natural gas supply to electric generators within the ERCOT region. The constraints will be identified by pipeline segments (transmission or distribution) or storage facilities that are fully utilized, usually accompanied by natural gas price spikes.

Rather than simply extrapolating historical data, Black & Veatch's analysis will incorporate projections of natural gas supply and demand over the 10-year study period that arise from our integrated view of the energy markets developed as part of the EMP process. This integrated view projects a significant growth in the use of natural gas for electric generation in North America driven by environmental policies and resulting coal retirements and the cost competitiveness of natural gas technology with other fuel sources on a fixed and variable cost basis. Our view also incorporates a growth in natural gas supply driven by unconventional gas and regional infrastructure development to relieve constraints and get this supply to market.

These views will be adjusted to incorporate the scenarios being modeled in order to capture the impact of the scenarios against the evolving natural gas and electric markets during the study period. We believe that incorporating and modeling an integrated view of the energy markets based on fundamentals is important to represent and communicate the true risks of gas curtailment to electric generators within the ERCOT region.

Table 3 summarizes the main data sources that Black & Veatch anticipates utilizing for completion of Phase 1.

Table 3. Anticipated Sources of Project Data.

CATEGORY	SOURCE	COST ANTICIPATED	COMMENTS
Historical Natural Gas Interruption Events	ERCOT Monthly Operations Reports	None	Online data.
	National Electric Reliability Corporation (NERC) System Disturbance Reports	None	Online data.
	Railroad Commission of Texas (RRC) Pipeline Incident Reports	\$0 - \$100	A tailored data request might be necessary.
	US Department of Transportation (DOT) Pipeline and Hazardous Material Safety Administration (PHMSA) Data & Statistics.	None	Online data.
	Pipeline Operational Flow Orders; Electronic Bulletin Boards	None	Online data; Data request may be required.
Texas and National Daily Weather Data	US National Climatic Data Center (NCDC).	\$100 - \$300	Sole source of official records with fees based on number of stations.
Hurricane Data	US National Hurricane Center (NHC).	None	
Storm Damage	US Storm Prediction Center (SPC) Archived Storm Reports.	None	Supporting details including wind and flood damage.
Pipeline and Storage Facility Capacity & Operating Characteristics	Railroad Commission of Texas (RRC) Public GIS Map Viewer.	\$0 - \$100	Online data. A tailored data request might be necessary.
	Ventyx Velocity Suite	None	Subscription data service under contract with Black & Veatch.
	Lippman Consulting Inc.	None	Subscription data service under contract with Black & Veatch.
	RBAC, Inc	\$0	Subscription service under contract with Black & Veatch
	Federal Energy Regulatory Commission	\$0	Online data
	Pipeline Electronic Bulletin Boards	\$0	Online data
	Black & Veatch database	\$0	Included in project cost estimate
Detailed Historic Pipeline Flow Data & Storage Use	Lippman Consulting Inc.	None	Subscription data service under contract with Black & Veatch.

CATEGORY	SOURCE	COST ANTICIPATED	COMMENTS
Market Prices and Market Intelligence	SNL Financial	None	Subscription data service under contract with Black & Veatch.
	Platts Gas Daily	None	

4.3.5 Proposed Project Schedule for Phase 1

Black & Veatch proposes to complete Phase 1 of the analysis in accordance with the listed timeframe in the RFP.

	TASK	COMPLETION DATE
1.	Review & analysis of historic gas curtailments in Texas	September 30, 2011
2.	Completion of natural gas system model for ERCOT	November 15, 2011
3.	Calculate risk of natural gas curtailment risk to Electric Generation Stations in ERCOT	December 15, 2011
4a.	First Draft Report on Natural Gas Curtailment risk in ERCOT	December 23, 2011
4b.	Final Report on Phase 1 Results	January 2, 2012

Following is the proposed timeline for completion of identified tasks to complete the study within the timeframe required by ERCOT.

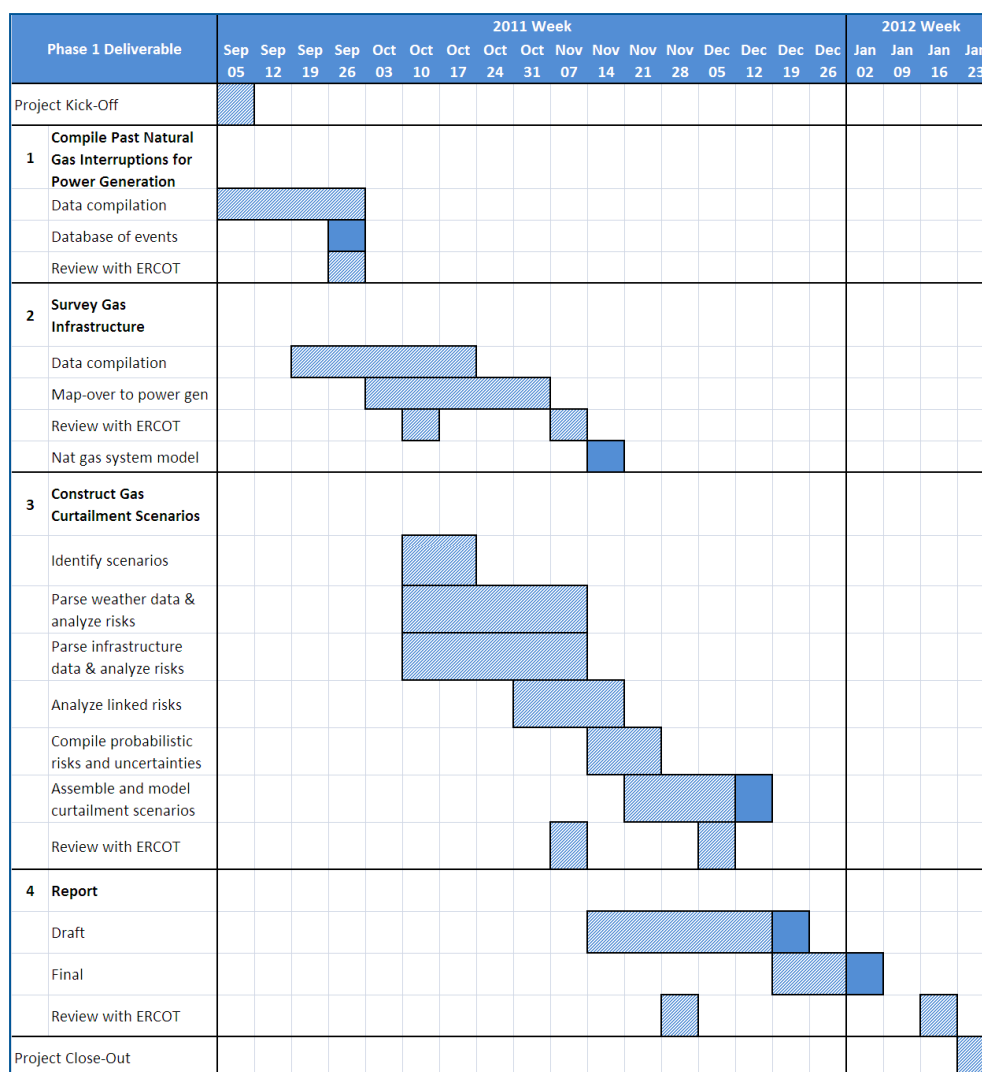


Figure 9. Proposed Schedule for Phase 1.

To meet this schedule, we request a collaborative effort with the ERCOT staff during the project to expedite the timely gathering of information and review of key assumptions and results. Our work plan estimates that data requests to ERCOT will be responded to within a week in order to facilitate completion of the study within the proposed timeline.

4.4 METHODOLOGY & APPROACH – PHASE 2: OPTIONAL SERVICE

To meet the Scope, Objectives and Deliverables of the Phase 2 requirements of the ERCOT RFP, Black & Veatch will flex its deep experience in evaluating the reliability of natural gas infrastructure to meet load requirements, relevant project experience evaluating a state-wide natural gas infrastructure's effect on the state-wide reliability of electric generation load and its collaboration with GL Noble Denton (GL), the purveyor of the most widely used physical gas flow system modeling software in the world. GL's Stoner Pipeline Simulator is the worldwide leader in transient flow simulation for liquid and gas pipelines. GL

will function as a subcontractor to Black & Veatch in this engagement under the supervision of Black & Veatch's Infrastructure Reliability/Planning Specialist and Pipeline Hydraulic Modeling Lead, Mr. John (Rod) Walker.

Black & Veatch staff has years of natural gas infrastructure planning, modeling and reliability evaluation experience and recently served in an advisory role to the California Energy Commission (CEC) to recommend a means to evaluate the effect on electric reliability of from 150-200 miles of main being taken out of service in California for replacement, re-testing or repairs by PG&E after the San Bruno incident.

In addition, Black & Veatch has significant project experience, through its Enspira group, in Geographic Information Systems (GIS) development, data collection and integration all of which are critical elements in the development of the base mapping, integration of data on which the system modeling software run the scenarios developed for Phase 2.

4.4.1 Phase 2 Objectives

1. Analyze interstate pipeline and external markets impact on ERCOT liquidity. Specifically, analyze competing residential, commercial, and industrial usage (both in-state and out-of-state) on potential curtailments of gas to ERCOT electric generation.
2. Gather data for, and utilize a commercially available gas pipeline modeling system to create a detailed hydraulic model of ERCOT gas pipeline infrastructure suitable for hourly analysis of gas consumption under scenarios
3. Create a methodology for using production cost model study results as input to the hydraulic model to create hourly gas flow profiles for each pipeline.
4. Create a methodology for allowing iteration between production cost model results and hydraulic model results.
5. Calculate with higher accuracy and precision than the phase 1 study, the risk of natural gas curtailments due to both physical risk to gathering and transport, and to commercial risks (lack of firm contractual arrangements during stress conditions)
6. Analyze sufficiency of the natural gas infrastructure within ERCOT to support the next 5 years with an expected loss of load expectation of less than 1 day in 10 years
7. Detailed hourly analysis of the natural gas needs of the power system under system stress scenarios in combination with uses by other sectors.

4.4.2 Project Approach

Black & Veatch will work collaboratively with GL Noble Denton to deliver the Objectives and Deliverables of Phase 2 based on a proven methodology used for

transient flow analysis of natural gas infrastructure systems. We propose the following Project Approach to meet these objectives and deliverables and provide interaction with ERCOT staff during the project:

1. Data Gathering & Data Request-Black and Veatch expects that data needed to support its analysis under Phase 2 will include but is not limited to the following:
 - a. Maps, data concerning the Texas natural gas pipeline infrastructure serving ERCOT
 - b. Locations and gas requirements for the natural gas power plants above 100 MW
 - c. Local Distribution Companies (LDC) tap locations and 3 years of flow/load history.
 - d. Other large gas loads connected to the pipelines directly and not downstream of the LDCs.
 - e. ERCOT Electric Model Data
 - f. Data concerning Project Drivers i.e. past curtailments, scenarios, previous studies, etc.

We anticipate that much of the data required may be acquired through Phase I work by Black & Veatch. To the extent that data not acquired in Phase 1 is required, Black & Veatch will submit a data request to ERCOT for applicable data in advance of the Kick-Off Meeting. Black & Veatch understands that ERCOT may not have all of this information and will tap internal and external sources to fill the data gaps.

2. Kick-off Meeting-Black & Veatch proposes a Project Kick-Off Meeting at ERCOT's offices to discuss and confirm Project Scope, Schedule, Roles and Responsibilities and Project Approach.
 - a. Team member introduction
 - b. Scope review & clarification (as required)
 - i. Includes Black & Veatch walk through of data sources, EMP, etc
 - ii. Level of detail to be available in ERCOT-provided documentation
 - c. Confirmation of deliverable and timing
 - d. Expected outcomes
 - e. Definition of a successful / unsuccessful project
 - f. ERCOT office location in either Austin or Taylor (or conference call with first deliverable presented in a face-to-face meeting)

3. Data Collection/Build Base Map-Black & Veatch will utilize the data collected in Task 1, 2 and through public, private sources to build the necessary GIS base map for the modeling effort.
4. Add Pipeline Information to Base Map-Black & Veatch in collaboration with GL Industries will add the pipeline data to the GIS base map and integrate into the Stoner gas system modeling software.
5. Integrate Load Data from Electrical Model, Other Sources-Working with ERCOT, Black & Veatch will integrate the ERCOT electrical model data and other data necessary for the pipeline simulation effort into the Gas System Model.
 - a. Acquire ERCOT Cost-Production (C-P) model
 - i. Acquire ERCOT C-P model or arrange with ERCOT to obtain output from specific scenarios
 - b. Model input-output interface
 - i. Model input-output interface
 - ii. Vet interface assumptions and approach through collaboration with hydraulic model team
 - c. Validation
 - i. Test & validate interface through collaboration with hydraulic model team
 - ii. Review interface design and test results with ERCOT
6. Iteration Methodology for Cost / Hydraulic Model Switches: Methodology for allowing iteration between production cost model results and hydraulic model results
 - a. Convergence criteria
 - i. Develop convergence criteria, including criteria for recognizing and arresting model overflow conditions
 - ii. Vet iteration assumptions and approach through collaboration with hydraulic model team
 - b. Validation
 - i. Test & validate iterative analyses through collaboration with hydraulic model team
 - ii. Review iterative design and test results with ERCOT
7. Develop Modeling Scenarios-Black & Veatch will analyze scenarios defined in phase 1 and additional scenarios through its experience and discussions with ERCOT to accurately assess risk. Scenarios are expected to include:
 - a. Severe cold weather with wind and nationwide cold weather

- i. For each ERCOT station, sub-divide weather data into successive Climate Normal periods and calculate risks for each period.
 - ii. For nation, simulate synoptic cold patterns using stations outside ERCOT that could pull gas to the West, North or South (for example, Phoenix, Chicago, Atlanta, New York) and calculate probabilistic risks.
- b. Hurricane threat eliminating supply from offshore and other effects.
 - i. Calibrate Gulf of Mexico supply interruptions vs. curtailment events (Phase 1) to produce an event filter.
 - ii. Compile historical tropical-cyclone tracks across to Texas and Louisiana coasts and calculate probabilities for occurrence 1-, 5- and 10-year horizons and pass through the event filter
- c. Hurricane threat eliminating supply from offshore and other effects.
 - i. Calibrate Gulf of Mexico supply interruptions vs. curtailment events (Phase 1) to produce an event filter.
 - ii. Compile historical tropical-cyclone tracks across to Texas and Louisiana coasts and calculate probabilities for occurrence 1-, 5- and 10-year horizons and pass through the event filter
- d. High swings in renewable power available to ERCOT, reflected in high swings in natural gas demand
 - i. Use B&V EMP to create time-variable profiles for renewable-energy capacity factors
 - ii. Create gas-demand variability profile by decrementing in sync with renewable capacity-factor profiles
- e. Other scenarios to be determined in consultation with the vendor and regulatory authority
 - i. Outage of major transmission pipeline as a result of rupture or other major failure
 - ii. Collaborate with ERCOT to identify and agree upon other scenarios
8. Run Modeling Scenarios-Black & Veatch in collaboration with GL Noble Denton will perform modeling runs in Stoner gas system modeling software to simulate the scenarios decided on by the Project team in Task 7.
9. Analysis Initial Modeling Runs/Calibrate Model /Analysis of sufficiency of modeling effort
 - a. Once calibrated, GL and Black & Veatch intend to show the effects of transient power loads on an intra-day basis and over a multi day period. While the impacts of intra-day swings are apparent, many times the impact to a particular pipeline segment builds up on a cumulative multi day basis. A pipeline may be able to accommodate heavy intra-day

- swings, but such swings, if repeated over several days, can diminish flexibility faster than a pipeline can “repack” overnight. This can also result from overnight wind de-ratings that shift loads onto pipelines at the time when the system linepack is typically restored. It is important to capture the multi day stress on the representative pipeline segment.
- b. Black and Veatch and GL Noble Denton will analyze the initial modeling runs and determine in collaboration with ERCOT the sufficiency of the data runs to meet project objectives including identifying the risks from a physical flow restriction/interruption of power generation assets and expected price/demand sensitivity of sectors.
10. Calculate with higher accuracy and precision than the Phase 1 study, the risk of natural gas curtailments due to physical risk to gathering and transport, and other risk factors:
- a. Sensitivity tests for:
 - i. Data sub-populations
 - ii. Best-fit model functions
11. Analyze sufficiency of the natural gas infrastructure within ERCOT to support the next 5 years with an expected loss of load expectation of less than 1 day in 10 years
- a. Use tornado-plot analyses to identify the top-ranked variables with regard to curtailment probability
 - b. Monte Carlo simulations of multiple risks
 - i. Use tornado-plot analyses to identify the top-ranked variables with regard to curtailment probability
 - ii. From Monte Carlo results, extract daily risk probabilities at 1, 5 and 10-year milestones and by season (summer vs. winter)
 - c. Consider risk drivers such as weather, infrastructure, demand swings
 - d. Aggregate uncertainties
 - i. Analyze and compile overall uncertainties for linked risks
 - e. Review & integrate Deliverables 1-5 results
 - f. Review preliminary findings with ERCOT
12. Develop Reports-Black & Veatch will produce a report that summarizes the data, methodology and findings of the modeling runs including identification of risks to power generation and potential curtailment issues within the ERCOT system.
13. Present Findings to ERCOT staff/Perform Training-Black & Veatch will meet with ERCOT at its offices to discuss its findings and instruct staff at a how to utilize the results and develop alert processes.

4.4.3 Deliverables

Through the above project approach, Black & Veatch will produce the following deliverables:

1. Creation of Hydraulic model of gas pipeline systems that impact gas supply to ERCOT generation.
2. Integration of Hydraulic natural gas model with electric generation production cost-model (may be procedural)
3. Define and Analyze Scenarios
4. Calculate risks with detailed model
5. Analyze sufficiency
6. Preparation of report
7. Provide results of detailed analysis of ERCOT pipeline hydraulic and market interaction for scenarios developed in Phase 1 (Section 2.3.3) of the study and three additional scenarios.

4.4.4 Proposed Project Schedule for Phase 2

Black & Veatch proposes to complete Phase 2 of the analysis in accordance with the timeframe indicated below in Figure 10.

	TASK	COMPLETION DATE
1.	Project Kick off - Notice to Proceed/Data Request	February 6, 2012
2.	Hydraulic Model of ERCOT Gas Pipelines	March 20, 2012
3.	Interface Methodology for ERCOT Cost-Production Model	April 3, 2012
4.	Iteration Methodology for Cost / Hydraulic Model Switches	April 3, 2012
5.	Detailed Analysis of Curtailment Risk Scenarios	April 10, 2012
6.	Risk Probabilities with Increased Precision	April 10, 2012
7.	Analyze Gas Sufficiency in ERCOT	April 24, 2012
8.	Present Findings to ERCOT/Staff training	May 22, 2012

Figure10. Phase-2 Delivery of Gas Sufficiency Outlook.

Following is the proposed timeline for completion of identified tasks to complete the study within the timeframe specified above.

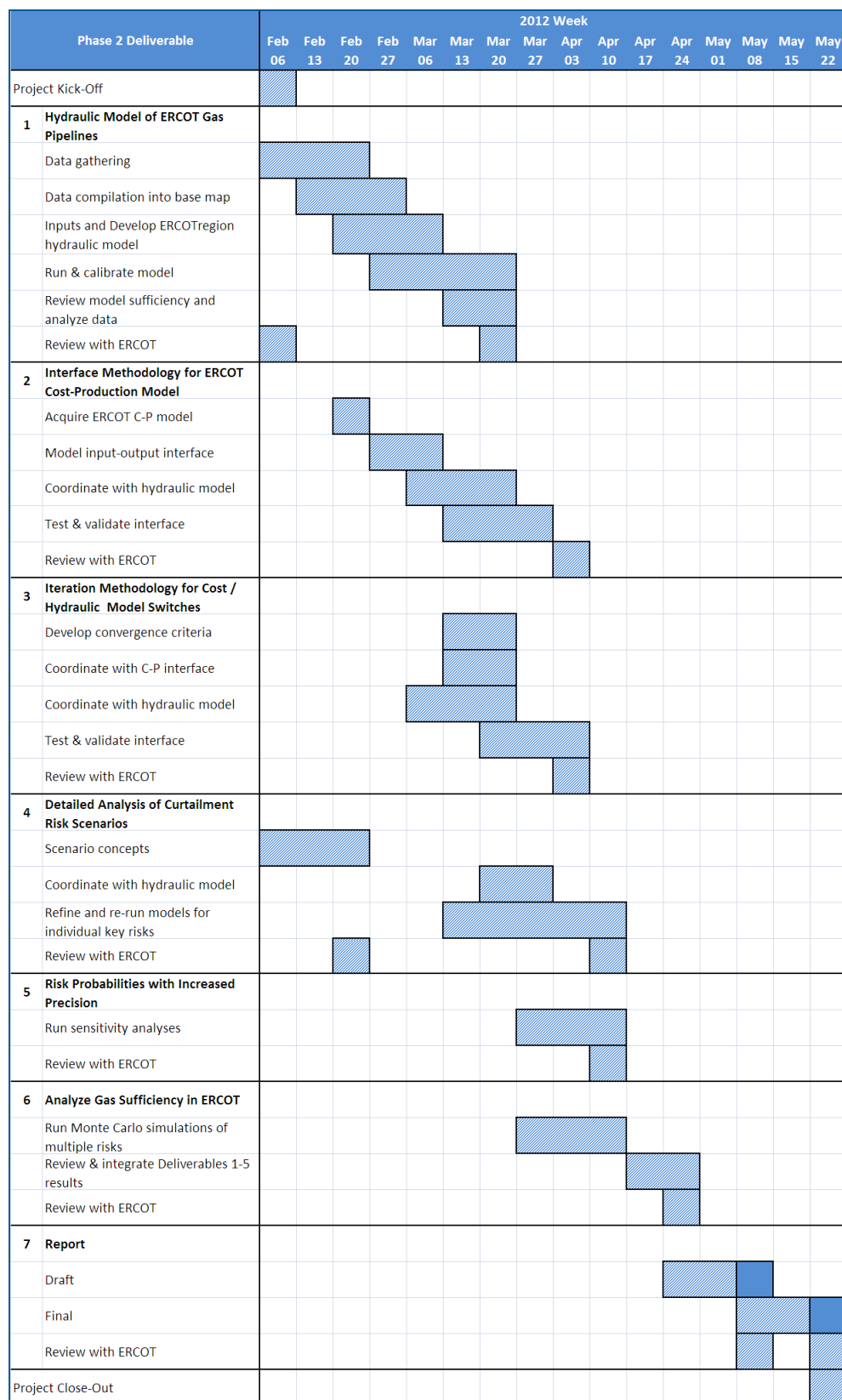


Figure 11. Proposed Schedule for Phase 2.

5.0 Assumptions

The work plan and schedule proposed above by Black & Veatch assumes availability and timeliness of information and feedback from ERCOT. The key assumptions are as follows:

■ Data and Information

- ERCOT will provide background data on the following topics no later than one week after project kick-off:
 - Characteristics of gas-fired power generation facilities, including locations, generation capacities and maximum hourly gas consumption plus confirmation about any dual-fuel capabilities
 - Inventory of electrically-powered gas-compression equipment, and other gas-related equipment, at gas-fired power generation facilities
 - Output results, and accompanying written explanations, from ERCOT's latest electric forecast model
 - ERCOT Monthly Operations Reports which might be archived online (i.e., not available from the ERCOT website)
- ERCOT will support and endorse special data requests to the Railroad Commission of Texas as prepared by Black & Veatch
- ERCOT will support and endorse special data requests to individual generation facilities, with regard to their natural gas use and infrastructure, as prepared by Black & Veatch

■ Schedule and Response

- ERCOT will provide feedback on draft work products and draft reports within two weeks of receipt
- ERCOT will provide in writing any change requests (scope or schedule) and will review with Black & Veatch before changes are accepted or implemented by Black & Veatch
- ERCOT is agreeable to conducting most regular or routine meetings through webinars or teleconferences with travel by Black & Veatch being reserved only for major milestones

■ Cost estimate – Phase 1

- Based on modeling the finite list of scenarios listed in the proposal with an additional one or two scenarios as needed
- In order to maintain cost effectiveness for ERCOT, Black & Veatch's proposal offers to provide periodic intermediate reviews to ERCOT through conference calls or meetings in Houston. We are happy to provide these reviews in Taylor or Austin at ERCOT's request with incremental travel-related expenses and fees for applicable professional hours.

- Can be refined at Kick-off meeting to adjust if Scope, Schedule and Work Products change.
- Cost estimate – Phase 2
 - The cost proposal is based on the work plan submitted. We recognize that ERCOT may elect to modify scope based on results from Phase 1. If ERCOT elects to do so, Black & Veatch will update our work plan and cost proposal to reflect modified needs.
 - Based on modeling 3 scenarios until each model calibrates.
 - Can be refined at Kick-off meeting to adjust if Scope, Schedule and Work Products change.

6.0 Appendices

6.1 BLACK & VEATCH EXPERIENCE MATRIX

Matrices below summarize Black & Veatch's experiences for each service area.

Natural Gas Services

PROJECT DESCRIPTION	CLIENT TYPE	SERVICES PROVIDED					
		STATE/COUNTRY	MARKET ANALYSIS	FACILITY/ PIPELINE VALUATION	MARKET RATES/ COST OF SERVICE	REGULATORY ANALYSIS/ MARKET POWER REPORT	STRATEGY & OTHER
Market Assessment and Strategy Support for Proposed LNG Receiving Terminal	Private Equity/ Developer	TX	●	●			
Strategic Assessment and Rate Review	LDC	GA	●	●	●	●	●
Potential LNG Development and Trade	Government	AK	●	●			●
Natural Gas Pipeline Development	Government	AK	●		●	●	●
Mid-West Gas Storage Assessment	Storage Developer	MI	●	●	●		
Northeast Storage Asset Financing	Storage Developer	NS	●	●	●		
LNG Regasification Capacity Valuation	Major Producer	Various	●	●			●
Gulf Coast Gas Storage Assessment	Marketer/Trader	TX		●			
Gulf Coast Gas Storage Asset Acquisition	Private Equity/ Developer	TX	●	●	●		
FERC Compliance	NG Marketing Company	Various				●	
Market Assessment and Strategy Support for LNG Receiving Terminal in the Northeast	Major Producer	Various					
Gulf Coast Market Power Study	Storage Operator	LA	●			●	
Gulf Coast Market Power Study	Storage Operator	LA	●			●	
Storage Valuation	Private Equity/ Developer	PA	●	●			
Due Diligence	Utility	LA	●	●	●	●	
Market Analysis and Strategy Support for Pipeline Development	Pipeline Operator	TX					●
Gulf Coast Gas Storage Assessment	Storage Developer	TX	●	●			●
Permian Gas Storage Assessment	Storage Operator	NM	●	●			●
Market Analysis and Strategy Support for Pipeline Development	NG Marketing Company	OK/TX	●	●			●

PROJECT DESCRIPTION	CLIENT TYPE	SERVICES PROVIDED					
		STATE/COUNTRY	MARKET ANALYSIS	FACILITY/ PIPELINE VALUATION	MARKET RATES/ COST OF SERVICE	REGULATORY ANALYSIS/ MARKET POWER REPORT	STRATEGY & OTHER
Gulf Coast Storage Valuation	Law Firm	LA		•		•	
Market Analysis and Strategy Support	Pipeline Operator	VA	•	•	•	•	•
Market Assessment and Strategy Support for LNG Receiving Terminal in the Northeast	LNG Developer	ME	•	•			•
Market Assessment and Litigation	NG Marketing/ Pipeline Operator	Various	•			•	
Gas Storage Assessment	Storage Developer	LA/CN	•	•			
Northeast Gas Storage Assessment	Storage Developer	PA/MI	•	•			
Gas Storage Assessment	Storage Developer	TX, MS, NW	•	•	•		
Gas Storage Valuation and Competitive Analysis	Storage Operator	TX/MS	•	•	•		
Market Index Analysis	Storage Operator	TX				•	
Market Analysis and Strategic Support	LDC	PA		•			•
Market Assessment and Strategy Support for Gulf Coast LNG Receiving Terminal	Major Producer	TX	•	•			•
Market Assessment and Project Valuation for Proposed LNG Header Pipeline	Major Producer	TX/LA	•	•	•		•
Gulf Coast Gas Storage Assessment	Storage Developer	MS	•	•	•		
Market Assessment and Strategy Support for Storage and Pipeline Assets	NG Marketing Company	Various	•	•			•
Florida Gas Storage Assessment	Storage Developer	FL	•	•	•		
Gulf Coast Gas Storage Assessment	Storage Developer	MS	•	•			
Gas Storage Valuation and Due Diligence	Marketer/Trader	MS	•	•	•		
Gas Storage Valuation and Due Diligence	Marketer/Trader	CO	•	•	•		
Gas Storage Valuation and Due Diligence	Marketer/Trader	CA	•	•	•		
Gas Storage Valuation and Due Diligence	Marketer/Trader	LA	•	•	•		
Gas Storage Valuation and Due Diligence	Marketer/Trader	MS	•	•	•		
Pipeline Valuation for LNG Header System	LNG Developer	TX	•	•			
Market Assessment and Strategy Support for LNG Receiving Terminal in the Canada	International Marketer	Various	•	•			
Litigation Support	Law Firm	TX				•	

PROJECT DESCRIPTION	CLIENT TYPE	SERVICES PROVIDED					
		STATE/COUNTRY	MARKET ANALYSIS	FACILITY/ PIPELINE VALUATION	MARKET RATES/ COST OF SERVICE	REGULATORY ANALYSIS/ MARKET POWER REPORT	STRATEGY & OTHER
Market Assessment and Price Projections for a Proposed LNG Terminal	Private Equity/ Developer	TX	●	●			●
Gas Storage Valuation and Due Diligence	Private Equity/ Developer	Various	●	●	●		
Market Assessment and Strategy Support for a Proposed Gulf LNG Receiving Terminal	Private Equity/ Developer	TX	●				
Market Assessment and Strategy Support for Major LNG Receiving Terminal in Eastern Gulf	Private Equity/ Developer	MS	●	●			●
Gulf Coast Gas Storage Assessment	Storage Developer	TX	●	●			
Report on Direct Use of Natural Gas	Trade Association	N/A	●			●	●
Economic Benefit Analysis	Government	Malta					●
Market Analysis and Strategic Support	Pipeline Operator	NY	●	●			●
Strategic and Regulatory Support	Government	CO	●	●			●
Market Assessment and Strategy Support Potential LNG Sponsors	International Marketer	Various	●				●
Gulf Coast Gas Storage Assessment	Storage Developer	TX	●	●		●	
Market Assessment and Project Valuation for Proposed Pipeline in the Northeast	Pipeline Operator	NY	●	●			●
Gas Storage Assessment	Storage Developer	CA/AB	●	●			
Market Analysis and Strategic Support for Pipeline Development	Pipeline Operator	Various	●	●	●	●	●
Gas Storage Valuation and Due Diligence	LDC	MS			●		
Rate Review and Expert Report	Pipeline Operator	Midwest			●	●	
LNG Regasification Capacity Valuation	LNG Developer	TX	●	●			●
Gulf Coast Gas Storage Assessment	Storage Developer	LA	●	●	●		
Mid-West Gas Storage Assessment	Private Equity/ Developer	KY	●	●	●		●
Gas Storage Assessment	Marketer/Trader	CA	●	●			
Market Analysis and Strategic Support	Utility	PA	●				●
Gulf Coast Gas Storage Assessment	Storage Developer	LA	●	●	●		
Gulf Coast Gas Storage Assessment	Private Equity/ Developer	MS	●	●			

PROJECT DESCRIPTION	CLIENT TYPE	SERVICES PROVIDED					
		STATE/COUNTRY	MARKET ANALYSIS	FACILITY/ PIPELINE VALUATION	MARKET RATES/ COST OF SERVICE	REGULATORY ANALYSIS/ MARKET POWER REPORT	STRATEGY & OTHER
Gulf Coast Gas Storage Assessment	Storage Developer	TX	●	●			
West Coast Storage Valuation	Storage Developer	CA		●	●		
Market Assessment and Supply Contract Analysis	Utility	SC	●		●	●	●
Market Assessment and Strategy Support for East Coast LNG Receiving Terminal	NG Marketing Company	N/A	●	●			●
Rockies Market Power Study	Storage Operator	WY	●			●	
Market Assessment, Strategy/Regulatory Support	Government	AK	●	●	●	●	●
Market Assessment and Strategy Support for Major LNG Receiving Terminal in the Northeast	Major Producer	MD	●	●			●
Production Expectation and Infrastructure Commercial Assessment of NA Unconventional Gas Productions	International Producer	Various	●	●			●
Gas Storage Assessment	Storage Operator	Canada	●	●			
Mexican/So. Texas Gas Storage Assessment	Storage Developer	MEX	●	●			●

Power Service

CLIENT	JURISDICTION	SERVICES PROVIDED											
		BOND FEASIBILITY/ENGINEER'S CERTIFICATE	DEPRECIATION/PLANT UNITIZATION	ECONOMIC/FINANCIAL FEASIBILITY	EXPERT WITNESS TESTIMONY	LOAD FORECAST/SYSTEM STUDIES/DSM	MANAGEMENT REPORTS	OPERATIONS REPORTS	OTHER	POWER SUPPLY EVALUATION	RATES/COST OF SERVICE	UNBUNDLING/TRANSMISSION RATES	VALUATION/APPRaisal
Alexandria Utilities Division,	LA										•	•	
Aquila													•
Aspen Electric Department	CO										•		
Associated Electric Coop Incorporated	MO	•											
Bamberg Board of Public Works	SC										•	•	
Black Hills Power	SD		•										
Board of Public Utilities - Kansas City	KS	•		•	•				•	•	•		•
Brownsville Public Utilities Board	TX					•					•	•	
Cheyenne Light, Fuel & Power	WY		•		•								
City Public Service - San Antonio	TX			•									
Cleveland Public Power	OH	•											
COELCE, Brazil	International												•
Columbus Power	OH			•						•			
CU Power/Suncor Inc	Alberta												•
Cumberland County	NC			•									•
Dayton Power & Light	OH			•					•	•			
Denton Municipal Utilities	TX						•						
Empire District Electric Company	MO		•	•	•	•				•	•		
ENMAX	Alberta				•			•			•	•	
Escanaba	MI									•	•		
Estes Park	CO										•		

CLIENT	JURISDICTION	SERVICES PROVIDED											
		BOND FEASIBILITY/ENGINEER'S CERTIFICATE	DEPRECIATION/PLANT UNITIZATION	ECONOMIC/FINANCIAL FEASIBILITY	EXPERT WITNESS TESTIMONY	LOAD FORECAST/SYSTEM STUDIES/DSM	MANAGEMENT REPORTS	OPERATIONS REPORTS	OTHER	POWER SUPPLY EVALUATION	RATES/COST OF SERVICE	UNBUNDLING/TRANSMISSION RATES	VALUATION/APPRaisal
Estrella Mountain Ranch	AZ			•									
Eugene Water and Electric Board	OP	•				•		•			•		
Florida Power Corporation	FL	•											
Foley-Bellows Falls	MA												•
Gainesville Regional Utilities	FL		•					•	•	•	•	•	
Gardner	KS												•
Geneva	IL					•					•	•	
Georgia Transmission Corporation	GA	•	•										
Grand Haven	MI			•						•			
Great River Energy (f/k/a United Power Association)	MN										•	•	
Greenville Utilities Commission	NC	•									•		
Griswald	CT												•
Harrisonville	MO										•		
Hastings Utilities Department	NE			•				•		•	•	•	
Hawaii Electric Company	HI												
Independence Power & Light Department	MO			•				•		•			
Indianapolis Power and Light Co	IN												•
Jamestown Board of Public Utilities	NY			•							•		
JEA	FL		•								•		
Kauai Island Utility Cooperative	HI										•		
Lincoln Wastewater System	NE										•		

CLIENT	JURISDICTION	SERVICES PROVIDED											
		BOND FEASIBILITY/ENGINEER'S CERTIFICATE	DEPRECIATION/PLANT UNITIZATION	ECONOMIC/FINANCIAL FEASIBILITY	EXPERT WITNESS TESTIMONY	LOAD FORECAST/SYSTEM STUDIES/DSM	MANAGEMENT REPORTS	OPERATIONS REPORTS	OTHER	POWER SUPPLY EVALUATION	RATES/COST OF SERVICE	UNBUNDLING/TRANSMISSION RATES	VALUATION/APPRaisal
Mead Corporation	MA									•			
Memphis Light, Gas & Water	TN							•					
Michigan Municipal League	MI									•			
Midwest Energy	KS				•							•	
Murray City	UT										•		
Nebraska Public Power District	NE									•			
Nomura Research Institute, Japan	International								•				
North Carolina Electric Membership Cooperative	NC		•										
Old Dominion Electric Cooperative	VA		•										
Oglethorpe Power Corporation	GA		•										
Oklahoma Municipal Power Authority	OK	•									•		
Orangeburg, SC Department of Public Utilities	SC		•			•	•			•	•	•	•
Orlando Utilities Commission	FL	•		•				•					
Otter Tail Power Company	MN	•											
PacificCorp	UT		•		•								
Pacific Gas and Electric	CA												•
Piedmont Municipal Power Agency	SC					•							
Platte River Power Authority	CO	•		•						•	•	•	
Public Service of New Hampshire	NH	•											
Public Service Electric & Gas	NJ												•

CLIENT	JURISDICTION	SERVICES PROVIDED											
		BOND FEASIBILITY/ENGINEER'S CERTIFICATE	DEPRECIATION/PLANT UNITIZATION	ECONOMIC/FINANCIAL FEASIBILITY	EXPERT WITNESS TESTIMONY	LOAD FORECAST/SYSTEM STUDIES/DSM	MANAGEMENT REPORTS	OPERATIONS REPORTS	OTHER	POWER SUPPLY EVALUATION	RATES/COST OF SERVICE	UNBUNDLING/TRANSMISSION RATES	VALUATION/APPRaisal
Raquette Hydro Power	NY												•
Santee Cooper	SC		•										
Sikeston Board of Municipal Utilities	MO							•			•	•	
Somerset, NY (Kintigh Power Station)	NY												•
South Norwalk Electric Works	CT			•									
Southern Maryland Electric Coop (SMECO)	MD		•										
Springfield City Utilities	MO		•					•					
Texas Municipal Power Agency	TX												•
Town of Somerset, NY (AES)	NY												•
U. S. Generation, Bear Swamp Plant	MA												•
University of California - Davis	CA			•						•			
University of California - San Francisco	CA			•						•			
Village of Freeport	NY				•						•		
Village of Rockville Centre	NY				•						•		
Wallingford	CT										•	•	
Westar Energy	KS		•		•					•			
Wyandotte	MI						•				•		

6.2 BLACK & VEATCH RESUMES

Scott Smith

Mr. Scott Smith is a Vice President with B&V Management Consulting and leads B&V's focus across industry sectors. He has over twenty five years of energy industry experience. Mr. Smith's consulting focus and expertise includes energy market analysis, risk management, energy asset valuation, energy asset optimization, business strategy development, and energy decision analysis.

PROJECT EXPERIENCE

State of Alaska – Alaska Pipeline Economic Advisory Services

Black & Veatch was engaged to assist the State evaluate proposals related to the Alaska Gasline Inducement Act. Mr. Smith's activities included overseeing a team of Black & Veatch professionals to analyze the economic impacts to the State from "sponsoring" a pipeline project. The effort included numerous public presentations and testimony to the State of Alaska Legislature in 2008. Key project activities were natural gas price forecasts, integration of 3rd party oil and LNG forecasts into the economic analysis, economic model development, Monte Carlo based risk analysis, and an assessment of strategic implications.

Confidential Client – CFTC and FERC Market Manipulation Investigation

Black & Veatch was engaged to provide an independent opinion whether a large North American energy marketer and trader manipulated specific natural gas markets. The project required Black & Veatch to review company transaction records, independently value transactions and provide an assessment as to whether the company's use of transportation capacity and financial swaps were inappropriate. Black & Veatch provided an expert report and interfaced with CFTC/FERC staff.

Dow Chemical Company – Rebuttal Expert Report

Black & Veatch was retained to review and rebut an expert report concerning the valuation of interruptible and parking and lending services associated with Gulf South's Magnolia storage project.

Confidential Client – Privileged Consultation for a Gas Storage Valuation Dispute

Black & Veatch was engaged to provide an independent opinion on the value of a disputed amount of natural gas storage working gas capacity. Black & Veatch provided expert opinions, general market advice and a valuation report to the client for use in resolving the dispute.

EnCana Corporation – Gas Market Analysis

Mr. Smith led a Black & Veatch team to provide long term forecasts of future natural gas flows and prices for pipelines connected to or near a proposed gas storage facility in Louisiana. The monthly forecasts were made using an economic model of the North American natural gas market and a combination of public and proprietary data regarding future gas supply, demand, transportation

VICE PRESIDENT

Specialization:
Energy Strategy, Market Analysis, Asset Valuation, Asset Optimization, Fuel Supply, Commercial Negotiations, Expert Witness, Decision Analysis

Education

- M.B.A., Southern Methodist University (1990)
- B.S., Chemical Engineering, The University of Texas at Austin (1982)

Professional Associations

- American Gas Association
- Energy Bar Association
- Southern Gas Association

Year Career Started
1985

Year Started with B&V
1999

capacities and transportation costs. The forecasts were completed for several scenarios regarding Gulf Coast LNG imports. The basis differential and gas flow forecasts were used to quantify the likely profitability of the proposed gas storage facility.

State of Alaska – Demand and Pipeline Study

Demand for natural gas in South Central Alaska is currently being met by production in the Cook Inlet region. Mr. Smith evaluated the need for new supplies via a spur pipeline from the North Slope based on expected declines in Cook Inlet production. Mr. Smith's analysis utilized existing forecasts to project the need for new storage capacity and pipeline capacity in the South Central region. The majority of the analysis involved converting an annual forecast into monthly and daily peak forecasts based on projected growths by sector, historical consumption patterns and variations in weather.

California Institute for Energy and Environment – Analysis of California Natural Gas Market

Mr. Smith led a team of Black & Veatch consulting professionals to analyze the natural gas market in the Western United States to understand the need for new natural gas supply infrastructure for California through the 2020 time period. The analysis and report completed for CIEE focused on storage and the impediments, operations and economic, that would hinder future storage development in the State of California.

CenterPoint Energy – Pipeline Strategy & Competitive Assessment

CenterPoint asked Mr. Smith to evaluate the competitiveness of its existing pipeline services relative to competing pipelines in key market regions. Mr. Smith evaluated pipeline flows, capacities, transaction trends and CenterPoint's position to understand relative supply costs. In addition, Mr. Smith identified targeted acquisition opportunities based on CenterPoint's corporate objectives.

Pacific Energy Partners – Lodi Storage M&A Support

Pacific Energy retained Mr. Smith to assist in the valuation and acquisition due diligence of Lodi Storage located in California. Mr. Smith evaluated and projected the value of storage services for Lodi using our Storage Valuation Advisor™ software based on alternative future market scenarios. In addition, we analyzed risk associated with Lodi's commercial portfolio and developed alternative revenue projections based on the buyers willingness to accept risk.

Arcapita – Falcon Gas Storage

Arcapita, an energy investment fund, retained Mr. Smith to assist in the valuation and acquisition due diligence of Falcon Gas Storage. The project required valuing the services from Falcon Gas' existing storage facility, Hill Lake, located in Texas. Mr. Smith utilized B&V Management Consulting's Storage Valuation Advisor™ model to understand how storage service values will change as Falcon Gas expands this facility. Mr. Smith was also asked to evaluate the

storage development projects that Falcon Gas owns to understand their commercial viability and key risks associated with development. In addition, Mr. Smith provided advice on the acquisition structure to mitigate risks for the buyer.

Stephens Group – Spiro Storage Project Valuation and Market Power Study

Mr. Smith was retained by Stephens Group to develop a market based valuation of a proposed independent storage facility in Eastern Oklahoma. Mr. Smith completed a market power study to assist the client in their request for market based rate treatment from FERC. In addition, we assisted Stephens Group develop a cash flow model and cash flow projections for the facility.

Chugach Electric – Alaska LNG Export Assessment

LNG exports from Alaska were analyzed to understand the potential netback prices to expect at the time of the export license renewal. Mr. Smith analyzed Asia basin LNG supply demand, shipping costs, production costs and expected netback prices to Cook Inlet producers.

Brazos Electric Cooperative – Fuel Supply Plan and Portfolio Development

Mr. Smith was retained by Brazos Electric Cooperative to develop a fuel supply plan for its Texas generation facilities. Fuel supply plans were developed and utilized as a basis for negotiating transportation and supply agreements and obtaining financing approval for Brazos through the RUS. Specific project tasks in developing the supply plan included identification of the key decision criteria for a fuel supply plan, incorporation of plant operating characteristics and associated uncertainty, identification of supply alternatives including transportation and storage, estimation of the cost of each alternative, development of a prioritized supply plan that maximizes value for the company relative to the key decision criteria and negotiating key commercial agreements.

SCANA – LNG Supply Strategy Development

The Cove Point and Elba Island LNG terminals have dramatically changed the natural gas market in the Southeastern U.S. Scana asked Mr. Smith to analyze the implications to natural gas basis and pipeline flows in the Southeast from these terminals and their associated expansions. Using our proprietary models, we forecasted how basis may change in the region under different pipeline expansion scenarios. Based on the results of this analysis, Mr. Smith assisted Scana develop pipeline capacity strategies for supplying its utility and unregulated marketing subsidiaries and pipeline expansion strategies for its intrastate pipeline subsidiary.

Equitable Gas – Hedging Portfolio Optimization

Equitable required assistance to analyze gas supply hedging strategies and develop a recommendation for the state utility commission for hedging gas supply purchases. Mr. Smith first interfaced with executives at Equitable to determine the company's tolerance for risk and the risk metrics to measure

hedging benefits. Once the risk metrics were formalized, Mr. Smith developed a proprietary hedging model to measure the effectiveness of numerous potential hedge portfolios given price uncertainty, weather uncertainty, load uncertainty and Equitable's existing supply portfolio. The model results were then ranked given the risk metrics developed. Mr. Smith also incorporated our recommendation into a report for Equitable to review with the state utility commission.

Montana Alberta Tie – Merchant Power Transmission Valuation

Montana Alberta Tie is a proposed independent transmission facility between Alberta Canada and northern Montana. Mr. Smith was asked to value transmission service from the proposed facility using a framework that considered the arbitrage value between the Alberta and Mid-C markets. Mr. Smith constructed an arbitrage model of the transmission facility that incorporated future projections of wholesale power prices, volatility of power prices and correlation between the two main markets. The valuation results were presented at Montana Alberta Tie's open season meeting.

NiSource – Columbia Pipeline Acquisition and Integration

Mr. Smith was retained by NiSource to support their successful effort to acquire Columbia Energy. Mr. Smith developed cash flow models of Columbia's pipeline, energy marketing and gas LDC business units; advised NiSource on the potential economic effect of pending regulatory issues; evaluated potential expansion strategies for the Columbia business units; and participated in risk analysis and scenario planning. Following the merger, Mr. Smith was retained to assist with merger integration. Focus of the effort was integration of energy marketing operations at the two companies. Mr. Smith led a task force comprised of NiSource and Columbia executives to identify specific strategies and action steps to achieve earnings growth targets.

Anadarko Petroleum Corporation – Structuring and Risk Management Support

Mr. Smith provided trading strategies, energy market analysis and quantitative analytical support of Anadarko Petroleum's natural gas and electric power projects from 2001 to the present. Part of Mr. Smith's work included the valuation of derivative contracts for gas and power, valuation of gas storage facilities and valuation of power purchase costs in the Southeastern US. For Anadarko's LNG projects, Mr. Smith used B&V Management Consulting's Energy Risk Advisor™ LNG Risk module to assess the incremental optionality value of spot LNG cargoes and LNG shipping under specific scenarios.

Asset Valuation and Optimization Models

Mr. Smith has developed proprietary software models to value and optimize energy assets. The software models include Storage Valuation Advisor, Storage Trader, Transportation Valuation Advisor, PAL Optimizer, EvoSuite Enterprise Risk Management, and the Analytical Tool Kit. Licensees for these models

include: Aquila, Dominion Energy, Cinergy, CMS, Panhandle Pipeline, Texaco, BP, ANR Pipeline, El Paso Corp, Sequent Energy, Western Hub Properties, Magnus Energy, Exelon, Unocal Midstream & Trade.

TESTIMONY

FERC – Market Power Report and Expert Testimony

Testimony on market power analysis for the Grama Ridge storage facility owned by Enstor Operating Company, LLC. Docket No. CP10-42-000. Written report filed January 11, 2010.

Dow Chemical Company – Rebuttal Expert Report

Oil Insurance Limited vs. The Dow Chemical Company, Dow Hydrocarbons & Resources, Inc., Frank’s Case Crew and Rental Tools, Inc., Grey Wolf Drilling, L.P. Rebuttal Expert Report and testimony in a civil suit regarding the value of storage services. Report filed October 2009 and deposition on January 7, 2010.

State of Alaska – Expert Testimony to State Legislature

Testimony to the 25th State Legislature 3rd and 4th Special Sessions in June through August 2008 concerning Black & Veatch’s economic analysis of pipeline alternatives to move North Slope natural gas production to market. Testimony focused on the expected market prices, economic benefit, and risk analysis.

FERC - State of the Natural Gas Industry Conference

Testimony on Current and Expected Trends in Natural Gas Price Volatility before the Federal Energy Regulatory Commission. Testimony commenting on the Staff Report on Natural Gas Storage. Docket No. PL04-17-000 (October 2004) Written report filed October 25, 2004.

Millennium Gas Marketing, LLC – Expert Report

In the Matter of the Dissolution of Millennium Energy Group, LLC, Millennium Gas Marketing LLC, Apollo Gas Gathering, LLC and North Star Natural Gas, LLC. Civil No. 08-02-C-01894. State of North Dakota. Expert testimony in a civil suit regarding the value of Millennium Gas Marketing LLC. Written evidence filed September 2004 and deposition on September 30, 2004.

PRESENTATIONS

“Black & Veatch’s Perspective for the Southeast Energy Markets”, Florida Gas Utilities Annual Meeting June 2009

“Natural Gas Demand Outlook”, SGA Presidents Roundtable May 2009

“Gas Storage Valuation Trends”, Infocast Gas Storage Conference April 2009

“The Business of Carbon Emissions Credits”, Carbon Sequestration Development and Finance Summit October 2008

“Growing a Midstream Portfolio”, Midstream A&D February 2007

- “Trends in Storage Value Key Drivers”, 5th Annual Gas Storage Outlook January 2007
- “The Impact of High Gas Prices on Gas Markets...Lessons Learned and Best Practices”, SGA Executive Conference November 2006
- “A Changing Environment for Natural Gas Storage”, Infocast Gas Storage Finance & Investment October 2006
- “North American Gas Supply and Implications for Natural Gas Prices”, SGA July 2006
- “LNG Supply & Implications for Natural Gas Prices”, Gas Mart, May 2006
- “Panel Discussion – Gas Storage Trends”, Platts Annual Gas Storage Outlook, January 2006
- “Outlook for the North American Energy Market”, Black & Veatch Outlook 2006, November 2005
- “The Outlook for Power Generation”, Southern Gas Association, October 2005
- “Overview of the Energy Policy Act 2005”, Western Energy Institute, October 2005
- “Global Marketplace – Financial Perspectives”, Western Energy Institute, October 2005
- “The Outlook for Gulf Coast LNG”, Bridgeline Customer Meeting, May 2005
- “Evolution in the Value of Storage” and Conference Chairman, Gas Storage Strategies 2004, September 2004 “Evolution in the Value of Storage” and Conference Chairman, Gas Storage Strategies 2004, September 2004
- “Current Issues Roundtable”, Southern Gas Association Management Conference, April 2004
- “Gas Storage Valuation – Methodologies & Models” CBI Gas Storage Outlook 2004, February 2004
- “Coming Together to Meet the Challenges”, Southern Gas Association Gas Supply Marketing Forum, October 2003
- “Identify Risks in an Energy Company”, Advanced Seminar on Enterprise Risk Management, September 2003
- “Current Issues Roundtable”, Southern Gas Association Management Conference, April 2003

“Understanding the Enterprise-Wide Risk of an LNG Strategy”, North American LNG Conference, November 2002

“Managing Price and Weather Risks: Storage Optimization in a Regulated Company”, Asset Optimization Symposium, October 2002

“Understanding Risk to Energy Asset Value in the “New” Energy Market”, Chicago LDC Forum, September 2002

“Valuing Energy Assets: A Real Options Based Approach”, 7th Annual LDC Forum, April 2002

PUBLICATIONS AND RESEARCH

“*Risk Domino Effects*”, Hart Energy Markets (co-author), March 2003

“Asset Valuation Methodologies: Simultaneous & Correlated Simulation of Commodities across Location & Type”, Commodities Now (co-author), March 2002

“*Asset Optimization*”, Hart Energy Markets, November 2001

Greg Hopper

Mr. Hopper is Managing Director of Black & Veatch Management Consulting. He leads the firm's Oil & Gas Strategy practice and holds primary responsibility for client management and for delivering advisory services to meet client needs.

Mr. Hopper began his career in natural gas pipeline business development with The Williams Companies, leading pipeline, storage, gathering and LNG project investments and joint ventures. He also led M&A due diligence initiatives in the natural gas midstream sector. Through industry and consulting activities he has deep expertise in natural gas and LNG market and regulatory matters. Specific areas include energy asset valuation, M&A analyses, market analyses, regulatory compliance and strategy development concerning natural gas infrastructure investments in North America.

PROJECT EXPERIENCE

LNG Development in the New York / New Jersey Market

Evaluated prospects for LNG import terminal accessing the New York and New Jersey market. Client deliverables included detailed analyses of regional sectoral gas consumption, gas flows on the New York Facility Group LDC system, import project pipeline pathing, and strategies to access broader regional markets. Also developed and presented recommended actions steps for subsequent development investments.

Advisor, State of Alaska, Alaska Gasline Initiative Act

Part of core team of advisors to the State of Alaska agencies pursuing implementation of the Alaska Gasline Initiative Act (AGIA) in regards to development of the Alaska Gas Pipeline. Reviewed and analyzed all applicant responses by companies seeking award of the AGIA pipelines. Delivered findings and recommendations in written reports to government agencies. Presented before state Senate and Representative Houses and the media on behalf of the State.

Strategy Development for a Global LNG Producer/Marketer

Led a multi-disciplined consulting team in the evaluation and recommendation of strategic choices for marketing large quantities of LNG in the eastern US market. Major engagement components included detailed fundamental analyses of the eastern North American gas market and opportunities for increased gas consumption in regional electricity markets. Client deliverables included recommendations for future capital investments in selected energy industry segments to leverage the value of LNG imports, competitor threat and opportunity assessments, and identification of potential joint venture partners.

MANAGING DIRECTOR

Specialization:

Natural Gas and LNG Asset Valuation; M&A & Transaction Support Services; Strategic and Business Development Advisory; Fuel Contracting and Negotiation Support; Gas Market Supply/Demand Studies; Energy Asset Risk and Optimization Advisory

Education

- M.B.A., Finance,
- Rice University
- B.B.A., Accounting,
- The University of Texas

Experience

- Energy Consulting
- Interstate Gas Pipelines
- Power Fuel Supply Contracting
- Investment Banking

Professional Associations

- Certified Public Accountant, State of Texas
- Southern Gas Association – Gas Supply Marketing Committee
- International Association of Energy Economists

Language Capabilities

- English
- Spanish (partial)

Natural Gas Pipeline Development Study

This client engagement provided due diligence analysis for a private equity funding of a proposed new Canadian pipeline. Findings considered demand outlook, rate and regulatory considerations, and market trading potential.

Impacts of Marcellus Shale on the Northeast US Pipeline Infrastructure

Client engagement reviewed B&V's production scenarios for Marcellus shale gas and regional long term gas demand growth expectations. Analytical results supported capacity development, routing and pricing recommendations and strategic assessments of partnering objectives.

North American Nonconventional Gas Supply Assessment

This project undertook a comprehensive outlook for long-term nonconventional gas supply development. Client report estimated reserves and production in tight sands, coal-bed methane, and shale basins, and presented infrastructure assessment with integrated basis price impacts. Results of report were used by the client to assess its successful acquisition of gas leases in the Appalachian Basin.

Haynesville Shale Capacity Study

Led multiple client engagements assessing the adequacy and timing of new pipeline projects serving the Haynesville and Bossier shale basins in Louisiana and Texas. Client recommendations included competitive pricing analyses for serving regional US markets, and potential impacts on Texas/ERCOT gas prices

US Gulf Coast Natural Gas Pricing Study

Led a B&V consulting team in the analysis of Gulf Coast (Texas to Alabama) natural gas basis prices. Principal findings analyzed the short-run and long-run impacts of LNG, non-conventional gas, and high deliverability storage on the evolution of regional gas prices at key trading hubs around the region. Study also provided forecasts of flows and capacity utilization on regional interstate pipelines.

Eagle Ford Shale Market Access and Pricing Assessment

Led project team in the analysis of potential gas production in the Eagle Ford shale plays of South Texas. Client study results included scenario assessments of the adequacy of Texas interstate and intrastate capacity to transport gas to in-state markets and beyond. Also included an analysis of the South Texas consumption potential for associated natural gas liquids.

Regulatory Compliance Analysis, Reporting and Witness

Led multiple client reviews of gas trading transactions to assess their compliance with federal regulations. Valued non-compliance implications and presented on behalf of clients to FERC Office of Gas Counsel staff.

Development of Gas Distribution Company (LDC) Revenue Strategy

Served as advisor to municipally owned gas company of one of North America's largest cities concerning new revenue opportunities. Engagement involved leading and supporting internal project teams in the identification and evaluation of revenue strategies based on synergies and risk with the utility's operations. Also provided lead and supporting services in negotiations with joint venture investors. Engagement is ongoing.

Funding of New Gas Distribution Company, Advisor to Private Equity Investor

Provided financial and operational analyses to a private investment group in connection with the funding of a "greenfield" LDC. The start-up company is envisioned to serve a rapidly growing Midwestern US city. Our report to management examined capital investments, customer saturation projections, revenue requirements, and cost of service forecasts. Cost of profitable service delivery was then benchmarked against alternative fuels to support decisions regarding investment and pricing strategy.

LDC Supply Strategy Investment Analysis

Provided market analysis and regulatory strategy analysis in support of a gas LDCs planned investment in large gas transmission facilities. Analysis considered the market need for and value of the infrastructure investment. Regulatory strategy assessed the risks of cost recovery.

Profitability Analysis of LDC Growth Investments

Led engagement team in the analysis of return on investments in new retail transmission and distribution facilities required to serve new markets. Analyses included a statistical selection of system extensions benchmarked against revenue and margin contributions realized from those investments. Recommendations were used by client in state rate strategy development and capital investment allocations.

Expert Witness in Federal Bankruptcy Trial

Served as a substitute expert witness on behalf of an interstate pipeline that sustained damages when a power generator breached a long term firm transportation contract in Chapter 11 proceedings. Substantive issues on which I was asked to opine included the appropriate discount rate to be used for calculating damages, specific matters relating to the operation of the US interstate pipeline grid, and outlook for North American gas production and flows.

LNG Import Terminal Pipeline Valuation and Optimization

Engagement leader in the valuation of pipeline capacity exiting a Texas LNG import terminal. Objective and client deliverable was an assessment of the relative value to shippers of investments in pipelines supporting the distribution

of large quantities of LNG into the Texas intrastate and US interstate pipeline grid.

LNG Terminal Development Project Management and Negotiations Services

LEG is the strategic advisor to PGW and the City of Philadelphia in the development of the Freedom LNG import terminal. PGW is the largest municipal gas company in the US. The project would expand on its existing facilities and infrastructure to provide LNG services to markets across the mid-Atlantic. LEG was retained to provide comprehensive strategy, negotiation, project management, valuation, and regulatory analysis and advice. LEG is also consults to PGW on other facets of the project, including a co-located natural gas generating plant and a long-term gas asset management arrangement.

Storage Asset Valuation and Transaction Support

Performed valuation and expansion assessment of an east coast high deliverability storage field as part of a gas utility acquisition. Valuation opinion was used by client in rating agency and merger accounting decisions. Analysis incorporated arbitrage and cost-based cash flow techniques, and included fundamental supply/demand analyses in the market region to assess the prospects for growth opportunities and de-contracting risks.

Interstate Pipeline Infrastructure Assessment

Led engagement to provide detailed evaluations and strategy recommendations for delivering imported LNG into the New York (City) Facility Group gas system and the New England and northern New Jersey interstate pipeline grid. Client services included the development of physical simulation of New York City and regional transportation capacity and gas flows, a review of transportation contract rights, and an economic analysis of transportation paths and alternatives. Client used our report and conclusions in planning and negotiations with regulators and gas purchasers.

Growth Strategy for an Interstate Pipeline

Led mutli-disciplinary team in the identification and analysis of strategic and tactical alternatives to increase client earnings. Strategic recommendations were part of a comprehensive engagement to optimize the corporate acquisition in its pipeline assets, and provide management with tangible analysis of the consequences of adopting various strategies ranging from large capital expenditure increases to status quo.

Regional Supply Infrastructure to Serve the Delmarva Peninsula

Evaluated and ranked alternatives for developing new, large-scale natural gas infrastructure to the Delmarva Peninsula. Study and recommendations were delivered in support of new electric generation projects to serve the region. Alternatives considered included greenfield pipelines, LNG satellite facilities, LNG by rail, and expansions of existing systems in the region. Results of our

conclusions were used to compare localized electric generation with new gas supplies to new electric transmission construction.

Supply Portfolio Analyses and Contract Negotiation Lead

Serve as the fuel and regulatory advisor to one of North America's largest electric cooperatives. Our services produced highly cost effective gas supplies solutions for four natural gas fired generating facilities on the Eastern Seaboard. In the course of this engagement we evaluated the company's fuel supply alternatives and developed strategies to optimize the client's costs and risks. Following on our recommendations, we led negotiations on behalf of our client for equitable long-term interstate pipeline contracts and interconnections. We assist the client on an ongoing basis with advice and analysis to protect their rights in the regulatory process.

LNG Import Terminal Site Evaluations

On behalf of an LNG terminal developer and importer, performed detailed evaluations of potential import terminal sites on North America's three major coastlines. Assessments and recommendations were developed from an integrated review of the regional pipeline and electric generation infrastructure, as well as the operating, regulatory and development elements of a successful project. Structured and managed the deliverables of external technical engineering, safety, security, and environmental experts to complete our recommendations to the client.

Fundamental Analysis of Market Demand for New Interstate Pipeline Capacity

For numerous clients, led various engagements to assess the need for large new pipelines spanning the Chicago to New York City markets. Analyses included regional supply and demand forecasts, and the impacts of deviations from normal weather, and the intra-day variations in regional gas consumption. Recommendations have been used by management in investment decision-making, and by local regulators assessing supply reliability and contracting.

Natural Gas Asset Acquisition Search and Evaluation

Led engagement for a large combination utility and interstate pipeline company to identify and evaluate potential growth acquisition targets. Based on our firm's intimate knowledge of the North American gas grid and our proprietary analytical tools, LEG identified numerous investment opportunities which potentially fit the client's criteria. The target acquisitions considered included high deliverability storage fields in the Gulf Coast, reservoir storage in the eastern US, an interstate pipeline and gathering systems in the northeast/Appalachian US, and new gathering systems in Atlantic Canada. The engagement produced successful transactions which remain in the client portfolio. The target acquisitions considered included high deliverability storage fields in the Gulf Coast, reservoir storage in the eastern US, an interstate pipeline and gathering systems in the northeast/Appalachian US, and new gathering

systems in Atlantic Canada. The engagement produced successful transactions which remain in the client portfolio.

PRESENTATIONS AND PUBLICATIONS

- “Strategic Energy Landscape in the West: Piercing the Haze”* Speaker, Annual Western Energy Association Board of Directors Meeting, Palos Verdes, California, February 1, 2011
- “Gas Market Outlook in the Southeast and Florida”*, Speaker, 2010 Florida Energy Power Association Summer Conference, Orlando, Florida, July 21-23, 2010
- “Costs and Market Trends in Power and Alternative Development”*, Speaker - 3rd Annual Power & Alternative Energy Law Conference, Houston, Texas, May 13, 2010
- “2010 North American Natural Gas Outlook - Change, for the Better”*, Speaker – Southern Gas Association Spring Gas Conference and Expo, Charlotte, NC, March 31, 2010
- “Perryville and the Shale Plays: Competing in a Supply-Long Market”* Speaker, Argus Shale Conference, Houston, Texas, March 9, 2010
- “Gas Asset Valuation Forecast”* Speaker, Infocast Midstream Summit Symposium, Houston, Texas, March 1, 2010
- “North American Natural Gas Outlook: Opportunities and Challenges for NY Producers”*, Speaker, Independent Oil & Gas Association of New York Annual Meeting, Buffalo, New York, November 4, 2009
- “Issues in Self-Reporting – A Commercial Perspective on Compliance Reviews and Analysis”*, Speaker, Infocast FERC Gas Compliance Conference, Washington, DC, June 10, 2009
- “Evolution in North American Midstream Gas Markets”*, Speaker - Infocast Midstream Gas Assets Acquisition & Divestiture Summit 2009, Houston, Texas, February 19, 2009
- “Unintended Consequences Collateral Effects and Costs of Reducing Emissions”*, Speaker – University of Texas – 7th Annual Gas and Power Institute, Houston, Texas, September 5, 2008
- “Market Drivers behind the Current Expansion in Gas Pipelines”* Speaker – Pipeline Renaissance: Development, Finance, & Investment Forum, Houston, Texas, June 11, 2008
- “North American Gas Outlook: It’s a Global Market Speaker”* – Southern Gas Association Commercial and Industrial Marketing Conference, Savannah, GA, July 10, 2008

“Natural Gas and GHG Regulation: The Difficult Path to Sustainable Policy and Sustainable Environment” Speaker – Southern Gas Association Annual Management Conference, Atlanta, GA, April 2008

“LNG – Globalization of the U.S. Industry” - Speaker, Western Energy Institute 2008 Operations Conference, Las Vegas, Nevada, March 27, 2008

“U.S. Non-conventional Gas Supplies: An Alternative to LNG in the North American Market?” Speaker – Flame 2008 Conference, Amsterdam, Netherlands, 3 March 2008

“The Future of Energy” Presenter – 5th Annual Wharton Energy Conference, Wharton School, University of Pennsylvania, Philadelphia, PA, November 30th, 2007

“A Good News Story: Near-term Outlook on the North American Natural Gas Market” Speaker - Carolina Gas Transmission Corporation Annual Customer Meeting, Columbia, SC, October 23, 2007

It's not easy being green: Outlook on U.S. Carbon Legislation and the North American Electric Market, Presenter to the Royal Bank of Scotland, October 10, 2007, Houston, Texas

“Outlook on U.S. Natural Gas Industry” Presented to the Board of Directors of EnergySouth, Inc., Mobile, AL, July 27, 2007

“North American 2007 Outlook for Demand and Supply” Speaker - Southern Gas Association Annual Marketing Conference, Austin, TX July 12, 2007

“North American 2007 Outlook for Demand and Supply”, Speaker – Brazilian Petroleum Institute, Houston, TX June 13, 2007

“North American 2007 Outlook for Demand and Supply”, Speaker – SEARUC Annual Conference, Little Rock, AR, June 4, 2007

“North American LNG and Natural Gas Storage- Supply Flexibility and Atlantic Basin Integration”, Speaker – Flame 2007 Conference, Amsterdam, Netherlands, 12 March 2007

“Issues and Opportunities in the North American Gas Market”, Speaker – Brazilian Petroleum Institute Seminar, Houston, Texas, June 7, 2006

“LNG Pricing – Forecasts and Drivers”, Speaker – Platts 5th Annual LNG Conference, Houston, Texas, May 18, 2006

“North American LNG Update”, Speaker – Independent Petroleum Association of American, IPAA Supply and Demand Committee, Spring Meeting, Houston, Texas, May 11, 2006

“Economic Drivers in the North American LNG Industry”, Panel Chair and Speaker
– Gulf Coast Power Association Spring 2006 Conference, The Woodlands,
Texas, April 6, 2006

“LNG – Globalization of the U.S. Industry”, Speaker – Western Energy Institute,
2006 Operations Conference, Costa Mesa, California, April 5, 2006

“LNG Imports and the Development of the North American Pipeline Grid”, Speaker
– 2006 EIA Energy Outlook and Modeling Conference, Washington, D.C.,
March 27, 2006

“Pricing Up LNG Opportunities in the US Gulf Coast”, Author, with Dr. Hua Fang –
LNG Journal, March 2006

“Outlook for North American LNG Development”, Conference Chair and Speaker –
American Conference Institute, Integrating LNG Conference, Houston, Texas,
February 2006

“LNG – Globalization of the U.S. Industry”, Speaker – North Texas Energy Council,
18th Annual Energy Symposium, Dallas, Texas, February 10, 2006

“LNG in the U.S. Gulf Coast - Siting, Economics, and Opportunities”, Speaker –
Strategic Research Institute, 6th Annual LNG: Economics and Technology
Conference, Houston, Texas, January 30, 2006

“LNG USA 2005 – Public Support and Education”, Workshop and Chair Speaker,
Houston, Texas, November 11, 2005

“The Up and Down on LNG from Florida’s Downstream Perspective”, Speaker –
Florida Natural Gas Association Annual Meeting, Palm Beach, Florida, June
23, 2005

“Freedom Energy Center”, Speaker – Philadelphia Gas Works Industrial Customer
Meeting, Philadelphia, Pennsylvania, February 17, 2005

“Freedom Energy Center, LNG and Community Awareness” Speaker – US
Department of Transportation Conference, Washington D.C., February 2,
2005

“New Pipelines and Capacity Allocation in the Southwest”, Speaker – Law
Seminars International, Santa Fe, New Mexico, July 15, 2004

“Opportunities and Barriers for LNG in the US Gas Grid”, Speaker – The
Petrochemical Feedstock Association of the Americas, Quarterly Meeting,
Houston, Texas, February 19, 2004

*“Effects of Gas-Fired Generation on the North American Natural Gas
Infrastructure”*, Speaker – The Interstate Natural Gas Association of America
Foundation Annual Meeting, Las Vegas, Nevada, November 8, 2003

"Business Transportation/Storage - Status Update of New Gas Pipeline Projects",
Speaker – Gas Week 2003, Natural Gas Industry Summit, Houston, Texas,
September 25, 2003

"A Market Ready to Set Sail", Author – World Pipelines, September 2003

Deepa Poduval

Principal Consultant

Deepa Poduval is a Principal Consultant with Black & Veatch Management Consulting and is responsible for business strategy and project management. Ms. Poduval's client engagements focus on strategic analytical services supporting portfolio optimization, asset acquisition, risk management, and business strategy development. Her expertise includes the valuation of energy industry assets, analysis of oil & gas marketing strategies and commercial agreements, performance and risk measurement, and analysis & utilization of natural gas industry structural models. Ms. Poduval has worked on extensive projects to analyze natural gas markets and develop business strategies to optimize asset portfolios. A long-standing client engagement involves assisting the State of Alaska by estimating the expected economics to various stakeholders from the proposed natural gas pipeline from the North Slope to Canada, providing strategic analysis and making presentations and testifying before the state legislature on the project's economics.

REPRESENTATIVE PROJECT EXPERIENCE

State of Alaska – AGIA Royalty and Tax Inducements Assistance

The Alaska Gasline Inducement Act (AGIA) provides for royalty and tax incentives to induce potential shippers to sign firm transportation contracts at the initial open season of an AGIA-licensed natural gas pipeline. Black & Veatch was engaged to assist the State of Alaska in conceptualizing approaches and assembling models to accomplish the proposed inducements. Ms. Poduval worked with both the Department of Natural Resources (DNR) and the Department of Revenue (DOR) to develop conceptual options for various key components of the royalty and tax calculations such as establishing the value of gas and oil, establishing fair transportation deductions, valuation and deductions related to markets that are yet to be fully evolved such as LNG and non-methane components. She led development of detailed models to understand the implications of the various options considered to the State as well as potential shippers. As part of the Black & Veatch team, Ms. Poduval made recommendations to the Commissioners, informed key policy decisions and developed term-sheet language as needed to describe policy choices. Black & Veatch contributed to the successful promulgation of AGIA related regulations in advance of the initial open season by both DOR and DNR.

Large Natural Gas Utility & Marketing Company

Black & Veatch was engaged by a large natural gas utility and marketing company to assess the operational and financial impacts of non-standard transactions relating to transportation capacity held on FERC-regulated interstate pipelines. Ms. Poduval led an analytical team reviewing and assessing the market impact of the transactions related primarily to released natural gas pipeline capacity and the shipper-must-have-title requirement. Transactions

PRINCIPAL CONSULTANT

Specialization:
Business Strategy, Strategic Analytical Services, Energy Asset Valuation & Optimization, Risk Management, Natural Gas Marketing Strategies, Project Management

Education

- B.E., Mechanical Engineering, B.I.T.S., Pilani, India, 1999
- M.Sc., Economics, B.I.T.S., Pilani, India, 1999
- Masters in Engineering Management, Dartmouth College, 2001

Experience

2001 – present

Joined Black & Veatch
2001

Professional Associations

Women's Energy Network, Houston

Language Capabilities

English, French, Hindi, Tamil, Malayalam

across multiple pipelines over several years spanning the North American natural gas pipeline grid were assessed as part of this engagement. Black & Veatch's report summarizing the operational and financial implications of these transactions was submitted to FERC.

Diversified International Conglomerate

Black & Veatch was engaged to assist a large, diversified, international conglomerate in developing a strategy to build a North American natural gas trading and marketing organization that will maximize the value of their equity natural gas and create additional value through the trading and marketing of natural gas acquired in the Gulf Coast region. Ms. Poduval led the development of an entry strategy into the Gulf Coast region and identified critical factors for success for the proposed trading and marketing organization. She also helped develop financial projections including revenue forecasts, personnel and infrastructure cost estimations, and financial costs estimations.

Large Integrated Electric and Gas Utility

Black & Veatch was engaged by a large integrated electric and gas utility to provide varied services in support of Client's earnings strategy development and implementation. Ms. Poduval's role in this engagement was to create analytics to evaluate alternatives to develop and implement a plan to stabilize near-term earnings, and to identify and provide due diligence support of initiatives that will drive medium- to long-term earnings. She also participated in Client steering and work groups in strategy and planning meetings and helped coordinate communications within the working group and with the steering committee. As a result of this engagement, specific measures were shortlisted and recommended to stabilize near-term earnings and additional incentives to drive longer-term earnings were identified.

State of Alaska – AGIA Support

Black & Veatch was engaged to assist the State evaluate proposals related to the Alaska Gasline Inducement Act. Ms. Poduval's responsibilities included overseeing the development of a comprehensive economic model evaluating the economic benefits to the different stakeholders of the Alaska Gas Pipeline during the initial 25-year period of operation of the pipeline incorporating detailed assumptions on factors such as production profiles, fiscal structures, market prices and pipeline tariffs during the analysis period. The effort included numerous public presentations and testimony to the State of Alaska Legislature in 2008. Key project activities were natural gas price forecasts, integration of 3rd party oil and LNG forecasts into the economic analysis, economic model development, Monte Carlo based risk analysis, and an assessment of strategic implications.

California Institute for Energy and Environment – Analysis of California Natural Gas Market

Ms. Poduval performed and managed analysis on the natural gas market in the Western United States to understand the need for new natural gas supply infrastructure for California through the 2020 time period. The analysis and report completed for CIEE focused on storage and the impediments, operational and economic, which could hinder future storage development in the State of California.

CenterPoint Energy – Pipeline & Storage Strategy

CenterPoint engaged Black & Veatch to evaluate the competitiveness of its existing pipeline services and to study the potential enhancement to its system that can be provided by storage services. Ms. Poduval evaluated various storage alternatives both independently and when integrated with CenterPoint's pipeline system to understand the benefits of storage to the CenterPoint system relative to the costs to acquire access to the storage.

Storage Investment Strategy for Large Independent Oil & Gas Company

Led an analytical team in the evaluation of various storage opportunities for a large independent oil and gas company. The analysis involved estimation of storage value for the opportunities being considered, competitive assessment relative to existing and other proposed storage facilities, estimation of the potential market impact of introducing more storage capacity into the study market, and development of alternate investment strategies. The study assessed the evolving fundamentals view of the natural gas market and their implications on storage. Investment recommendations to senior management were made based on the results of the analysis.

American Gas Foundation – Direct Use of Natural Gas Study

Ms. Poduval performed and led analysis examining the impact of the increased direct use of natural gas for residential & commercial end uses. End uses considered include space heating, water heating, cooking, and clothes drying. The study analyzed the effect of the increased direct use of natural gas on expected use of gas for electric generation and the net effect in total energy use, energy costs and CO2 emissions.

Strategy Development for a Global LNG Producer/Marketer

Led an analytical team in the evaluation and recommendation of strategic choices for marketing large quantities of LNG in the eastern US market. Major engagement components included detailed fundamental analyses of the eastern North American gas market and opportunities for increased gas consumption in regional electricity markets. Client deliverables included recommendations for future capital investments in selected energy industry segments to leverage the value of LNG imports, competitor threat and opportunity assessments, and identification of potential joint venture partners.

Bobcat Gas Storage – Market Power Study

Ms. Poduval completed a market power study to assist the client in their request for market based rate treatment from FERC for proposed expansion of the Bobcat natural gas storage facility located in Louisiana. The study considered the competitive alternatives to the Bobcat storage facility in the relevant products and geographic markets to provide evidence of a highly competitive market landscape.

Independent Trading and Marketing Company – FERC Compliance

Black & Veatch was engaged by an independent trading and marketing company to assess the operational and financial impacts of non-standard transactions relating to transportation capacity held on FERC-regulated interstate pipelines. Ms. Poduval led an analytical team reviewing and assessing the market impact of the transactions related primarily to posting and bidding requirements for released natural gas pipeline capacity and the shipper-must-have-title requirement. Black & Veatch's report summarizing the operational and financial implications of these transactions was submitted to FERC.

Arcapita – Falcon Gas Storage

Arcapita, an energy investment fund, retained Black & Veatch to assist in the valuation and acquisition due diligence of Falcon Gas Storage. The project required valuing the services from Falcon Gas' existing storage facility, Hill Lake, located in Texas. Ms. Poduval utilized B&V Management Consulting's Storage Valuation Advisor™ model to understand how storage service values will change as Falcon Gas expands this facility. Ms. Poduval was also asked to evaluate the storage development projects that Falcon Gas owns to understand their commercial viability and key risks associated with development.

Gas Marketing Strategy Analysis for Large Producer

Ms. Poduval developed, examined and recommended strategies to optimize gas marketing efforts in North America for a large integrated oil and gas corporation. Strategies included alternative gas supplies to company facilities, revisiting the methods by which the company managed volume uncertainty, strategically positioned storage commitments, arbitrage opportunities for existing or new pipeline positions and downstream positions.

Minerals Management Service (Department of Interior)

Ms. Poduval managed several staff members during an independent assessment of the Federal RIK Program and development of a five-year RIK business plan. Particular emphasis was on developing recommendations surrounding a comprehensive suite of performance metrics for the monitoring and evaluation of the RIK program's performance, including extensive client interaction and an on-site capability assessment in Denver, Colo. The five-year business plan has been implemented. Ms. Poduval also created detailed processes and procedures for the implementation of the performance metrics. She provided assistance in

developing risk policies and procedures as part of the implementation of the five-year business plan.

Strategic Growth Plan for Major Natural Gas/Electric Utility

Ms. Poduval conducted analysis of strategic growth opportunities for a large natural gas transmission, distribution and storage company, including detailed market analysis. Detailed modeling and analysis of company's assets and market footprint was performed using advanced economic market models. The study resulted in the development of a five-year strategic roadmap, along with specific action items to meet the dual objectives of optimizing existing operations and identifying targeted growth opportunities.

Market and Risk Analysis for the State of Alaska

Ms. Poduval created models and performed analysis to assist the state in negotiating fiscal and commercial incentives for the development of the Alaska Natural Gas Pipeline. The Project scope included market analysis, risk assessment and economic analysis to provide negotiation support.

Natural Gas Infrastructure Study

Ms. Poduval performed analysis of the impact by gas-fired electric generation on the natural gas infrastructure, while she considered the historical and emerging differences between the electric and natural gas industries and analysis of the capability of existing infrastructure to provide adequate take-away capacity for a proposed pipeline project.

Various Asset Valuation & Optimization Studies

Ms. Poduval's efforts were focused on real option evaluation of storage assets, interstate and intrastate transportation assets for various clients to assist in developing optimization strategies, contract negotiation support, and asset sale or purchase.

Risk Analysis for Large Natural Gas Utility

Ms. Poduval performed analysis of infrastructure replacement programs, leak experience, incident reports, data and materials from public sources to develop a forward-looking analytical approach for pipeline, service line and related equipment replacements. She developed expert testimony and exhibits that supported the implementation of such a forward-looking approach to system replacements for presentation of findings and testimony to the company's Board of Directors and regulatory agencies.

Capacity Planning Review for Large Natural Gas Utility

Ms. Poduval performed an independent analytical and statistical review of supply capacity planning process for large natural gas utility to determine if the near-term and future requirements of the utility were being met in the most reliable and cost-efficient manner. The review included detailed statistical analysis; benchmarking with other utilities; and consideration of strategic and

regulatory implications, in addition to issues related to the anticipated growth in retail choice.

PUBLICATIONS & PRESENTATIONS

“North American Gas – A Market in Flux”, Southern Gas Association Offshore Gas Operations Conference, June 2011

“Alaskan Natural Gas Pipeline Update”, Moderator, Pipeline & Gas Journal-Pipeline Opportunities Conference, April 2011

“Alaskan Natural Gas Pipeline Update”, Moderator, Pipeline & Gas Journal-Pipeline Opportunities Conference, March 2010

“Alaskan Natural Gas Pipeline Update”, Moderator, Pipeline & Gas Journal-Pipeline Opportunities Conference, March 2009

“LNG Impacts on Pipeline Development”, Platts Pipeline Development & Expansion Conference, September 2009

“Storage Valuation – Cost Avoidance Approach”, Infocast Second Annual Gas Storage Development Tutorial, April 2009

“Storage Valuation – Regulated Cost of Service Approach”, Infocast Second Annual Gas Storage Development Tutorial, April 2009

“Natural Gas Industry – A View from the Top”, Southern Gas Association Supply Chain Management Conference, February, 2009

“Strategies for Facilities Development with Intent to Sell”, Infocast Gas Storage Finance and Investment Summit, November 2008

“North American Gas Outlook – A Market in Flux”, Southern Gas Association – Fall Leadership Conference, September 2008

“Future of the Midstream Industry”, Infocast Midstream Asset & Divestiture Summit, February 2008

“Valuing Storage Through Cost Avoidance,” CBI Gas Storage Outlook 2004: Gas Storage Valuation – Methodologies and Models, February 2004.

“Valuing Storage in a Regulated Market,” CBI Gas Storage Outlook 2004: Gas Storage Valuation – Methodologies and Models, February 2004.

“Calming Stormy Seas,” with Dan Ives, American Gas, November 2003.

“Getting Real: How to Optimize the Value of Storage Assets,” with Jay Lukens, Natural Gas, October 2002.

“Valuation of Natural Gas Transportation Using an Option-Based Framework,”
Infocast Gas Volatility & Transportation Valuation Conference, September
2002.

Denny Yeung

Denny Yeung is a Manager at Black & Veatch, with expertise in natural gas fundamental market analysis. He is responsible for modeling detailed fundamentals factors in the North America natural gas market, and assessing the impact on price, basis on proposed pipeline and storage infrastructure. He has accumulated extensive knowledge on market fundamentals, and natural gas storage valuation in his experience with B&V.

PROJECT EXPERIENCE

California Institute for Energy and Environment – Analysis of California Natural Gas Market

Mr. Yeung participated in an engagement to analyze the natural gas market in the Western United States to understand the need for additional natural gas supply infrastructure for California. Mr. Yeung assisted in the fundamental market analysis and presentation to the CIEE. The report completed for CIEE focused on storage and the impediments, operations and economics that would hinder future storage development in California.

Gulf Coast LNG Partners, Independent Report on Market for Capacity and Services

Mr. Yeung assisted in the market assessment and fundamental analysis, providing projections of price/basis and natural gas pipeline flows near the proposed LNG receiving terminal for a six year period. The monthly forecasts were made using a microeconomic model of the North American natural gas market and a combination of public and proprietary data regarding future gas supply and demand and transportation capacities and costs. The forecasts were completed for several scenarios regarding the amount and timing of new LNG receiving terminal development. The results of the analysis were used by the client in their discussions with potential customers regarding new LNG import capacity.

Gulf Coast Storage and Pipeline Header Valuation

Mr. Yeung supported the engagement to develop an independent estimate of the likely future revenues for a proposed Gulf Coast natural gas storage and header facility. Mr. Yeung used B&V's proprietary Storage Valuation Advisor™ (SVA) and Transportation Valuation Advisor™ (TVA) software to estimate likely future revenues for both storage and header services. The estimates were based on a real option valuation methodology what accounts for both intrinsic and extrinsic value. The independent report was used by the client to secure development financing.

Market Analysis and Storage Asset Valuation

Mr. Yeung participated in the market assessment, price forecast and evaluation of investment opportunities for various storage facilities. Analyses were done to

MANAGER

Specialization:
Market Analysis, Asset Valuation, Asset Optimization, Business Strategy

Education

- M.B.A., University of Texas in Austin 2009
- B.A., Economics, Political Science, Managerial Studies
Rice University, 2004

Total Years Experience
7

Joined Black & Veatch
2004

Professional Associations

International Association of Energy Economics

Language Capabilities

- English

complete independent assessments and valuations of storage services for potential storage opportunities across North America.

James L. Gooding, Ph.D.

Senior Consultant / Manager

Dr. Gooding is a geoscientist and energy market analyst with extensive technical, supervisory and management experience in government and industry. He is accomplished in building and directing organizations responsible for basic or applied research and operations. His multiple careers have included technical and commercial roles at small businesses as well as large corporations. Before joining Black & Veatch he was an independent consultant in geology and meteorology and a trainer of industry professionals as an instructor at San Jacinto College; Keller Graduate School of Management (DeVry University); and the University of Houston. Dr. Gooding also has contributed more than 50 peer-reviewed journal articles, book chapters and encyclopedia and magazine articles on the topics of Earth and planetary science.

In his role with Black & Veatch, Dr. Gooding is responsible for coordinating research, analysis and delivery of services for clients focused on energy issues. He directs work performed by analysts and defines and develops new services and capabilities with emphasis on natural gas and other carbon-based enterprises.

REPRESENTATIVE PROJECT EXPERIENCE

Washington Gas Light Company, Springfield VA | 2007

As the project manager, coordinated a comprehensive review of the design-day process used by WGL to plan fuel purchases that supply natural gas customers in Washington DC, Maryland and Virginia. The review included informational interviews with WGL employees, statistical analysis of the WGL forecast process as well as benchmarking against processes used by comparable utilities. Findings were used by WGL to plan for improvements and to validate their compliance with various public utility commissions.

Chugach Electric Association, Inc., Anchorage AK | 2007-2008

As the project manager, coordinated two separate analyses related to long-term supplies and prices of natural gas in the Cook Inlet region of Alaska. The first analysis focused on supply-demand dynamics in the Asia-Pacific LNG basin while the second analysis focused on relationships among Cook Inlet supplies, weather-driven demand and alternative price formulas. Findings were used by CEA to refine supply plans and filings with public utility commissions.

Shell Exploration & Production Co., Houston TX | 2007-2008

As a sub-project team leader, coordinated development of project management tools for Alaska Venture activities in the offshore North Slope. Participated in development of informational materials for stakeholders.

SENIOR CONSULTANT / MANAGER

Specialization:
Energy Market Analysis;
Geophysical & Economic Review of Hydrocarbon Resources;
Climate-Related Risk Management;
Environmental Geoscience;
Process Improvement

Education

- B.S. (with honors), Analytical & Physical Chemistry, California Polytechnic State University – San Luis Obispo, 1972
- M.S., Environmental & Atmospheric Geochemistry, University of Hawaii – Honolulu, 1975
- Ph. D. (with distinction), Earth & Planetary Science, University of New Mexico – Albuquerque, 1980

Experience

1979 – present

Joined Black & Veatch

- 2007

Industry Certifications

- Registered Professional Geoscientist, State of Texas 2003 – present
- Certified Manager of Quality & Organizational Excellence, American Society for Quality 2004 – Present

Professional Associations

- American Meteorological Society
- American Society for Quality
- Geological Society of America
- Research Society of Sigma Xi

StatoilHydro, Stavanger, Norway & Houston TX | 2008

As a sub-project team leader, coordinated a review of industrial participants in the exploration and production of natural gas from unconventional plays in North America. The analysis included a review of competitor investments and development of an index to help the client evaluate resource acquisition prospects.

SourceGas LLC, Lakewood CO | 2008

As project manager, coordinated a review of Client's needs with regard to financially hedging of natural gas volume sales against substantial variations in winter weather in a multi-state service region. Examined Client's data, models and previous weather-hedge contracts and recommended policy and process improvements. Supervised development of a software tool for use by Client in valuing prospective weather-hedge instruments.

Alaska Energy Authority (AEA), Anchorage AK | 2009

As sub-project leader for the fuel-supply task, coordinated forecasting of future supplies and prices for hydrocarbon fuels, including natural gas, to be available for residential, commercial and industrial users in South-Central Alaska. Work involved extensive interactions with State officials, producers, shippers and fuel end-users as well as construction of forecast models for 10-year and 50-year projections. Supervised development of a software tool for making probabilistic forecasts for natural gas.

Litigation & Regulatory Support for Confidential Clients | 2009-2010

Provided technical analyses and drafted expert testimony for companies engaged in natural gas and petrochemical businesses. Work included preparation of technical reports required for regulatory filings with the Federal Energy Regulatory Commission (FERC) as well as responses to FERC and the Commodity Futures Trading Commission (CFTC) regarding energy trading records. Participated in forensic technical and economic analyses involved in litigation of business interruption and property damage claims. As needed, interacted directly with Clients, organized and directed work by analysts, drafted reports and provided analytical support to expert witnesses.

American Cast Iron Pipe Co. (ACIPCO), Birmingham AL | 2010

As project manager, worked with Client to develop a greenhouse gas (GHG) footprint for Client's ductile iron pipe manufacturing facility. Helped Client identify records required for the footprint calculation then supervised input of those data into a calculation template based on the ISO14064 GHG reporting standard. Prepared report and led presentation of results to Client.

America's Natural Gas Alliance (ANGA), Washington DC | 2010

Served as lead author of a white paper on carbon capture and sequestration (CCS) commissioned by the Client for use in communications with ANGA members, State PSC/PUC authorities, and electric utilities. Simplified complex information on chemical technologies, pipeline systems, geologic repositories,

economic assessments and environmental/regulatory risks into a presentation suitable for a diverse community of industry stakeholders.

INDUSTRY PRESENTATIONS FOR BLACK & VEATCH

“Technology and Cost Considerations in CO₂ Sequestration”. Business Risks and Opportunities in a Carbon Controlled Environment, Interstate Natural Gas Association of America (INGAA), Houston, Texas, September 21, 2007

“Climate-Change Management Risks Across the Spectrum”. 3rd Annual International Symposium on Energy Risk Management, Active Communications International (ACI), San Antonio, Texas, September 27-28, 2007

“An Overview of the Uses of an Holistic QMS Standard for Improved Operational Performance in the Oil & Gas Industries”. 35th Annual Energy & Environmental Conference, American Society for Quality (ASQ), Raleigh, North Carolina, September 15-17, 2008

“Moderator for panel discussion on “Sequestration Technology Risks”. Carbon Sequestration Development & Finance Summit, Infocast, Houston, Texas, October 22-24, 2008

“Leader for post-conference workshop on “The Business of Carbon Emission Credits”. CO₂ Capture and Storage Conference, The Canadian Institute, Calgary, Alberta, February 24-26, 2009

“Moderator for panel discussion on “Generators’ Perspectives on the Market”. Carbon Sequestration Development & Finance Summit, Infocast, Houston, Texas, July 22-24, 2009

“Topical organizer, panelist recruiter and moderator for a 1.5-hour, live panel discussion and webcast, including question & answer session”. Water Footprint Issues in Shale Gas Production, Infocast, online webinar, April 1, 2010

PRIOR EXPERIENCE

Universal Weather & Aviation, Houston, Texas | 2006-2007

As the Vice President of Operations for the ImpactWeather subsidiary, Dr. Gooding supervised 28 weather forecasters supporting the energy and transportation industries in short- and long-term weather risk management, including offshore oil & gas operations. He also directed research and analysis, and guided quality improvements for clients around the world.

Duke Energy, Houston, Texas | 1999-2006

As Director of Meteorology & Market Analysis for Duke Energy North America, Dr. Gooding designed, developed and implemented customized weather and climate information systems for natural gas and electric power businesses. He

also hired, trained and led the forecast team that provided daily support to commercial gas, power and risk-management operations. His collaborations on weather risk management spanned power-generation and pipeline business units as well as corporate strategic planning.

Enron Corporation, Houston, Texas | 1997-1999

As the Research Manager for Capital & Trade Resources (1997-1998) and for Corporate Risk Assessment & Control (1998-1999) at Enron Corporation, Dr. Gooding defined, developed and conducted time-critical, proprietary research for natural gas and electric power businesses, including forecast models. He directed work by interns and analysts and provided early technical support to the emergent weather-derivative business.

National Aeronautics and Space Administration (NASA), Lyndon B. Johnson Space Center (JSC), Houston, Texas | 1981-1997

As Chief (1994-1997) and Manager (1992-1994) of NASA's Planetary Missions & Materials Branch, Dr. Gooding controlled a multi-million dollar annual budget, supervised 14 civil-service scientists and engineers, and directed work by 30 support contractors. He organized and managed projects for ground-, aircraft- and spacecraft-based research in NASA's Earth & Planetary Science programs involving the international science community. As a program planner, he recommended scientific strategies and instruments for planetary space flight missions and directed science support for stratospheric and Antarctic research programs (1981-1992).

Jet Propulsion Laboratory (JPL), California Institute of Technology (Caltech), Pasadena, Calif. | 1979-1981

As a Senior Scientist, Dr. Gooding conducted original research on planetary atmosphere-surface interactions. He also served as a technical design reviewer for spaceborne experiments on planetary surfaces and atmospheres.

AWARDS & HONORS

Arthur S. Flemming Public Service Award, Downtown Jaycees of Washington DC, 1989

NASA JSC Certificate of Commendation for scientific research, 1987

NASA Manned Flight Awareness Certificate of Appreciation, Space Shuttle Challenger Accident Investigation, 1987

Rod Walker

Rod Walker is a 25 year veteran of the natural gas industry having spent nineteen years working in a variety of Operations, Management and Engineering (OME) positions for a large investor-owned gas utility and two municipal gas utilities. As a consultant, he has had extensive experience providing solutions to domestic and international clients on issues they face from a management consulting and engineering perspective. He is recognized as an OME risk-based audit expert from the dozens of audits and due diligence projects he has been involved with in his career.

Additionally, he has had the opportunity to provide engineering design, system modeling and planning, project management, owner's engineering, benchmarking, organizational review, operations consulting, regulatory compliance, and training to utilities, pipeline companies, financial institutions, developers and governments. The basis of Mr. Walker's work as a consultant is a unique blend of understanding of the business requirements of operating and managing a utility combined with a deep technical and engineering understanding of the best practices needed to install, operate and maintain the utility's infrastructure.

Mr. Walker honed his engineering, technical and operations skills in the field as young engineer working alongside long-tenured field personnel to understand the basics of natural gas infrastructure installation, operations and maintenance. He is well versed at what it takes to design, install, operate, and maintain a natural gas distribution system for large local natural gas distribution companies, as well as small municipal gas systems. He has served as project manager for hundreds of natural gas infrastructure projects from the feasibility stage to design/permitting/right-of-way acquisition to bid of the project/construction to testing/placing into service and annual operations and maintenance. These infrastructure projects included distribution and transmission mains, compressed natural gas (CNG) vehicle refueling facilities, tap and district regulator stations, commercial and industrial meter sets for expansion projects, aging infrastructure replacement/renewal projects, and Department of Transportation relocation projects.

PROJECT EXPERIENCE

Prior to joining Black & Veatch, Mr. Walker's experience included:

Puget Sound Energy, Macquarie Securities Inc. | Utility Assets and Operation Review, Bellevue, WA | 2007

Project Leader of the Gas Due Diligence Team, provided an independent review and prepared a report on the operations, management, regulatory compliance, technical, engineering and environmental areas of the Utility, whose assets included natural gas distribution and electric generation, transmission, and distribution. Reviewed and reported on the condition of the operations, management and technical aspects of the utilities as well as provided an

PRINCIPAL CONSULTANT

Specialization:
Engineering and management

Education

- BS, Civil Engineering, Clemson University, 1985

Professional Registration
MEA Operator Qualification
Master Evaluator (natural gas systems)

Professional Associations

- American Public Gas Association
- Southern Gas Association

Year Career Started
1985

Year Started with B&V
2011

assessment of assets, the performance of the assets, and the risks to the Utility associated with the assets. The independent review included impacts on the pro forma, different types of risks or opportunities and ways to mitigate those risks. The specific review tasks included capital budgets;

operations & maintenance budgets; asset condition with an eye towards operations and maintenance costs, obsolescence risk, equipment failure risks and risks associated with “Acts of God” and/or opportunities to modernize; asset performance and 10-year plans to evaluate adequacy of capital budgets and risks to higher capital outlays due to higher than expected load growth, higher than expected obsolescence, new generation interconnection, changes in mandatory reliability criteria or other causes; environmental risks. The independent review identified issues uncovered during the review and proposed an approach to resolve each issue. Project Value \$500,000

Three Separate Confidential Utilities | Utility Assets and Operation Review, Marcellus Shale area, West Virginia, SW Pennsylvania | 2010

Project role: Project Manager/Project Lead of the Due Diligence Team, provided an independent review for due diligence and a report on the operations, management, technical, engineering, regulatory compliance and environmental areas of these Utilities, whose assets included natural gas distribution and transmission, storage and production wells. Reviewed and reported on the condition of the operations, management and technical aspects of the utilities as well as provided an assessment of assets, the performance of the assets, and the risks to the Buyer associated the operations, management and engineering practices of the target utility company and its assets. Project Value \$125,000

AEI, LLC, Confidential Utilities | Utility Assets and Operation Review, Turkey and Egypt | 2008

Project role: Project Manager/Project Lead of the Due Diligence Team for an independent review for due diligence of and a report on operations, management, technical, engineering, regulatory compliance and environmental areas of these Utilities, whose assets included natural gas distribution and transmission. Reviewed and reported on the condition of the operations, management and technical aspects of the utilities as well as provided an assessment of assets, the performance of the assets, and the risks to the Buyer associated with the operations, management and engineering practices of the target utility company and its assets. Project Value \$30,000

AEI Portfolio of Utilities | Risk Based Operations, Management and Engineering (OME) Audits. Environmental Resources Management, El Salvador, Peru, Colombia, Chile, Argentina and China | 2008-2010

Project Role: Client manager/subject matter expert served as a subconsultant to Environmental Resources Management. Lead teams that performed a risk based operations, management and engineering(OME) audit of the various power generation, power transmission and distribution and natural gas utilities owned

by AEI in emerging countries. Mr. Walker was the lead natural auditor on the audits of natural gas utilities as well in China, Peru and Colombia. The audits determine findings of high level risks associated with the operations of utilities based on data review, staff interviews, site visits of assets and discussions with management with regard to AEI procedures, applicable regulations, and industry best practices and standards. Project Value \$250,000

AGL Resources | Natural Gas Infrastructure Due Diligence of Master Meter Operator Complexes, Atlanta, Georgia | 2006-2008

Project Role: Project manager led team in a full assessment of the condition of the natural gas infrastructure at each master meter operator's complex i.e. apartments, colleges, housing authorities. The team established an understanding of existing issues and financial investment requirements related to AGL Resources' potential ownership of the gas systems of these complexes. Addressed the impact of new regulatory requirements that recently raised concern from AGL Resources and its subsidiary, Atlanta Gas Light Company that master meter operators would switch from natural gas to electricity instead of attempting compliance with the new regulations. Project Value \$100,000;

Paducah Power System (PPS) | Natural Gas Pipeline, Paducah, Kentucky | 2007-2010

Project Role: Project manager for gas pipeline project to new 120 MW natural gas fired power plant; also served in a variety of capacities as Owner's Engineer to assist PPS leaving the Tennessee Valley Authority (TVA) system and procuring power supply from other sources. The 120 MW natural gas fired power plant was constructed by PPS to provide peak electrical power, in order to address rising electric costs from its wholesale generation provider. Led the natural gas project team that handled all of the activities necessary for the successful installation of natural gas pipeline, from concept in 2007 to completion in 2010, including Pipeline Planning and Project Management, Design Services, Permitting and Right-of-Way Acquisition, Regulatory Siting and Compliance, and Bid and Construction Management Services. The pipeline was constructed on a mixture of public and private right-of-way from a tap with Texas Gas Pipeline near Calvert City, KY approximately 16 miles to the power plant needed southeast of Paducah, KY. Construction of the \$16.3 Million pipeline was completed on time before the March 1, 2010 deadline as it was in service on February 27, 2010 with approximately 1% construction change orders. Project value \$1.45 Million

JP Morgan, Southern Missouri Natural Gas (SMNG) | Expansion Projects, Lebanon and Branson, Missouri | 2009-2010

Project Role: Project manager/lead engineer performed an Independent Engineering review of the SMNG expansion projects. The team identified numerous issues with the design and installation of the Lebanon gas pipeline project, which was already under construction. Recommendations were made to correct the contractors' project construction practices with the Lebanon

expansion project and led to the second phase for the Branson expansion project being removed from the initial contractor and existing SMNG technical management and re-designed and re-bid by Mr. Walker's team. Mr. Walker led the project team that re-designed and re-bid the 55-mile Branson expansion in 2 months and provided the project management until new SMNG personnel were in place to guide the project to its completion in the fall of 2010. Mr. Walker also provided organizational development/restructuring consulting, operations consulting and advisory services to JP Morgan for the operations and management of the SMNG utility. Project Value \$500,000

Solid Waste Management Division, Sioux Falls, South Dakota | Landfill Gas Pipeline | 2008-2009

Project Role: Project engineer for the 11-mile transmission pipeline and compressor station that delivers landfill gas (LFG) to an ethanol plant owned by POET LLC. Managed the engineering, regulatory and business components of the project, which involved prudent environmental leadership and the innovative use of LFG in the production of a renewable fuel. The project involved a public involvement process to inform and build support from the community. Helped to coordinate with the Public Services Commission and assisted the City in developing becoming a regulated utility. The project earned a Solid Waste Association of North America Silver Excellence Award for landfill gas utilization. Project Value \$250,000

Terrebonne Parish Consolidated Government | Annual Engineering Review of Gas System, Louisiana | 2008-2010

Project role: Lead gas auditor for the annual review of the Terrebonne Parish Consolidated Government. Responsibilities included a comprehensive operations, management and engineering (OME) review of the gas utility and its ability to function in present and forecasted environments. The analysis also addressed various phases of system operations and recommended changes in operation and the making of repairs, renewals, replacements, extensions, betterments and improvements, including recommended improvements in organization and compensation practices and regulatory compliance. Project Value \$150,000

AGL Resources | Corporate Welding Procedures, Atlanta, Georgia | 2008

Project role: Project manager responsible for assisting AGL Resources in developing corporate welding procedures. From AGLR's data sources, he led a gap analysis by comparing to State and Federal Pipeline Safety regulations, pertinent pipeline and welding standards, and pertinent industry best management practices with the numerous welding procedures from AGL's 7 member companies. Working with engineering and welding experts, he developed written welding procedures to State and Federal Pipeline Safety regulations and pertinent pipeline and welding standards. Project Value \$150,000

CPS Energy – Natural Gas Unit | Assessment of Natural Gas Operations Financial Benchmarking Study, San Antonio, Texas | 2008-2010

Project Manager responsible for leading team to evaluate level financial operations of the largest municipal gas operations in the U.S. with the focus on operational costs and the payment each gas utility makes to its City's general fund. Work on this project included recruiting municipal participants and analyzing the information obtained to produce a final comparative report. \$85,000

City of El Paso, Texas | CNG/LNG Cost/Benefit Study| 2008

Project Role: Project Engineer on a team that performed a cost/benefit study for the City of El Paso, Texas to evaluate fuel options for the City's Sun Metro Transit system. Mr. Walker and team members versed in compressed natural gas and liquefied natural gas technologies interviewed internal stakeholders, reviewed the technology options available, evaluated the use of pipeline gas off Texas Gas Service distribution system, and then gathered cost/benefit data from CNG and small-scale LNG suppliers. \$65,000

6.3 INFORMATION ON ENSPIRIA SOLUTIONS

Corporate Overview

Enspira Solutions, a Black & Veatch Company. — a company dedicated to the utility and public sector markets — offers a unique combination of experience, strategy, and implementation expertise. Enspira helps organizations improve operational effectiveness, asset performance, customer service, and energy efficiency.

Enspira Solutions experts provide business and technology consulting, systems integration and implementation, data services, lifecycle data management, and maintenance/upgrade services. The company is backed by the financial strength of parent company Black & Veatch, a leading global engineering, consulting, and construction company with \$2.3 billion in annual revenue.

Enspira offers solutions based on proven industry software products, integration standards, and business models. Providing rapid delivery through integration frameworks and configurable solutions, we deliver complete business solutions, not just enabling technology. These services enable utilities to fully realize the benefits of past, current, and future technology investments. We specialize in:

- Geographic Information Systems (GIS)
- Outage Management Systems (OMS)
- Advanced Metering Infrastructure/Automated Meter Reading (AMI/AMR) and Meter Data Management Systems (MDMS)
- Substation/Distribution Automation
- Mobile Work Management (MWM) and Field Force Automation (FFA)
- Work Management Systems (WMS)
- Asset Management

Enspira Solutions has experience with the leading commercial vendors for every aspect of the utility systems, including GIS, OMS, AMI, WMS, computerized maintenance management, T&D planning, design, mobile dispatching, and billing and customer care systems. We work with major technology product vendors and data conversion/migration vendors, providing solutions best fit to meet the needs of our customers.

Enspira Solutions Clients

Enspira Solutions has an extensive history of project success; our client satisfaction results in frequent requests for follow-on assistance and new project support. We are proud to have supported and ensured project success for our energy and utility, public utility, public sector, and other industry clients:

Enspira Solutions, Inc. Clients

PUBLIC UTILITIES/PUBLIC SECTOR ENTITIES

- | | |
|--|---|
| <ul style="list-style-type: none"> ■ Anaheim Public Utilities Department (CA) ■ Aspen/Pitken County (CO) ■ Baldwin County (AL) ■ Boston (MA) ■ Burbank Water and Power (CA) ■ Cabarrus County (NC) ■ Charlotte (NC) ■ Charleston Water Supply ■ Concord (NC) ■ Colorado Springs Utilities ■ CPS Energy (San Antonio) ■ Columbia Power & Water Systems (TN) ■ Federal Transit Administration ■ Gastonia (NC) ■ Greenville County (NC) ■ Jackson Electric Membership Corporation (EMC) | <ul style="list-style-type: none"> ■ JEA (Jacksonville, FL) ■ High Point (NC) ■ Kansas City Board of Public Utilities ■ Los Angeles Department of Water and Power (LADWP) ■ Monroe (NC) ■ Navopache Electric Cooperative ■ Orange County (FL) ■ Pasadena (CA) ■ Portland (OR) ■ Raleigh (NC) ■ San Antonio Water System (TX) ■ Salt River Project (AZ) ■ Southern Maryland Electric Cooperative ■ Tacoma Water ■ Tallahassee (FL) ■ Tri-State Generation and Transmission Association |
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INVESTOR-OWNED UTILITIES

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| <ul style="list-style-type: none"> ■ Alabama Power Company ■ Allegheny Power ■ Alliant Energy ■ Arizona Public Service (APS) ■ Atlanta Gas Light Resources ■ Baltimore Gas & Electric (BG&E) ■ BC Transmission/BC Hydro ■ Cinergy ■ ConEdison ■ ENMAX ■ E.ON US (LG&E) ■ EPCOR ■ Exelon Energy Delivery ■ FirstEnergy ■ Florida Power & Light (FPL) ■ Georgia Power Company ■ Hawaiian Electric Company, Inc. (HECO) ■ Laclede Gas Company ■ Mississippi Power Company ■ Nicor Gas | <ul style="list-style-type: none"> ■ Northern Indiana Public Service Company (NIPSCO) ■ Northeast Utilities ■ NSTAR ■ Pacific Gas & Electric (PG&E) ■ PECO (Subsidiary of Exelon) ■ Pepco Holdings, Inc. (PHI) ■ Piedmont Natural Gas Company ■ Portland General Electric ■ San Diego Gas and Electric ■ SaskPower ■ Semptra ■ South Carolina Electric & Gas ■ South Jersey Gas ■ Southern California Gas ■ Southern Company ■ TXU Energy Delivery ■ Union Gas ■ United Illuminating Company ■ WE Energies ■ Westar Energy |
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Other

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| <ul style="list-style-type: none"> ■ Cellnet ■ eMeter ■ ESRI ■ General Electric ■ Gold Fields Exploration ■ Honeywell ■ Itron ■ Jeppesen ■ Landis+Gyr | <ul style="list-style-type: none"> ■ Level 3 Communications ■ Neptune Technology Group ■ Ontario Independent Electricity System Operator (IESO) ■ Port of Portland ■ Sensus Metering Systems ■ Time Warner Cable ■ Technology Edge ■ Transit Cooperative Research Program ■ University of North Carolina |
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GIS Expertise and Project Experience

Enspiria Solutions history demonstrates a commitment to serving the GIS industry since 1986. Enspiria Solutions is a system integrator and GIS implementer with an unparalleled record of GIS implementation and integration. We have successfully completed many GIS projects and support efforts for utilities and other organizations. Because we are not a product company, our role is dictated by the needs of our customers and not downstream product sales. Our position enables us to excel in providing the best solutions, maximizing our client's past and current technology investments and identifying and implementing the optimal go-forward solution.

Enspiria Solutions personnel are heavily involved in the GIS industry, developing articles and presenting papers and courses. The following sample list represents our most recent recognition in terms of press, conference, and symposium presentations:

- "Enterprise GIS – are we there yet. Spatially Enabled BI for Utilities." *Electric Energy T&D Magazine*, April 2010 Issue
- "Spatially Enabling Outage Communications." (Co-presented with E.ON U.S.) ESRI User Conference 2010.
- "Enterprise GIS Turns Infrastructure Data into Valuable Business Intelligence (Serviceability Determination)." *ESRI Telecom Connections*, Spring Issue
- "Scaling the Cairngorms: Test-Driven Flex and ArcGIS Server Development Utilizing Cairngorm 3." ESRI Developers Summit 2010.
- "Maintaining Currency, Minimizing Disruptions: Utility uses phased migration from CAD to GIS," ESRI ArcUser, April–June 2007.
- "Beyond GIS: System Integration and Interfacing." GITA Oil & Gas 2009 — User Group Conference 2009, GITA Oil & Gas 2009.
- "ESRI, Microsoft and Spatially Enabled BI Technology." ESRI Electric and Gas User Group 2008.
- "How GIS Helps Plan, Implement and Operate your Smart Grid." 2009 ESRI Electric and Gas User Group (EGUG).
- "Enabling Spatial Intelligence." EUCI's GIS 2.0: Technical and Programming Developments for Electric and Gas Utilities, 2009.
- "Data Refresh: Breathing New Life into a GIS Database." *Electric Energy T&D Magazine*, March/April 2008.
- "Field Data Communications: Transition to the Fat-Pipe World." Geospatial Information Technology Association (GITA) Conference, 2008.
- "Geospatial Systems Integration Strategies." *Electric Energy T&D*, March/April 2007.
- "Integrating GIS and AMR: An Enterprise Application Approach." GITA 2007.

- “Using GIS Technology to Maximize Operations Data Marts.” DistribuTECH 2007.
- “Integrated GIS — Another Level of Benefits for Local Government.” GeoWorld, September 2006.
- “Integrating GIS and AMR to Increase Enterprise Benefits.” Utility Automation and Engineering T&D, May 2006.
- “ArcSDE Best Practices.” North Carolina Spatial Database User Group, March 2006.
- “Get it Off the Shelf: SRP seeks a comprehensive, automated, integrated approach to work and asset management.” T&D World, March 2006.
- “Balancing Environmental Mandates and Fiscal Responsibilities with Geospatial Technology.” ESRI Electric and Gas User Group 2008.
- “Solving the BIG Problems — Lessons Learned at Georgia Power.” (Co-present with GPC), ESRI 2008 Users Conference & ESRI Electric and Gas User Group 2008.
- “Intelligent Geospatial Information Systems as a Platform for Enterprise Integration.” GITA 2008.
- “Phased Migration from CAD to GIS Maintains Currency, Minimizes Disruption.” ESRI Energy Currents, February 2008.
- “How Vendor Mergers are Shaping T&D.” Utility Automation and Engineering T&D, July 2007.
- “Maintaining Data Quality During a Phased Enterprise GIS.” ESRI Users Conference 2007.
- “Deploying GWD as Value-Added Extension of GIS.” ESRI Energy Currents, Spring 2007.
- “Georgia Power Makes a Smooth Move to GIS.” T&D World, March 2008.
- “Plan for Migration Supports CAD to GIS Changeover.” ESRI Energy Currents, Spring 2007.
- “Realizing Port of Portland’s Investment in Imaging through IMAGE SERVER.” ESRI Users Conference 2009.
- “Can I Have It Now? (GIS Organizational Impacts and Project Management).” DistribuTech 2007.
- “Leveraging GIS and Mobile for Field Applications: UGI’s Field Level Asset Management Environment (FLAME) Project.” (Co-presented with UGI), DistribuTECH 2007 and GE Smallworld UC 2009.
- “Geospatial Information Systems Provide a Platform for Visualization of Integrated Business Data.” GeoWorld, March 2008.

- “Foundation Building - An Enterprise Approach to Automating Facility Inspections,” (Co-presented with E.ON/LG&E and Mapframe), GE Smallworld UC 2008 and 2009, and GITA 2009.
- “Leveraging Benefits through Enterprise GIS Deployment,” ESRI Users Conference 2009.

The following provides project descriptions for representative client organizations we have supported. We met and/or exceeded client expectations with regards to budget and schedule performance on all projects.

Alabama Power Company (APC)

Developed a distribution information system to support APC viewing, editing, querying, and reporting of pole inspection data, including web functionality for graphical data viewing and map reporting.

Allegheny Power

Provided critical support to a number of Allegheny Power projects including:

- Design, delivery, and data migration for GE Smallworld GIS, WMS, mobile, and distribution management; integration with other business systems, including CIS and materials management
- Performed major upgrade of Allegheny Power’s enterprise GIS — Included migration from Smallworld 3.2.1 to Smallworld 4.0; upgrading key business applications and data model code; and upgrades to GIS integrations with other systems including CIS, WMS, OMS, and others
- Ongoing software maintenance and support services for Smallworld GIS, GIS applications, and Work Integration Manager (WIM)

Alliant Energy

Assisted Alliant Energy in planning an AMI/MDM project.

- Performed cost/benefit review, prioritization, and refinement
- Defined high level enterprise requirements in three categories: AMI technology, information systems and systems integration, and business process impacts
- Developed overall Total Cost of Ownership (TCO) model for enterprise wide implementation and operation of AMI
- Supported Alliant’s project team in recommending pilot project charter, goals, requirements, recommendations, and costs/benefits to senior management

Supported RFP phase of the project to develop and evaluate AMI technologies.

- AMI network and AMI meters, deployment of the AMI network, and the AMI data collection system), meter installation, and AMI information systems, including a Meter Data Management System (MDMS) and associated systems integration support

- Detailed requirements specification for AMI technology, installation of endpoints, and MDMS/system integration; customer segmentation analysis and deployment planning; RFP/evaluation support; and change management

Supported Alliant's initial phase of deployment.

- Helped ensure that the meters and communications infrastructure were installed efficiently and with minimum disruption to customers, existing utility systems and business processes
- Provided overall project management support for Alliant's deployment, from acquisition to installation to provisioning to activation
- Supported regulatory compliance activities
- Performed field acceptance test management and support: developed and implemented a field test plan to validate AMI system functionality and benefits achievement, including a performance dashboard to monitor and communicate AMI system performance.

Supported Alliant's Smart Grid Vision and ARRA Funding Application development.

Anaheim Public Utilities (California)

Assisted Anaheim in acquiring an MDMS as an integral component of its AMI strategy — Provided visioning and strategic planning, enterprise architecture, integration requirements, technical and functional requirements specifications, proposal evaluation framework and process, technical assessments and total cost of ownership analysis, and vendor demo requirements and facilitation.

Currently, Enspiria is working as an integral member of the APU management and project team to support the delivery of the integrated MDMS. Tasks include:

- Providing Project Management support
- Developing requirements specs for MDMS and system integration
- Analyzing business process impacts and technical applications
- Production implementation, transition, and rollout planning
- Supporting design/development of MDMS and system integration
- Test planning and support; developing training plan
- Production support

Enspiria is also providing consulting services to Anaheim to support the selection of an Enterprise Service Bus (ESB) to facilitate integration of mission critical applications. Services include assessment of current applications and interfaces, assistance with development of detailed requirements, assistance in RFP development, and assistance in evaluation of proposals for ESB provider.

Arizona Public Service (APS)

Project for expanding departmental AM/FM mapping system to enterprise GIS, prepared a Solution Implementation Roadmap (SIR) including a technology

strategy, data strategy, applications, plans, estimates, timelines, and data conversion; and provided project implementation services including field inventory/conversion management, project management and planning, quality control, and reviewing and accepting converted data.

Assisting APS to plan for upgrade/replacement of its Distribution and Outage Management System (DMS/OMS), provided consulting support including requirements specification, implementation planning, vendor selection, and procurement/contract negotiations assistance.

Aspen, City of/Pitkin County, (Colorado)

Conducted GIS strategic planning session to review GIS activities to date and develop a strategy for future project direction.

Provided aerial photography project assistance.

Atlanta Gas Light Resources (AGLR)

Assisted with system wide upgrade of ESRI GIS and related software and customizations/integrations (including Miner & Miner's ArcFM). Provided technical leadership and guidance for GIS initiatives including migration of Virginia Natural Gas, Inc. (VNG) from GE Smallworld to ESRI GIS platform. Provided planning support related to merging of databases and use of GIS test environments, and assessed hardware environment and provided application development and testing support. Provided technical leadership and guidance in an initiative to add to the functionality of AGLR's GIS.

Baldwin County, (Alabama)

Provided GIS services including system architecture review/design, database support, redesigning and ArcIMS site, and planning for new GIS technologies.

Baltimore Gas & Electric

Supported BGE's AMI / MDMS / endpoint installation initiatives including business case, deployment plan, requirement specifications, RFPs development, proposal and vendor evaluation, and management recommendations; and supporting regulatory compliance activities.

Also supported the BGE Demand Response Infrastructure (DRI) project including requirement specifications, RFP development, and technology/vendor assessments. Support BGE in soliciting and selecting both DRI technology (Cannon) and DRI marketing (Honeywell) vendors.

Supported systems integration vendor selection through requirements development, RFP development and vendor evaluation.

Currently, Enspiria is serving as BGE's AMI Technical Consultant support AMI Vendor Negotiations. Support ranges advising BGE on the development of a vendor negotiation strategy to review and assistance in developing documents

associated with the contract (scope of work, statement of work, master agreements, terms and conditions, license agreements, service level agreements, high-level test plans and agreements, RFP, and others).

BC Transmission/ BC Hydro

Supported BC Transmission/BC Hydro in Distribution Management System (DMS) definition and planning, to issue and review RFIs/RFPs to procure a DMS vendor product. Provided expertise regarding DMS integration with a variety of systems including GIS, OMS, MDMS, WMS, EMS, SCADA, EAM, etc.

Helped ensure the new Smart Grid advanced DMS applications such as Fault Detection Isolation and Restoration (FDIR) and On-Line Power Flow and Voltage/VAR Optimization (VVO) would be ready to integrate and take advantage of the new field communication infrastructure being installed for their AMI project. (Work performed as subcontractor to Quanta/InfraSource.)

BC Hydro

As senior advisor for BC Hydro's Smart Metering Infrastructure (SMI) Program, providing independent, expert advice on strategic aspects of the project, including program design, project structure, costs/benefits calculations, procurement strategy, project delivery, risk management, and regulatory design. Executive External Advisor reports to Chairman of the Board and the CEO of BC Hydro, as well as the entire Senior Management Team. Also working directly with SMI program leadership team to advise, assist, and provide subject matter expertise in general support of the program.

Boston, City of, (Massachusetts)

Supported Boston's Enterprise GIS project — Performing needs assessment, leading visioning sessions, performing business case analysis, and making recommendations for organizational and business process change.

Burbank Water and Power

Supported Burbank Water and Power's MDMS RFP initiative, providing visioning and strategic planning, enterprise architecture, integration requirements, technical and functional requirements specifications.

Working as an integral member of project team to support the delivery of the integrated MDMS, including requirements specs for MDMS and system integration; business process impacts and technical applications; production implementation, transition, and rollout planning; supporting design/development of MDMS and system integration; and test and production support.

Cabarrus County, (North Carolina)

Provided SDE tune up services.

Central Illinois Light Company (now AmerenCILCO)

Implemented integrated suite of electric/gas technologies including GE Smallworld GIS, OMS, and distribution planning system, and integrated GIS with CILCO's CIS and WMS.

Charleston Water Supply

Provided GIS services including upgrading Charleston Water Supply's existing ESRI SDE to Version 9.2, and monitoring and tuning the installation.

Charlotte, City of, (North Carolina)

Created a central spatial data repository for all capital investment initiatives with ASP.NET web application interface that allows updating of simple features within the SDE repository.

Created an ArcIMS intranet and Internet site for the Charlotte/Mecklenburg Police Department. (Work performed as a subcontractor to ESRI)

Cinergy

Services provided to Cinergy include:

- Upgrading the interfaces to Centricity/OMS included Call Center to OMS, IVR to OMS, RACADE to OMS
- Solution architecture support for Cinergy's MWM vendor migration
- Providing solution architecture consulting for the Cinergy CAPEX strategic implementation plan, including review of operational systems and strategic implementation planning addressing enhancements to their planning, budgeting, scheduling and work management business processes and supporting business systems

Enspira personnel (under successor Convergent Group) supported Cinergy in planning and implementation of a turnkey project to replace over 30 software packages with five integrated technologies

- Roles: Project Manager, Integration Consultant, and Systems Integrator
- Key program components: GIS, OMS/Trouble Call, RA/CAD, WMS, CIS, EDAS, DPS, and associated integrations
- Included multimedia customer contact center and eBusiness Applications

Cleco Power LLC

Worked as an integral member of the Cleco project team to refresh their existing business case for implementing an AMI solution.

Colorado Springs Utilities

Supported integration of multi-commodity (electric, water, and gas) AMR with utility operations systems. Developed system requirements, architecture, and system design. Provided implementation project management.

Columbia (TN) Power and Water System (CPWS)

Supported CPWS in studying and evaluating AMI systems. Identified AMI system and technology options, prioritized benefits, and developed roadmap for implementation.

Concord, City of, (North Carolina)

Provided ESRI based support — Web enabled spatial data site development, reorganization of SDE databases and servers, transitioning site maintenance via education and technology transfer, and mentoring City resources in web development skills, as well as ArcSDE 9.0 upgrade, implementation/configuration of Orion and ArcIMS products, and data modeling for water/wastewater/storm water administrative boundaries. (Work performed as a subcontractor to SiteTech Systems)

ConEdison of New York

Assisted with the Corporate Mapping Systems project business justification. Prioritized project elements based on benefits and costs; created an actionable project plan with implementation options and recommended project phases, tasks, key performance indicators, and milestones/timelines; and established an estimated project budget.

Also developed a conduit migration strategy, and provided GPS Consulting.

CPS Energy

Worked as an integral member of the CPS project team to develop an AMI/MDMS solutions plan and competitive vendor solicitation. The scope of support included AMI/MDMS project planning; specifications, RFP, and support to CPS in selecting the most suited solution vendors; change management planning including communication and training plans; implementation plan for AMI/MDMS development and deployment; and AMI/MDMS business case development.

Currently serving as CPS' AMI/MDMS system integrator. The MDMS systems integration project integrates AMI and MDMS with various areas of CPS Energy's operational systems, including asset management, customer service, mobile workforce management, demand response, GIS, outage management and customer web applications.

Department of Energy (DOE) National Energy Technology Laboratory (NETL)

Provided solution architecture expertise for the North American SynchroPhasor Initiative Network (NASPInet). Developed the NASPInet system reference

architecture (including system context diagram, system component diagram, system integration diagram, system security diagram, conceptual system architecture diagram, and significant use cases as sequence diagrams), as well as and supporting specifications development. (Subcontractor to Quanta/InfraSource)

Électricité de France (EDF)

Conducted detailed technical review and audit of Cornerstone data model, providing significant recommendations to improve performance, functionality, and usability of the model. Recommendations were implemented.

Enbridge Natural Gas

Provided GIS Roadmap and Vendor Evaluation support including development of a Strategic Roadmap with target enterprise GIS architecture and business requirements, Implementation Plan, and Business Case, as well as GIS vendor RFQ development and evaluation.

ENMAX (Calgary)

Developed AMI business case, solution and system integration architecture, technology assessments, implementation roadmap, and associated regulatory support.

E.ON U.S. (LG&E)

Provide critical support to a number of projects including:

EPCOR

Performed Smart Grid assessment and visioning. Included technology assessments, strategy and roadmap, high level enterprise architecture, major gaps and improvement areas, and recommendations for an action plan.

Also developed a GIS connectivity implementation strategy and business case, including integration with other systems (work management, outage management, SCADA, mobile dispatch and customer information systems).

ESRI

Subcontracted by ESRI to support various projects from strategic GIS planning/assessment to ArcSDE support to ArcObjects and ArcIMS custom application development.

Exelon Energy Delivery/ComEd

Provided AMI/MDMS/Smart Grid support to Exelon Energy Delivery/ComEd. Projects include:

- Evaluated and recommended the implementation of AMI in the ComEd (Chicago city and metro area) service territory. This included identifying functional and information requirements of the future state business

processes; developing a customer base segmentation strategy; evaluating existing and candidate AMR technologies with respect to identified functional, information, and segmentation requirements; Developing a high level system architecture; Developing a business case with quantified and strategic benefits and associated total lifecycle costs; Developing a Solution Implementation Roadmap (SIR) and AMR deployment plans with appropriate phases and milestones commensurate to prioritized benefits and acceptable investments; and Assisting in RFP development, evaluation, and negotiation.

- Performed an AMI Market and Regulatory Assessment. This included State-by-state regulatory assessment, Market penetration by technology; Technical assessment; and Assessments for MDMS and meters.

Also provided consulting in MWM, FFA, and Mobility Enablement Services to Exelon including business process assessment and To-Be solution design; market and vendor research; system requirements; systems integration specifications including MWM, OMS, WMS, HR systems, etc.; project plan and schedule for implementation; business case costs/benefits; and RFP development and vendor selection.

FirstEnergy

Assisted with the development of an AMI Pilot strategy — Defining business requirements and associated benefits, and building a business case for justification of Enterprise AMI deployment throughout the service territory.

General Electric

Provided DMS/SCADA/OMS consulting and advising. Helped GE review and refine their DMS/OMS strategy. Contracted by GE to provide first line support for Smallworld utility customers.

Georgia Power Company (GPC)

Managed and provided technical expertise for GPC's ESRI/Miner & Miner GIS implementation and migration project — Full spectrum of support from enterprise data model/specifications development to management of conversion vendor performance includes leading development and implementation of a comprehensive Organizational Change Management Strategic Plan to address communication and training needs.

Supported GPC Distribution in evaluating the process of moving to the ESRI technology platform including implementation and migration plans, feasibility, costs, and business impacts.

Developed Network Underground GIS Business Case to validate how implementing a GIS for Network Underground could increase GPC's operations efficiency, provide better data management, and improve data accessibility. Currently supporting Network Underground GIS initiative.

To achieve increased efficiencies and cost savings throughout the company, modeled GPC Land's current use of GIS technology and identified opportunities where integrating GIS might benefit various business processes and workflows.

Greenville County, (North Carolina)

Provided ESRI consulting including system design review for the County's Geodatabase implementation, and best practices recommendations for ArcSDE installation and configuration, and hardware and server installation/configuration.

Gold Fields Exploration

Provided ESRI GIS technology support including ArcSDE installation, configuration, and data loading. Also installed ArcGIS server and created map services and applications.

Hawaiian Electric Company (HECO)

Supported HECO's efforts to develop and implement an MDMS as part of an overall AMI strategic initiative designed to help HECO leverage existing CIS and OMS investments and achieve its goals to facilitate a more efficient and accurate meter to cash process, increase overall customer service quality and reliability, and enable more effective energy efficiency improvement programs.

Supported HECO in AMI regulatory application on behalf of HECO, Maui Electric, and Hawaii Electric Light Company (HELCO); which included validation/refinement of AMI business case costs and benefits for the AMI regulatory application and development of HECO's AMI regulatory filing document.

Performed an assessment of AMI technologies currently available in the market, their future direction, and the ability of these AMI platforms to support Smart Grid applications such as Distribution Automation and Demand Response. Participated in a regulatory workshop for PUC staff and key interveners as an expert witness on the state of the AMI marketplace and larger smart grid opportunities.

Provided OMS and MWMS solution architecture consulting — Developing the integration architecture, leading the client through all of the configuration and integration workshops, and assisting with test plan development and deployment planning.

Provided outage management system services to create an OMS dynamic wallboard display for HECO.

Hydro One

Serving as Lead Smart Grid Solution Architect supporting one of North America's most ambitious Smart Grid programs: Hydro One's ADS transformational program. Developing smart grid solution architecture that will

be used to guide Hydro One's investments in smart grid related technologies over the next 20 years. Also a key participant in evaluating the DMS and P&C vendor technologies and system integration proposals.

Conducted an Enterprise GIS Strategy and Geospatial Roadmap project to assess the current state of GIS utilization related to work management, asset management, outage management, and engineering/planning business processes; identify gaps between the current and desired state; design the "To-Be" model; and establish an implementation plan.

Currently implementing an image serving solution. Hydro One's business objective is to ensure the most efficient delivery of image data to Hydro One lines of business, independent of business location or platform (LAN, WAN, Citrix, Web and Intranet). Our solution utilizes ESRI's ArcGIS Server Image Extension technology and builds on the existing GIS solutions deployed primarily using ESRI & Telvent Miner & Miner (TM&M) technologies.

Indianapolis, City of, (Indiana)

Indianapolis outsourced City GIS to us, including responsibility for operations and management of one of the largest GIS implementations in the US. During a six year period we designed, developed, and deployed an ESRI based enterprisewide GIS and integrated many systems including permitting and development functions. This project received the ESRI User Conference award for "Special Achievement in GIS."

Indianapolis Power & Light Company

Developed phased implementation plan for outage management and mobile workforce management, including integration with SCADA and AMR systems, including high level functional and integration requirements definition, support for vendor solicitation/selection and contract negotiations with the selected vendor, and hardware requirements specification.

Itron

Provided consulting support related to marketing of AMI technology.

JEA, Jacksonville, Florida

Held key role in delivering a new meter data management system repository to serve as a single source for metering and billing related analysis and business intelligence. Integrated metering data with JEA's existing legacy CIS, mobile workforce management system, OMS, handheld meter reading system, transformer load management, and distribution planning systems.

Performed consulting engagement to develop the project implementation plan designed to increase the return on JEA's investments in network meter reading through integration with other systems. Developed a business case, established

system integration and data requirements, and defined business process alignments related to City electric, water, and sewer services.

Jeppesen

Provided Information Technology services including software design, architectural consulting, and server configuration. Redesign of software to use ESRI and Oracle Spatial. Determination of technology options that address architectural requirements, including alternatives and pro and cons and the risks related to alternatives.

Kansas City, City of (Missouri)

Conducted requirements gathering for the design and pilot of a spatial central data repository to provide for interoperability between a variety of geographic information systems and databases. Project includes extensive addressing rectification and a central repository and solution components: ArcGIS, Geodatabase, ArcIMS, Oracle, and SDE.

Kansas City Board of Public Utilities

Provided IT consulting and advice on integration of Board of Public Utilities (BPU) systems. Supporting BPU in verifying and further defining IT goals and objectives. Assessed the current environment, and developing a roadmap for future integration/initiatives.

Kansas City Power and Light

Developed an enterprise integration strategy, implementation roadmap, and business case for enhancing the benefits of investments in AMI and related information technologies.

Laclede Gas Company

Conducted needs assessment for mobile work management system resulting in requirements, architecture, business case, and a budgeted implementation plan. Also supported WMS/MWM RFP development and vendor selection.

Currently supporting Laclede in developing functional and non-functional requirements for the proposed Asset and Materials Management System, including refreshing solutions architecture plans.

Landis+Gyr

Performed AMR assessment and provided related support.

Level 3 Communications

Supported Level 3's ArcSDE implementation, including reviewing the current implementation and assisting with go forward recommendations including performance issues and tuning.

Los Angeles Department of Water and Power (LADWP)

Provided systems integration for a large substation automation project (120 stations), including system procurement, document management, change management, training, factory testing and commissioning, site support and maintenance, and project management.

Mississippi Power Company

Performed a pilot for the Facilities Inspection and Maintenance (FIM) system.

Navopache Electric Cooperative

Provided strategic planning for systems integration and work process improvements with information flow to users of mapping, SCADA, engineering, and customer information databases and systems. Provided recommended order/priority of integration of systems, strategic integration vision, and strategic implementation roadmap development including a one-day workshop at the cooperative's annual board retreat.

Nebraska Public Power District

Provided systems integration and project management for GE Smallworld GIS/OMS/graphic work design implementation, data migration, and full integration with existing enterprise resource planning/work management system and CIS.

Neptune Technology Group

Conducted an AMI Market and Technology Assessment.

New Jersey Natural Gas

Developed strategic implementation roadmap for GIS vertical applications, including useful business based integrations with CIS, back office financial systems (JDEdwards), Engineering Analysis (Stoner), graphical job design, work management, mobile workforce management (MDSI), and mobile geographic information systems; as well as data conversion, training, and OCM. This assignment focused on developing a solid business case and a realistic GIS implementation plan.

Nicor Gas

Performed a review of the Nicor Gas AMI business case.

North Dakota, State of

Provided design and pilot of a spatial data central repository to enable use of variety of GIS and other information from numerous statewide agencies using ESRI ArcGIS 9 Geodatabase, Oracle, ArcIMS, and SDE.

Northeast Utilities (NU)

Provide critical support to a number of projects for Northeast Utilities (NU) and its operating subsidiaries (Connecticut Light and Power Company, Public Service Company of New Hampshire, Western Massachusetts Electric Company, North Atlantic Energy Corporation, Yankee Gas Services Company), including:

- Implemented enterprise wide GIS, including migrating existing geographic information systems to a unified GIS asset registry system across the NU operating companies.
- Developed a five year plan and supported integration of GIS with WMS, graphic work design, OMS, and mobile workforce management — Included developing a common enterprise wide system architecture and technology recommendation and generating a business case cost/benefit analysis identifying strategic/quantifiable benefits across the enterprise.
- Developed a Strategic Implementation Roadmap for Yankee Gas; Moved Yankee Gas from Bentley Microstation based mapping system to the GE Smallworld GIS platform. Implemented integrated gas applications: Cathodic Protection tracking and survey with Leak Survey and Advantica SynerGEE integration with Smallworld GIS.
- Helped the NU Transmission Business (NUTB) unit define a process and technology strategy and plan for a standalone business unit. Recommended process improvements and an integrated technology solution.
- Provided project management and system engineering for NU's full inventory of field assets and database update project.
- Integrated field inventory asset data with Smallworld GIS; integrated the GIS with CIS.
- Provided strategic planning for GIS/asset management, which included process reviews (for GIS, asset management, mobile computing, graphic work design, and GIS Landbase Strategy), business case analysis, enterprise wide technology solution definition, and implementation planning.
 - Conducting upgrades and providing support.

Northern Indiana Public Service Company

Managing the ESRI/Miner & Miner data migration for the Northern Indiana Public Service Company (NIPSCO) Integral Mapping System (NIMS) and providing ongoing support including:

- Production support (database administration, configuration, custom code support, bug fixes, administrative data updates, system performance management, end user support, system wide interface support, and general system tuning).
- Assisting with design, development, and implementation of new initiatives (ArcFM gas tracing enhancements, WM/GIS integration, etc.).

- Supporting NIMS data migration/integration into the NiSource GIS and WMS.
- Providing user training and demonstrations.
- Supporting NIPSCO's upgrade of the ArcSDE database, ArcGIS software, ArcFM software, and custom NIMS software to a more current Arc9 Platform.
- NSTAR

Conducted Gas Bulk Data Migration and Conversion from Intergraph's FRAMME to the GE Smallworld GIS platform. Objectives were to digitally migrate existing FRAMME CAMRIS data, confirm migrated data quality, perform specific cleanup of CAMRIS source data, update and enhance landbase data, convert scanned images of redlines and attachments, and verify acceptability of the resulting data.

NV Energy

Providing consulting support to NV Energy's (Nevada Power and Sierra Pacific) Advanced Service Delivery (ASD) project. Integral part of the team developing the ASD model for the latest advancements in AMI, DR, HAN, DRMS (Demand Response Management System), MDMS and CEMP (Customer Energy Management Portal) technologies. Led vendor selection process and engaged in contract negotiation support for AMI Technology, MDMS, and Endpoint Installation. Actively supported NV Energy in submission of application for ARRA funding. As the ASD Program Integrator, Enspira is providing program management, solution architecture development and mapping, deployment planning, field acceptance testing, regulatory support, and systems integration oversight and support to the ASD program.

Ontario Independent Electricity System Operator

Participated in the team charged with developing and delivering a Meter Data Management Repository for the IESO, the organization responsible for operating wholesale electricity markets in Ontario. Enspira's role included leading the integration design with the IESO and the supported local distribution companies (LDCs), and assisting the enrollment process for 94 LDCs, system testing, and system cutover. (Work performed as subcontractor to IBM.)

Oncor/TXU Energy Delivery

Supported TXU in the selection of DMS and OMS. The selection consulting was provided as part of an overall effort to develop and implement a Smart Grid Software System to create a unified, integrated IT and user environment to transform distribution operations, raise reliability levels, and reduce operations and support costs. Enspira supported TXU in developing strategy implementation plan, and technology vendor assessments for OMS, DMS, MWM, and GIS designed to maximize the use of TXU investments in AMI, Broadband on Power Line (BPL), mobile technologies, SCADA, Distribution Automation, and other Smart Grid technologies.

Developed enterprise wide strategy and implementation roadmap and technology assessment for an integrated Smart Grid Software System to transform distribution operations and maximize return of TXU investments in AMI, BPL, mobile computing infrastructure, SCADA, distribution automation, and other Smart Grid technologies.

Supported TXU's AMI/MDM project, including requirements gathering and specification, and assisting in defining the system/integration architecture to automate the AMI conversion process and the meter to bill process for nearly 3M electric customers and establish data management and exchange standards.

Orange County, (Florida)

Provided ESRI ArcSDE/Oracle system design, development, and deployment to support the County's Growth Management organization, including implementing enterprise ArcSDE and integrating data and applications between four major County departments using GIS. (Work performed under subcontract to ESRI.)

Part of the winning team that was recently selected to provide GIS Consultant Services to Orange County for a multi-year period.

Pacific Gas & Electric (PG&E)

Provided consulting to Pacific Gas & Electric in the development of their NMR business case for the California Public Utilities Commission. Assessed PG&E cost basis and NMR benefits. (Support provided as a subcontractor to eMeter.)

PacifiCorp

Developed a detailed business case and deployment plan for PacifiCorp's ten year IT Master Plan. Prepared functional requirement specifications and a detailed implementation plan for GIS and related systems.

Pasadena, City of, (California)

Supported development of a Request for Proposals to identify and select a GIS program management and implementation vendor.

PECO (Subsidiary of Exelon)

Provide AMI/MDMS/Smart Grid support to PECO. Projects include:

- Currently, providing consulting to PECO in support of its AMI evaluation for PECO's service area. Consulting services support includes AMI Business Case development, project management, preparation of regulatory filing, regulatory testimony, technical assessment, and contract negotiations.
- Developed integration of Cellnet AMI Data into OSIsoft PI Historian for load management of transformers and secondary mains. This included a graphical interface to quickly show assets at risk, as well as daily reporting to provide information on abnormal load changes.

Pepco Holdings, Inc. (PHI)

Worked with PHI to ensure a successful AMI acquisition. The project included development of comprehensive functional, performance, and technical specifications for PHI's AMI system; development of a procurement strategy and appropriate competitive solicitations for the procurement of an AMI system; updating PHI's existing AMI business case; and developing an implementation plan and timeline. Also provided regulatory compliance support.

Supported PHI in defining a Smart Grid and Distribution Automation (DA) strategy.

Performing field test management and support. Developed and implemented a field test plan to validate AMI system functionality and benefits achievement, including a performance dashboard to monitor and communicate the performance of the AMI system. Validating the accuracy of meter reads obtained and processed through PHI's AMI solution.

Piedmont Natural Gas Company

Provide critical support to a number of Piedmont Natural Gas Company (PNG) projects including:

- Data modeling/migration and implementation for an enterprise GIS solution, including GE Smallworld GIS with various applications and tools such as facility inspection and maintenance and gas outage management and custom interfaces to various systems such as a Document Management System (DMS), DataMart, and CIS.
- Data migration project to consolidate North Carolina Natural Gas and PNG.
- Ongoing software maintenance and support services for Smallworld GIS, Facilities Inspection and Maintenance (FIM), and Work Integration Manager (WIM).
- Major upgrades of PNG's enterprise GIS, including migration from Smallworld 3.1 to Smallworld 3.3; from 3.3 to 4.0; and 4.0 to 4.1 upgrade delivered in August 2007; upgrading key business applications and data model code, and upgrades to GIS integrations with other systems (CIS).
- Configured GE Smallworld Spatial Intelligence tool.
- Provided upgrades and enhancements to FIM for a gas industry standard solution based on DOT regulations, and rollout of a major upgrade for the FIM application to 15 districts.
- Supported GIS – Pipeline Integrity integration including solution development to meet PNG pipeline integrity requirements, involving development of new software, data model enhancements, and integration of GE Cornerstone P components.

Port of Portland (Oregon)

Provided consulting support for assessing the Port's GIS implementation and needs. The initiative included user, business, and executive interviews; definition of strategic visions and high level business requirements; business case analysis; and a comprehensive findings and recommendations report. Resulted in initiation of the Enterprise GIS (E-GIS) Project. Currently providing project management, solution architecture, implementation, and integration services for E-GIS. The project includes providing: a three tier GIS architecture that supports centralized data and application servers; Windows terminal server access for ad hoc thematic maps, portal accessible maps, reports, and geospatial analysis; Scalable web architecture with portal access; Integrations with operational business systems and financial systems, and Enterprise Asset Management (EAM) technology.

Portland, City of, Oregon

Pioneered Spatial Central Data Repositories — Worked with the City to design, develop, and deploy a GIS Hub integrating over ten different geographic information systems and a rich mix of other databases into a central data repository to be used by the City and its partners. Tasks included data modeling, migration, and extensive addressing work and rectification. The solution incorporated various third party software products and ESRI's ArcGIS 9, Geodatabase, Oracle, ArcIMS, and SDE.

Portland General Electric

Strategic implementation planning for PGE's Distribution Technology Platform (DTP). Encompasses GIS, WMS, OMS, and EAM technologies and delivers a business case and technology roadmap.

Provided support for the AMI implementation at PGE, including project management, system engineering, and software development. The project automates PGE's entire service territory of approximately 850,000 meters. (Subcontractor to Sensus.)

Currently supporting PGE in rapidly and accurately assessing performance of the AMI vendor solution. This includes metrics support for site acceptance testing and for deployment.

Assisted PGE in evaluating options for implementing advanced MDM capability.

Raleigh, City of, North Carolina

Conducted GIS server upgrades including pre-planning requirements, initial setup of the servers and GIS, and assisting the City during cutover to the new system.

Rappahannock Electric Cooperative

Managed and performed GIS data migration from a Smallworld GIS implementation to an ESRI Origin GIS™ implementation, integrating different, populated models into one database. Rappahannock was acquiring a portion of an adjacent utility's service territory. The data migration was part the bigger effort to migrate the adjacent utility's information systems to a common set of systems. The project was performed under a tight and critical schedule as the GIS data formed the basis of testing for other systems (e.g., outage management).

Salt River Project

Provided subject matter expertise in selection and implementation of a new WMS, advising on WMS products and functionality and supporting selection and implementation. The WMS is part of an integrated solution that includes GIS, graphical work design, and asset management.

San Antonio Water System

Providing consulting services for the Automated Meter Reading Project Initiative, including support for business case, RFP/vendor selection (for AMR, MDMS and Meter Installation), and implementation planning.

San Diego Gas and Electric

Provided trusted advisor strategic consulting to Sempra with their OpEx 20/20 Utility of the Future initiative, including Field Force Enablement, Smart Grid, and Asset Management — MWM, DMS/OMS, GIS, WMS, and other advanced technologies.

Assisted with Business Case development for the company's Advanced Meter Infrastructure (AMI) program. The project includes documentation of AMI business process requirements; developing functional, system, and technical requirements for maximizing the benefits of the AMI initiative; development of AMI sourcing strategy; cost/benefit analysis; and assisting with vendor solicitation/selection.

Retained to help develop and manage field tests of the shortlisted AMI technologies prior to final selection. This included developing a field trial reporting tool to verify the accuracy and availability of the piloted AMI technologies. Supported the AMI application process by helping answer questions from CPUC and Consumer Advocacy groups, serving as expert witness in regulatory proceedings, and serving on the CPUC Technical Advisory Panel on behalf of SDG&E.

SaskPower

Supporting SaskPower in evaluating the business case related to AMI. Responsible for engaging the organization to identify benefit areas, determine system requirements, develop the financial model and create an integrated

business case for the utility's Board approval in early 2010. (Subcontractor to Solvera)

Shenandoah Valley Electric Cooperative

Managed and performed GIS data migration from Shenandoah's existing GIS to a new Milsoft WindMilMap implementation, integrating different populated models into one database. Shenandoah was acquiring a portion of an adjacent utility's service territory. The data migration was part of a larger effort to migrate the adjacent utility's information systems to a common set of systems. The project was performed under a tight, critical schedule as the GIS formed a basis for multiple other system migrations.

South Jersey Gas

Provided consulting to South Jersey Gas for the Work Smart project (new Work Management system (WMS) with mobile workforce capabilities) that meets the needs of both South Jersey Industries (SJI) and South Jersey Energy Service Plus (SJESP), including detailed functional requirements related to WMS for each of the two business units of SJI, comprehensive RFP for a new Work Management, Mobile Workforce Management System to support all major work processes within SJI and SJESP subsidiaries, a SJI WMS Business Case to reflect the WMS/Mobile phased implementation strategy, RFP response and vendor presentation evaluation, developing a recommendation to be presented to SJI Executive Management, vendor contract negotiation.

Currently providing implementation support for the new WMS/Mobile system.

Southern California Gas

Assisted SoCalGas with its Smart Metering Business Case project. Benchmarked benefit and cost estimates against Enspira and industry experiences. Developed specifications and RFPs, and supported vendor evaluations for four SoCalGas solicitations covering Smart Metering, MDMS, System Integration, Program Support, and Operational Services.

Southern Company

Provided AMI systems integration and project management support for the Sensus AMI implementation at Southern Company (as subcontractor to Sensus).

Supporting efforts to better integrate GIS technology with STOMP (Southern Transmission Operational Maintenance Program). Developed alternatives for GIS STOMP interfaces, integration, and application architecture options.

For Enterprise GIS initiative, prepared a going forward ESRI based GIS business case and consolidation strategy for Southern Company and its operating companies (Alabama Power, Mississippi Power, Georgia Power, Gulf Power, and Savannah Electric), including architectures and implementation plans. Currently

supporting implementation of the plan, with the first phase of implementation at Georgia Power Company.

Additional support provided to Southern Company includes ArcSDE/Oracle performance tuning, custom ArcObjects application development, creation of a customized website, as well as web application design and support.

Southern Maryland Electric Cooperative (SMECO)

Performed a strategic assessment of AMI and related technologies. Identified critical next steps/priorities for an Integrated Smart Grid Strategy and Roadmap. Performed business case analysis. Currently developing AMI requirements and the Smart Grid roadmap. Supported ARRA SGIG submission.

Springfield City Utilities (Missouri)

Developed Operations Technology Strategic Plan for City electricity, natural gas, water, and public transportation. Addressed wide range of technologies including GIS, OMS, WMS, mobile computing, purchasing, inventory, and materials management.

Tacoma Water

Conducting a review and evaluation of Tacoma Water's GIS platform, development and production processes. Providing recommendations on how to maximize the utilization of GIS as a vital component in the engineering, operating and planning of the utility, building a roadmap for the future.

Tallahassee, City of (Florida)

Assisted with MDMS development including, visioning; MDMS system and integration requirements; MDMS system specifications and service requirements; and supporting RFP evaluation/contracting. Currently supporting the MDMS implementation project at the City of Tallahassee by providing system integration project management expertise in managing the MDMS and other related vendors, and the MDMS hardware and software implementation. (Work performed as subcontractor to Honeywell.)

Time Warner Cable

Provide support to various Time Warner Cable (TWC) projects including:

- Developed internal website displaying all of the company's cable facilities and related information. Created Data Updater tool to update ArcSDE database with CAD data. Building database and marketing application for TWC Online services Corporate. Performing requirements phase of Focus/Telcordia Network Engineer integration project.
- Web development to build a call center web application included the implementation of a GIS web service bus, which allows the same web services utilized by the call center application to be integrated into other applications to help with billing data clean up and other tasks.

- Developed an Oracle Spatial network data model for fiber and coaxial cable networks. Implemented a data migration application, using Safe Software's FME product and Enspira's change detection methodologies, to update the enterprise outside plant data model with Bentley Comms data from TWC's regional offices. The application included a web interface for administrators to configure migration environments and manage the transfer schedule and email notifications sent by the service when the translations are complete, which provides accurate, near real time data for the call center web application, improving new service signup rates and reducing truck roll counts.
- Developed a desktop application to allow Bentley Comms users to determine the number of facilities and footage of plant based on an existing Bentley file.
- Design and implementation of a web based mapping portal — known as the GeoPortal — to host business driven web based GIS mapping applications and business information tools.

Transit Cooperative Research Program

Supporting Portland State University and TriMet in a transit study, "Transit Market Research: Leveraging ITS and Transit ITS Data," through Federal sponsorship under the Transit Cooperative Research Program (TCRP).

Tri-State Generation and Transmission Association

Providing consulting services for Tri-State G&T's MDMS initiative. Support is focused on assisting with requirements, technology assessment, technology/vendor selection, solution architecture, and vendor scope of work development.

Tucson Electric Power

Reviewed operational systems and developed strategic implementation plan to enhance planning, budgeting, scheduling, and work management business processes and supporting business systems.

Union Gas, a Duke Company

Provided strategic planning and GIS expertise for Union Gas' GIS Replacement Project, including architecture, business and functional requirements, migration planning, and vendor selection support.

United Illuminating

Providing consulting services in support of UI's Meter Data Management System (MDMS) Implementation. Areas of support include configuration, test planning, system validation, integration planning, MDM integration, and 5 Year MDMS Roadmap.

Served as systems integrator for UI's outage management project — Working with UI and the product vendors to plan, design, develop, integrate, and deploy

the necessary interfaces to fully enable the OMS at UI. The project involves integrating Oracle/SPL's OMS with business systems that include CellNet's Network Meter Reading System (NMR), SAP's Customer Information System (CIS)/Customer Care Module, Aspect's Interactive Voice Response (IVR) system, and ACS's Supervisory Control Data Acquisition (SCADA) system. Enspira is also responsible for migrating ESRI GIS Data (approx 400 circuits) to OMS.

Performed an audit of GIS data maintenance processes for United Illuminating and developing a comprehensive strategy consisting of both procedural and technical recommendations to ensure data quality for reliable outage management. These recommendations are being implemented in conjunction with a full system field audit and transformer replacement program, and include formal QA/QC tools, a redesigned GIS maintenance process with supporting workflow management tools, user productivity tools, and tools and processes to transfer data between the GIS and Osmose FastGate.

University of North Carolina

Developed comprehensive, 12 unit ArcSDE/Oracle data model for the entire campus (including electric distribution, other utilities, and facilities maintenance) and developed data migration and application requirement specifications. (Work performed under subcontract to ESRI.)

Vattenfall (Finland)

Provided MDMS solution architecture services in support of the Vattenfall — Nordic project, including supporting requirements workshops and producing/reviewing design documents.

Westar Energy

Providing systems integration support for Westar's AMI program.

Assisting Westar with the selection of its OMS. Support has included: reviewing OMS RFP functional, technical and integration requirements, helping to define shortlist of OMS, DMS and OMS/DMS vendors, and defining OMS/DMS integration touch-points and interfaces.

Provided consulting services to assist Westar in assessing outage management system capabilities, business and technology directions, and reliability and service requirements. Recommended a plan to meet future OMS needs.

WE Energies (formerly Wisconsin Electric Power Co)

Supported substation automation/integration — architecture, build up, testing, and delivery of substation automation systems at new substations, as well as upgrade of existing substations with substation automation retrofits — to provide improved technology and operability, modernization and expansion, and reduced cost.

6.4 INFORMATION ON GL NOBLE DENTON

Company Organization and History

Brief Introduction to GL Noble Denton

GL Noble Denton is part of the Germanischer Lloyd group of companies. GL is a world class technical assurance and consulting company providing technical engineering services to the industrial (oil and gas, renewables and water) and maritime (ship classification society) business sectors.

Both business fields follow the same approach of technical competence, uncompromising quality and first-class services around the world. With its head office in Hamburg (Germany), GL employs more than 7,000 engineers, surveyors, experts and support staff in 80 countries. The global network consists of more than 200 offices around the globe.

GL Noble Denton is a global independent technical advisor to the oil & gas industry providing assurance, consulting, marine operations and project execution services across the complete asset lifecycle.

With over 3,000 employees based in 30 countries, GL Noble Denton combines advanced engineering and analytical skills with extensive operational experience of complex offshore and onshore oil & gas assets, enhanced by our leading-edge software portfolio.

GL Noble Denton was formed from the merger of Germanischer Lloyd (GL) Oil & Gas and Noble Denton. This unique fit draws upon GL's position as a leading technical assurance and consulting company, with Noble Denton's global capability in complex marine operations and offshore engineering, to create a truly independent global technical advisor with a combined experience of over 240 years.

GL Noble Denton understands the challenges you face to ensure compliance, manage safety, reduce your costs and at the same time achieve operational excellence and optimize your assets. They can all seem complex and daunting when viewed in isolation. Our highly skilled, experienced and dynamic personnel take a holistic approach to deliver safe, smart, sustainable and innovative solutions to complex problems. As a truly independent advisor we understand when designs are optimal, installations fit for purpose and how to maximize operational efficiency. We generate genuine added value to you, as a client.

At GL Noble Denton there is a passion for quality and safety. Combine this with a heritage and unparalleled Oil & Gas domain knowledge that goes back over a century, and you have a company that really does provide a unique package of integrated lifecycle solutions on a global scale for all sectors of the Oil and Gas industry.

GL Noble Denton Organization

GL Noble Denton is organized into 4 regions: Americas, Europe, Middle East/Africa, and Asia Pacific. Figure 1, below illustrates the four regions and the headquarters for each region. This project will be conducted out of the Americas region with technical staff in Mechanicsburg, PA.

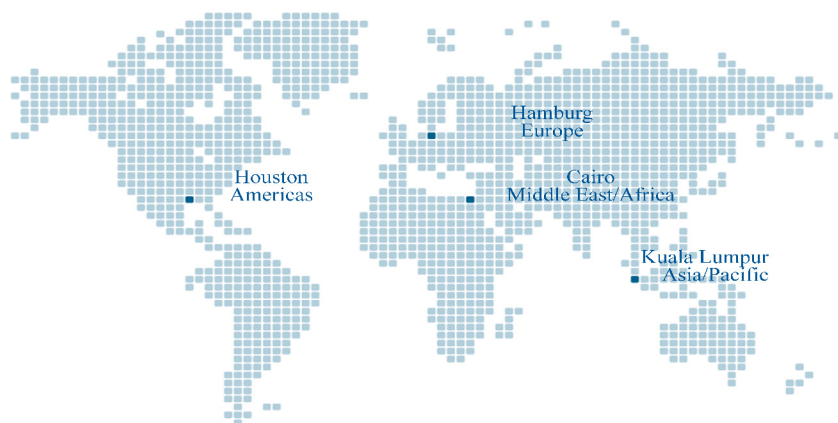


Figure 1: GL Noble Denton Regions

GL Noble Denton Financials

GL Noble Denton is a privately held company and therefore does not have publicly available financials. A copy of the company's annual report is available for review.

GL Noble Denton Qualifications

GL Noble Denton respectfully provides Black & Veatch Corporation with a short overview of our qualifications. GL Noble Denton is a very diverse company that provides solutions and consulting services to the energy and water industries worldwide. Our core competency is found in the natural gas industry where we have over 40 years of experience that stretches across the globe. In comparing our vast industry experience with ERCOT's RFP requirements; we have tried to group our industry knowledge into two main categories: Oil and Gas Industry Knowledge, and Software Development. We feel the blending of these areas of expertise makes us a unique fit for ERCOT's requirements. As you will see from reading the sections to follow, we have extensive experience in the oil and gas industry. In addition we have a proven history of developing software applications and solutions that are of high quality and meet our users' expectations.

Oil and Gas Industry Knowledge

GL Noble Denton is a premier provider of advanced technology and systems solutions that help high-performance oil and gas companies worldwide improve their operating performance and achieve their business vision. With origins in Stoner Associates in the US and British Gas in the UK, we have a proven track record of over 40 years experience servicing more than 550 clients in over 50

countries. Our employees possess a blend of strong technology, software, engineering, training, and testing skills and experience.

GL Noble Denton offers a range of engineering consultancy services to the oil and gas, pipeline and utility industries. Our state-of-the-art services include pipeline pressure up-rating, hydraulic analysis, hazard and risk assessment of facilities, design optimization and defect repair prioritization. GL Noble Denton has a number of software products within the oil and gas industry that assist with the maintenance and compliance lifecycle of an asset. The Stoner Software™ suite is comprised of SynerGEE, Essentials for maintenance and regulatory compliance, Uptime for Integrity management, Stoner Pipeline Simulator (SPS), and Forecaster for demand forecasting. Our SynerGEE Gas product is widely regarded as the premier natural gas hydraulic modeling program in the industry. Among America's largest gas distribution companies, GL Noble Denton has a market share of about 95%. A high percentage of these clients have been using our Stoner Software products for more than 30 years. Within the oil and gas industry, GL Noble Denton has worked with various companies on a variety of projects including systems integration, hydraulic model development, pipeline management systems (online and offline), simulation-based Trainers, operation qualifications, pipeline integrity, asset management and forecasting solutions.

We have been part of the oil and gas industry not only through the clients we serve, but by actively participating in industry organizations. Our longest standing membership has been with the American Gas Association (AGA) where we continue to contribute to the Distribution and Transmission Engineering, Distribution Construction and Maintenance, and Gas Control Committees. We routinely submit articles and papers to both the national and regional AGA organizations. In addition to AGA, we are involved with the Gas Piping Technology Committee (GPTC), Pipeline Simulation Interest Group (PSIG), and the National Association of Corrosion Engineers (NACE). All of these activities support our business model of being a proactive and contributing member of the industry.

Software Development

GL Noble Denton's product development legacy started in the early 1970s with our initial development of a natural gas hydraulic analysis program, GASSS. The GASSS program was a non-graphic product that provided pressure and flow calculations for natural gas networks. Since this initial development, we have grown our software development expertise into a number of business sectors within a gas utility. GL Noble Denton has five major product lines (SynerGEE, Stoner Pipeline Simulator (SPS), Uptime, Essentials, and Forecaster) for the natural gas industry that run in environments ranging from a laptop PC to full enterprise-wide systems.

The development of the Stoner Software product suite has been governed by a strict development process that ensures a high-quality product with a timely release to market. Our software development group follows an industry-standard process of developing software in stages (Alpha, Beta, and Final Release) while adhering to the standards that define those various stages of development. We have a dedicated Quality Assurance staff that is responsible for testing the software solutions to ensure not only reliability in the product functionality but also in the accuracy of the answers produced. The users of our software can attest to our quality and high standards.

Ultimately the success of our software depends on meeting the users' requirements. We take this aspect of development very seriously. To support this effort, we have generated several avenues to solicit user feedback. We have a dedicated Client Services department that is available Monday-Friday from 8am to 5pm EST along with an emergency support number for during non-business hours. Each year we host a user's forum, TEAM, focused on our Stoner Software product line. Finally, we are very active in the industry and in meeting with our clients on-site to learn more about how they use the software and how their requirements are changing day-to-day to adapt to an ever-changing industry.

We believe this type of legacy is critical to the success of ERCOT's requirements for a software program that provides the foundation for Gas Curtailment Risk Study. Two of the most important factors in selecting a software vendor include the quality of their work and the level of their support. If you speak to any of our clients about our Stoner Software products, you will find that GL Noble Denton excels at both.

7.0 Vendor Information & Other Required Forms

7.1 NON-DISCLOSURE AGREEMENT



Confidentiality and Non-Disclosure Agreement [Evaluation]

This **NON-DISCLOSURE AGREEMENT** (the "Agreement") is entered into between the undersigned ("Recipient") and Electric Reliability Council of Texas, Inc., a Texas non-profit corporation ("ERCOT").

WHEREAS, ERCOT seeks proposals in response to certain Requests for Proposal or Requests for Information ("RFPs") and Recipient seeks to respond to such RFPs. In order for Recipient to prepare its proposals for ERCOT, ERCOT must provide certain Confidential Information (defined below) to Recipient. Because Recipient desires to obtain the Confidential Information from ERCOT for the sole purpose of providing ERCOT with proposals in response to the RFPs, ERCOT is willing to disclose the Confidential Information to Recipient under the terms and conditions set forth herein.

NOW, THEREFORE, Recipient agrees as follows:

Recipient agrees not to disclose or use the Confidential Information except to evaluate it as contemplated by this Agreement. Recipient agrees to keep the Confidential Information in strict trust and confidence and shall not disclose any of it to any person except to a limited number of its own employees or subcontractors who require the knowledge to perform the evaluation and who have agreed to maintain the confidentiality obligations in this Agreement.

The Confidential Information and all copies thereof shall remain the exclusive property of ERCOT and all Confidential Information, shall, upon request of ERCOT, be promptly returned by Recipient to ERCOT, accompanied by all copies of such Confidential Information made by Recipient. Recipient agrees to immediately notify ERCOT upon discovery of any unauthorized use or disclosure of Confidential Information and to cooperate in any reasonable way to help ERCOT regain possession of the Confidential Information and prevent further unauthorized use or disclosure.

"Confidential Information" shall mean all information, technical data or know-how which relates to the business, facilities, services or products of ERCOT or ERCOT's Market Participants or other vendors including, without limitation, any designs, plans, research, products, services, developments, inventions, processes, techniques, designs, scientific, technical, engineering, distribution, marketing, financial, merchandising and sales information, which is disclosed to Recipient by ERCOT, directly or indirectly, in writing, electronically, orally or by drawings or inspection. Confidential Information does not include information, technical data or know-how which (i) is already published or available to the public; (ii) is proven to have been known to Recipient prior to disclosure; or (ii) is independently developed by personnel or agents of Recipient without reliance on the Confidential Information.

Recipient acknowledges and agrees that a breach of this Agreement may result in irreparable and continuing damage to ERCOT, for which there would be no adequate remedy at law, and that, in the event of such breach, ERCOT will be entitled to injunctive relief and/or a decree for specific performance, in addition to all such other and further relief as may be available at law, in equity, or otherwise.

Signed this 18 day of August, 2011.

AGREED BY RECIPIENT:

Company Name: Black & Veatch Corporation

By:  (Signature)

Name: Mark A. Gabriel

Title: Senior Vice President

Internal Use Only

ACCEPTED BY ERCOT:

By: _____ Date: _____

Printed Name: _____

7.2 VENDOR INFORMATION FORM

ERCOT Vendor Information Form (VIF)

Vendors must complete this form to be considered as a vendor for ERCOT or to update information per ERCOT's request. Please **e-mail completed/signed form with requested attachments** to: NewVendorInfoForms@ercot.com or fax fully completed and signed form to ERCOT's Procurement Department at (512) 248-3118, to the Attention of "Vendor Information". If this is in conjunction with a RFP/RFQ, please note the RFP/RFQ name as well as an ERCOT contact name in your e-mail or fax coversheet.

Requested Attachments:

1. **Executed W9** (no older than one year);
2. **Texas Secretary of State Proof of active Status** (required for Texas entities and non-Texas entities with offices in Texas);
3. **Texas Comptroller Proof of Good Standing** (i.e. Certification of Account Status from Texas Comptroller website);
4. **A list identifying all company Officers and Board of Directors members;**
5. **Documentation of assumed name(s)**, if any;
6. **If outside of Texas, Secretary of State Certificate proof of active status and/or good standing** (from state of organization);
7. **If the anticipated annual sales to ERCOT is > \$250,000**, Vendor's most recent two (2) years audited financial statements (enclose un-audited financials if vendor is not audited); Publicly held companies may attach (or send link to) Vendor's most recent Forms 10-K and 10-Q.

Vendor Legal Name and Company Information

Vendor Legal Name (as shown on W9): Black & Veatch Corporation dba: Black & Veatch Corporation

Vendor Contact: Scott Smith Title: Vice President
Phone: 713.590.2270 Fax: 913-458-3817
E-mail: smithsr@bv.com Company Website: www.bv.com

Vendor Tax ID Number: 43-1833073 DUNS Number: 09-225-5939
State of Organization: KS
Type of Entity: **Corporation** State of Formation: Delaware

Reason for Submitting VIF: **Response to RFP/RFQ**
Provide name of RFP/RFQ, if applicable: Gas Curtailment Risk Study If other, describe: _____
Products or Services sold/provided by Vendor: **Consulting Services** If other, describe: _____
Expected \$ Annual ERCOT Business: \$350,000.00

ERCOT Contact Person (if any): Jimmy Ramirez Phone or e-mail: 512-248-3118

Purchase Order/Primary Corporate Address

Specify area codes on all telephone and fax numbers. Use format (123) 456-7890
Telephone: 713-590-2270 Fax: 913-458-3817

Contact Person: Scott Smith Title of Contact: Vice President
E-mail: smithsr@bv.com

Address: 11401 Lamar Avenue
City: Overland Park Prov/State: KS Postal/Zip: 66211

If not Canada or USA then complete Postal/Zip above and insert Country and Prov/State below:
Country: N/A Prov/State: N/A

Remit Address		
<input checked="" type="checkbox"/> Same as purchase order/primary corporate address		
Specify area codes on all telephone and fax numbers. Use format (123) 456-7890		
Telephone: _____	Ext. _____	Fax: _____
Address: _____		
City: _____	Prov/State: _____	Postal/Zip: _____
If not Canada or USA then complete Postal/Zip above and insert Country and Prov/State below:		
Country: _____	Prov/State: _____	
❖ ERCOT is a Tax-Exempt entity and should not be charged sales tax on the purchase of any good or service. All payments made by ERCOT will be in United States Currency.		

Product/Service Description
Provide a detailed description of the products or services that you intend to provide to ERCOT (include expertise if services). <u>Consulting Services related to Gas Curtailment Risk Study</u>


Projected Sales > \$250,000: Complete section below & include two years of financials
Vendor credit contact: <u>Sandra Collier</u>
Phone number: <u>312.461.2292</u> E-mail: <u>N/A</u>
Full legal name of vendor parent company (if any): <u>N/A</u>
Other Vendor affiliates: <u>N/A</u>
Is company publicly traded? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
If so, please provide stock symbol: _____

Does any ERCOT employee, officer, or director: (a) have any ownership in, (b) have any position with, or (c) received any money or other benefit from Vendor? ☐ Yes ☒ No
If yes, identify each such employee and his/her relationship/benefits. _____

Does any ERCOT Market Participant: (a) have any ownership in, (b) have any position with, or (c) receive any money or other benefit from Vendor? ☐ Yes ☒ No
If yes, identify such Market Participant and its relationship/benefits. _____
The market participant list can be found at <http://www.ercot.com/mktparticipants/>.

By your signature below, you hereby affirm that the attached documents and information provided above are true and correct and you acknowledge and agree that:

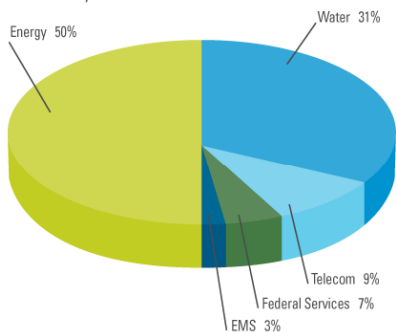
- The vendor may not give or receive any gift or benefit to/from any ERCOT employee, officer, or director if such gift or benefit violates ERCOT's Conflict of Interest Corporate Standard
- The vendor will notify ERCOT General Counsel (legalrequest@ercot.com) if any ERCOT employee, officer, director, or Market Participant requests from you any gift or personal benefit for itself, himself, herself, or his or her family
- If the vendor is a consulting company, the vendor employs all of its individual consultants: (If not, percentage of consultants that are employees: _____%)
- If the vendor is a consulting company, Vendor provides individual consultants with employee benefits (401k, pension, health insurance) and pays employer social security

Signature: 
Printed Name: Mark A. Gabriel

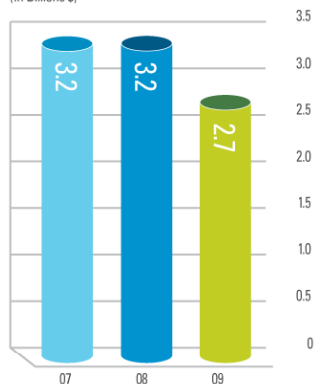
Title: Senior Vice President
Date: August 18, 2011

FINANCIAL REVIEW 2009

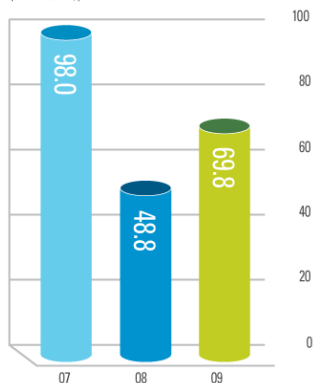
Revenue by Business



Revenue
(In Billions \$)



EB ITD A
(In Millions \$)



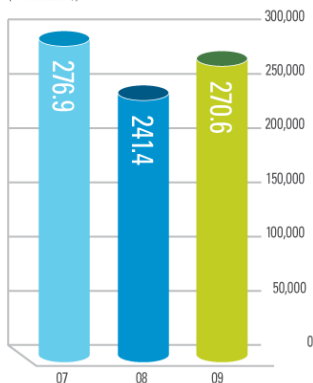
Condensed financial information for Black & Veatch Holding Company as presented below (000s):

For Year Ending December 31	2009	2008
Revenues on Contracts	\$2,714,592	\$3,237,549
Costs of Contracts	2,279,047	2,821,482
Overhead Expenses	385,301	390,663
Operating Income	\$50,244	\$25,404
Other (Income) Expenses & Taxes	17,938	(1,474)
Net Earnings	\$32,306	\$26,878

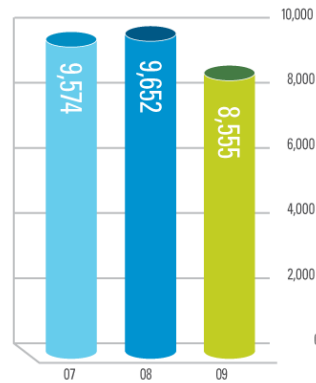
At December 31

Cash & Cash Equivalents	\$354,339	\$345,447
Contract Receivables	411,873	420,805
Costs & Estimated Earnings in Excess of Billings	233,455	226,728
Other Current Assets	102,653	76,373
Total Current Assets	\$1,102,320	\$1,069,353
Building, Equipment & Other Non-Current Assets	225,483	171,850
Total Assets	\$1,327,803	\$1,241,203
Notes Payable & Current Portion of Long-Term Debt	\$5,998	\$4,870
Billings in Excess of Costs & Estimated Earnings	395,835	330,377
Accounts Payable & Other Current Liabilities	582,690	622,150
Total Current Liabilities	\$984,523	\$957,397
Other Non-Current Liabilities	72,719	42,380
Equity	270,561	241,426
Total Liabilities & Equity	\$1,327,803	\$1,241,203
Revenue Backlog	\$2,733,267	\$3,423,097

Equity
(In Millions \$)



Total Workforce



FINANCIAL REVIEW 2010

Condensed financial information for Black & Veatch Holding Company
as presented below (000s):

For Year Ending December 31	2010	2009
Revenues on Contracts	\$2,265,844	\$2,714,592
Costs of Contracts	1,794,224	2,279,047
Overhead Expenses	402,339	385,301
Operating Income	\$69,281	\$50,244
Other Expenses & Taxes	34,452	17,938
Net Earnings	\$34,829	\$32,306
At December 31		
Cash & Cash Equivalents	\$353,234	\$354,339
Contract Receivables	312,696	411,873
Costs & Estimated Earnings in Excess of Billings	178,392	233,455
Other Current Assets	102,296	102,653
Total Current Assets	\$946,618	\$1,102,320
Building, Equipment & Other Non-Current Assets	221,251	225,483
Total Assets	\$1,167,869	\$1,327,803
Notes Payable & Current Portion of Long-Term Debt	\$8,510	\$5,998
Billings in Excess of Costs & Estimated Earnings	340,509	395,835
Accounts Payable & Other Current Liabilities	469,366	582,690
Total Current Liabilities	\$818,385	\$984,523
Other Non-Current Liabilities	67,219	72,719
Equity	282,265	270,561
Total Liabilities & Equity	\$1,167,869	\$1,327,803
Revenue Backlog	\$2,577,357	\$2,733,267

Request for Taxpayer Identification Number and Certification

Give form to the
requester. Do not
send to the IRS.

Print or type
See Specific Instructions on page 2.

Name (as shown on your income tax return)

BLACK & VEATCH CORPORATION

Business name, if different from above

Check appropriate box: ☐ Individual/Sole proprietor ☒ Corporation ☐ Partnership
☐ Limited liability company. Enter the tax classification (D=disregarded entity, C=corporation, P=partnership) ▶
☐ Other (see instructions) ▶

☒ Exempt
payee

Address (number, street, and apt. or suite no.)

8400 WARD PARKWAY

City, state, and ZIP code

KANSAS CITY, MO 64114

Requester's name and address (optional)

List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on Line 1 to avoid backup withholding. For individuals, this is your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the Part I instructions on page 3. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN* on page 3.

Note. If the account is in more than one name, see the chart on page 4 for guidelines on whose number to enter.

Social security number

or

Employer identification number

43-1833073

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me), and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding, and
3. I am a U.S. citizen or other U.S. person (defined below).

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the Certification, but you must provide your correct TIN. See the instructions on page 4.

Sign
Here

Signature of
U.S. person ▶



Date ▶ **01/06/2011**

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Purpose of Form

A person who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) to report, for example, income paid to you, real estate transactions, mortgage interest you paid, acquisition or abandonment of secured property, cancellation of debt, or contributions you made to an IRA.

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN to the person requesting it (the requester) and, when applicable, to:

1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued),
2. Certify that you are not subject to backup withholding, or
3. Claim exemption from backup withholding if you are a U.S. exempt payee. If applicable, you are also certifying that as a U.S. person, your allocable share of any partnership income from a U.S. trade or business is not subject to the withholding tax on foreign partners' share of effectively connected income.

Note. If a requester gives you a form other than Form W-9 to request your TIN, you must use the requester's form if it is substantially similar to this Form W-9.

Definition of a U.S. person. For federal tax purposes, you are considered a U.S. person if you are:

- An individual who is a U.S. citizen or U.S. resident alien,
- A partnership, corporation, company, or association created or organized in the United States or under the laws of the United States,
- An estate (other than a foreign estate), or
- A domestic trust (as defined in Regulations section 301.7701-7).

Special rules for partnerships. Partnerships that conduct a trade or business in the United States are generally required to pay a withholding tax on any foreign partners' share of income from such business. Further, in certain cases where a Form W-9 has not been received, a partnership is required to presume that a partner is a foreign person, and pay the withholding tax. Therefore, if you are a U.S. person that is a partner in a partnership conducting a trade or business in the United States, provide Form W-9 to the partnership to establish your U.S. status and avoid withholding on your share of partnership income.

The person who gives Form W-9 to the partnership for purposes of establishing its U.S. status and avoiding withholding on its allocable share of net income from the partnership conducting a trade or business in the United States is in the following cases:

- The U.S. owner of a disregarded entity and not the entity,

Black & Veatch Corporation

DIRECTORS:

T.W. Triplett

OFFICERS:

D.L. Abrams	Vice President
J.A. Achenbach	Vice President
J.R. Aillet	Associate Vice President
B.A. Ainsworth	Executive Vice President
B.M. Allender	Associate Vice President
M.T. Amick	Vice President
D.D. Anderson	Associate Vice President
J.C. Anderson	Vice President
T.R. Andry	Associate Vice President
T.R. Apple	Associate Vice President
C.E. Araoz	Associate Vice President
D.G. Argo	Senior Vice President
S.A. Armbruster	Associate Vice President
J.N. Austin	Associate Vice President
E.A. Baldwin	Vice President
M.I. Barcroft	Associate Vice President
I.D. Barrett	Associate Vice President
H.O. Bennett	Vice President
M.E. Bennett	Associate Vice President
L.W. Bishop	Associate Vice President
S.A. Blauwiekel	Vice President
T.M. Bloomer	Associate Vice President
P.M. Boersma	Associate Vice President
D.M. Bond, Jr.	Associate Vice President
C. Boyle	Vice President
R.C. Boynton	Vice President
S.H. Bozeman	Associate Vice President
R.T. Bozeman	Associate Vice President
J.R. Brake	Associate Vice President
M.L. Brase	Vice President
D.J. Brill	Associate Vice President
B.K. Britton	Associate Vice President
R. Brnilovich	Associate Vice President
H.H. Brouwer De Koning	Vice President
D.R.C. Brown	Associate Vice President
D.F. Buhrmaster	Associate Vice President
B.B. Burger	Vice President
D.C. Butcher	Associate Vice President
A.C. Byers	Associate Vice President
A.R. Cabrera	Associate Vice President
L.A. Cabreriza	Vice President
D.B. Campbell	Associate Vice President
S.D. Canney	Senior Vice President
D.J. Carlson	Vice President
R.G. Chapman	Vice President
M.C. Charlton	Vice President
H.W. Cheong	Senior Vice President
J.D. Cherry	Vice President
T.E. Christensen	Associate Vice President

J.H. Clark	Senior Vice President
A. Close	Vice President
G.D. Clum	Vice President
J.D. Coggins	Associate Vice President
W.C. Cole	Vice President
A.E. Collins	Senior Vice President
C.C. Connell	Vice President
H.B. Coppage	Vice President
J.M. Coyle	Vice President
W.A. Crabb, Jr.	Associate Vice President
R.N. Crowdis	Vice President
K.L. Currence	Vice President
J.D.M. Currie	Associate Vice President
R.J. Dagwell	Vice President
K.L. Daniel	President & Chief Financial Officer
W.R. Davis, III	Associate Vice President
J.C. Davisson	Associate Vice President
C. DeBarbadillo	Associate Vice President
D.A. DeMaio	Associate Vice President
S.J. Dicks	Associate Vice President
J.W. Doane	Vice President
J.D. Doull	Vice President
L.F. Drbal	Associate Vice President
W.T. Dudley	Associate Vice President
S.L. Duxbury	Vice President
R.J. Dyro	Vice President
R.T. Eberts, III	Senior Vice President & Managing Director - Asia
S.L. Edwards	Executive Vice President
D.F. Egger	Senior Vice President
F.J. Ellermeier	Associate Vice President
G.M. Erickson	Vice President
K.B. Erington	Senior Vice President
R.A. Feingold	Vice President
J.W. Felski	Associate Vice President
H.D. Fiddick	Associate Vice President
O.E. Finnigan	Vice President
S.N. Foellmi	Vice President
M.A. Fournier	Vice President
F.H. Freeland	Associate Vice President
R.J. Frendt	Associate Vice President
M.E. Gammill	Vice President
A.C. Gardner	Vice President
L.A. Gast	Vice President
E.K. Gaston	Associate Vice President
S. Gaufin	President & Chief Human Resources Officer
M.A. Gaumnitz	Vice President
R. Germinder, Jr.	Vice President
J.E. Gettinger	Associate Vice President
S.M. Gibbs	Associate Vice President
L.F. Gil	Associate Vice President
D.H. Ginn, Jr.	Associate Vice President
M.K. Goff	Associate Vice President
R.J.F. Goodfellow	Associate Vice President
D.R. Griffin	Associate Vice President
G.P. Gruber	Vice President
J.M. Gustke	Senior Vice President

J.R. Hansen	Associate Vice President
R.R. Harbron	Associate Vice President
T.E.J. Harding	Associate Vice President
J.R. Hardt	Associate Vice President
M.E. Harmon	Associate Vice President
A.F. Harris	Vice President
D.K. Harris	Vice President
G.W. Hart	Vice President
J.M. Hawkins	Associate Vice President
B.F. Hays	Associate Vice President
B.E. Hemken	Vice President
R.E. Henderson	Vice President
J.A. Hengel	Vice President
J.W. Henson	Associate Vice President
J.C. Hesby	Vice President
S.L. Heyborne	Associate Vice President
C.G. Hill	Senior Vice President
K.T. Hinkle	Associate Vice President
A.L. Hoffman	Vice President
D.L. Holt	Associate Vice President
R.R. Huggins	Associate Vice President
J.R. Hughes	Associate Vice President
R.A. Hulsey	Associate Vice President
D.B. Hunt	Senior Vice President
C.L. Hutchison	Vice President
J.J. Janchar	Executive Vice President
J.D. Johnson	Vice President
T.L. Johnson	Senior Vice President
M.W. Johnson	Associate Vice President
J.H. Johnson	Associate Vice President
M.S. Johnson	Associate Vice President
J.E. Johnson	Associate Vice President
W.R. Jones, Jr.	Senior Vice President
T.A. Jordan	Vice President
M.N. Kamath	Associate Vice President
A.A. Kamp	Vice President
V.I. Kantor	Associate Vice President
J.R. Kaufman	Associate Vice President
P.H. Kaushik	Associate Vice President
W. Kemp	Associate Vice President
P.P. Kenel	Associate Vice President
D.E. Kerns	Executive Vice President
K.A. Kerschen	Associate Vice President
J.R. Kersten	Vice President
S.R. King	Associate Vice President
R.F. King	Vice President
I. Kirkaldy	Vice President
C.L. Kling	Vice President
P.R. Kneitz	Associate Vice President
D.J. Knotts	Vice President
D.J. Koehler	Associate Vice President
R.J. Kriesel	Associate Vice President
L.J. Kriesky	Associate Vice President
K.C. Kruzal	Associate Vice President
R.D. Kuchenrither	Senior Vice President
R.S. Kulash	Associate Vice President

H.L. Kupfer	Senior Vice President
J.E. Kurtz	Associate Vice President
S.D. Labonde	Associate Vice President
K.A. Lackey	Associate Vice President
L.K. Lampe	Vice President
D.A. Lampitt	Senior Vice President
L.C. Lapham	Vice President
T.R. Larson	Associate Vice President
N.F. Lau	Associate Vice President
L.W. Lee	Associate Vice President
D.M. Lefebvre	Associate Vice President
D.A. Leligdon	Associate Vice President
R.P. Lenertz	Vice President
J.R. Lewis	Executive Vice President
M.A.W. Lewis	Associate Vice President
D.S. Lindberg	Vice President
P. Lloyd-Henry	Vice President
P.D. Loftspring	Senior Vice President & Asst. Secretary
B.W. Long	Vice President
C.R. Lottich	Associate Vice President
W.C. Luelf	Associate Vice President
J.R. Lusby	Senior Vice President
D.R. Mahaffay	Senior Vice President
J.A. Mahendran	Associate Vice President
H.L. Man	Vice President
M.W. Marek	Vice President
P. Martin	Vice President
C.J. Martin	Associate Vice President
C.G. Mather	Associate Vice President
D.W. McCarthy	President & CEO - B&V Water
M.A. McDermott	Associate Vice President
J.G. McKelvey	Associate Vice President
D.F. McMenemie	Associate Vice President
J.L. Meegan	Senior Vice President
D.C. Mendelsohn	Senior Vice President
D.W. Meyer	Vice President
A.L. Mickells	Vice President
S. Miller	Vice President
P.M. Miller	Vice President
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J.S. Morrow	Associate Vice President
G.D. Morrow	Senior Vice President
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B.C. Moxham	Vice President
C.G. Mueller	Associate Vice President
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J.E. Murphy	Vice President
J.B. Nagle	Associate Vice President
M.R. Nott	Vice President
T.M. O'Brien	Associate Vice President
J.E. O'Connor	Vice President
F. Oksuz	Associate Vice President
E.J. Oldenhuis	Vice President & Director, Proposal Mgmt/Energy
M.G. Orth	Vice President

O.H. Oskvig	President & CEO B&V Energy
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F.F. Pacinelli	Associate Vice President
G.D. Parks	Associate Vice President
A.P. Pattani	Associate Vice President
A.B. Pease	Associate Vice President
M.A. Perry	Senior Vice President
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C.F. Petz	Associate Vice President
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K.D. Pollins	Senior Vice President
J.R. Poojara	Associate Vice President
A. Powell	Associate Vice President
M.A. Prenni	Vice President
J.R. Pressdee	Associate Vice President
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S.S. Qadri	Vice President
I.S. Rackley	Associate Vice President
M.J.S. Ramsay	Associate Vice President
T.J. Ratzki	Vice President
J.S. Rector	Associate Vice President
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D.V. Reel	Vice President
T.P. Reorda	Senior Vice President
B.M. Reuss	Vice President
L.P. Rinck	Vice President
D.W. Roberts	Associate Vice President
G.W. Robertson	Associate Vice President
C.O. Robinson	Associate Vice President
M. Robinson	Vice President
L.C. Rodman	President & CEO
R.D. Romack	Associate Vice President
J.A. Rose	Vice President
S.E. Rus	Senior Vice President
D.R. Schapker	Vice President
D.L. Schmidt	Vice President
B.E. Schmidt	Associate Vice President
J.D. Schneider	Vice President
J.H. Schnieders	Vice President
J.A. Schonwetter	Vice President
M.E. Schrimp	Vice President
B.C. Schubert	Vice President
C.W.T. Scott	Vice President
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S.K. Shaw	Associate Vice President
G.F. Shimp	Associate Vice President
J.R. Sigman	Associate Vice President
J.A. Silver	Vice President
A.F. Slavens	Vice President

C.W. Smith	Associate Vice President
S.R. Smith	Vice President
R.E. Smith	President-Strategic Sales & Mrktg
H.E. Smith	President - Construction & Procurement
A.L. Sneath	Associate Vice President
R.L. Spears	Associate Vice President
G.S. Stallard	Vice President
J.J. Stamm	Vice President-Tax Counsel
M.S. Stark	Associate Vice President
M.T. Steichen	Associate Vice President
D.R. Stevens	Senior Vice President
L.E. Stoddard	Associate Vice President
S.A. Stolze	Associate Vice President
W.S. Stoner	Vice President
J. Strayer	Associate Vice President
P.A. Street	Associate Vice President
J.P. Sundberg	Associate Vice President
M. Tahiliani	Vice President
J.H. Talib	Vice President
G.R. Talmage	Vice President
S.C. Tan	Vice President
J.M. Tattersall	Vice President
A. Toro	Associate Vice President
G.W. Townsend	Vice President
M.G. Travers	President - Telecommunications
T.W. Triplett	Executive Vice President & Secretary
K.E. Trout, Jr.	Vice President
R.I. Unruh	Senior Vice President
D.E. Upchurch	Associate Vice President
W.R. Van Dyke	President - Federal Services
B.G. Van Heest	Vice President
A. Varma	Vice President
P.B. Vaughan	Senior Vice President & Chief Information Officer
J.G. Voeller, III	Senior Vice President
D.J. Voss	Associate Vice President
T.G. Wahl	Associate Vice President
R.A. Waite	Associate Vice President
D.M. Walker	Associate Vice President
J.W. Waller	Vice President
C.L. Wallis-Lage	Vice President
E.J. Walsh	Executive Vice President
C.S. Ward	Associate Vice President
M.D. Webber	Vice President
P.W. Weida	Vice President
W.J. Wells	Associate Vice President
J.E. Welp	Vice President
K.J. Westermann	Senior Vice President
D.E. Williams	Vice President
K.L. Williams	Sr. Vice President & Treasurer
J.A. Wilson	Executive Vice President
F.A. Winterlind	Vice President
H.G. Withey	President & Chief Administrative Officer
S.E. Wood	Senior Vice President
K.P. Woodward	Senior Vice President
D.L. Woody	Associate Vice President
E.D. Wright	Sr. Vice President

E.K. Wrighton	Associate Vice President
L.D. Yoest	Associate Vice President
K.L. Zernickow	Vice President
L.W. Zimmerman	Vice President

COMPANY TYPE: General Business Corporation

FEIN: 43-1833073

REGISTRATION NUMBER: NA

DATE OF INCORPORATION: 11/16/1998 **PLACE OF INCORPORATION:** Delaware

PRINCIPAL ADDRESS: 8400 Ward Parkway
Kansas City, MO 64114

**REGISTERED AGENT IN
STATE OF INCORPORATION:** The Corporation Trust Company
1209 Orange St.
Wilmington, DE 19801

FORMER NAMES:

SHAREHOLDERS: Black & Veatch Holding Company

SHARES AUTHORIZED: 3,000 common stock \$1.00 par value

SHARES ISSUED:

PURPOSE:

1. To engage in any and all lawful acts or activities for which corporations may be organized under the Delaware General Corporation Law.
2. Engineering, procurement, and construction consulting and management in the power plant industry, waste water facilities, and telecommunications systems.