



Public Service Commission

State of North Dakota

COMMISSIONERS

Randy Christmann
Julie Fedorchak
Brian Kroshus

Executive Secretary
Darrell Nitschke

600 East Boulevard, Dept. 408
Bismarck, North Dakota 58505-0480
Web: www.psc.nd.gov
E-mail: ndpsc@nd.gov
Phone: 701-328-2400
ND Toll Free: 1-877-245-6685
Fax: 701-328-2410
TDD: 800-366-6888 or 711

June 27, 2017

Mr. Matt Mooren
PA Consulting Group, Inc.
1700 Lincoln Street, Suite 1550
Denver, CO 80203

Re: Case No. PU-17-140
Otter Tail Power Company
Advance Prudence – Astoria Project
Application

Case No. PU-17-141
Otter Tail Power Company
Advance Prudence – Merricourt Project
Application

Case No. PU-17-143
Otter Tail Power Company
150 MW – Merricourt Project
Public Convenience & Necessity

Dear Mr. Mooren:

At its regular meeting on June 27, 2017, the North Dakota Public Service Commission approved a contract with PA Consulting Group, Inc. for consulting services in the above referenced cases.

A copy of the Commission motion and contract is enclosed.

Best Regards,

Patrick Fahn, Director
Public Utilities Division

Enclosures

- 27 PU-17-143 Filed 06/27/2017 Pages: 101
Letter enclosing Commission Motion and executed contract
Public Service Commission
- 23 PU-17-141 Filed 06/27/2017 Pages: 101
Letter enclosing Commission Motion and executed contract
Public Service Commission
- 18 PU-17-140 Filed 06/27/2017 Pages: 101
Letter enclosing Commission Motion and executed contract
Public Service Commission

APPROVED

ATE: 6-27-17
[Signature]

MOTION

June 27, 2017

**Otter Tail Power Company
Advance Prudence – Astoria Project
Application**

Case No. PU-17-140

**Otter Tail Power Company
Advance Prudence – Merricourt Project
Application**

Case No. PU-17-141

**Otter Tail Power Company
150 MW - Merricourt Project
Public Convenience and Necessity**

Case No. PU-17-143

I move the Commission execute a contract with PA Consulting Group, Inc. for consulting services in Otter Tail Power Company, Advance Prudence – Astoria Project, Application, Case No. PU-17-140, Otter Tail Power Company, Advance Prudence – Merricourt Project, Application, Case No. PU-17-141, and Otter Tail Power Company, 150 MW – Merricourt Project, Public Convenience and Necessity, Case No. PU-17-143.

VFS

25 **PU-17-143** Filed: 6/27/2017 Pages: 1
Commission Motion to execute contract for consulting services

Public Service Commission

21 **PU-17-141** Filed: 6/27/2017 Pages: 1
Commission Motion to execute contract for consulting services

Public Service Commission

16 **PU-17-140** Filed: 6/27/2017 Pages: 1
Commission Motion to execute contract for consulting services

Public Service Commission

PURCHASE OF SERVICE CONTRACT

The parties to this contract are the State of North Dakota, acting through its North Dakota Public Service Commission, Public Utilities Division (STATE) and PA Consulting Group, Inc. 1700 Lincoln Street, Suite 1550, Denver, CO 80203 (CONTRACTOR).

1. SCOPE OF WORK

CONTRACTOR, in exchange for the compensation paid by STATE under this Contract, agrees to provide the services enumerated below. CONTRACTOR shall be registered with the North Dakota Secretary of State and the North Dakota State Procurement Office prior to Contract execution.

CONTRACTOR agrees to perform services outlined in Section 3.01 per the schedule outlined in Section 3.05 of RFP number 408.17.05.009 and CONTRACTOR's May 30, 2017 response to RFP number 408.17.05.009 (the "CONTRACTOR's Proposal"). The written proposal provided by CONTRACTOR is attached to and incorporated into this agreement.

2. COMPENSATION

Contractual Amount

STATE shall pay for the accepted services provided by CONTRACTOR under this Contract an amount not to exceed \$250,000. For the purposes of clarity, the services included in the contractual amount are Tasks 1 – 8 in the CONTRACTOR'S Proposal with the exception that an onsite visit as discussed in Task 1 is not necessary.

The Contractual Amount is firm for the duration of the Contract and constitutes the entire compensation due CONTRACTOR for performance of its obligations under this Contract, unless amended, regardless of this difficulty, materials or equipment required, including fees, licenses, overhead, profit and all other direct and indirect costs incurred by CONTRACTOR, except as provided by an amendment to this Contract.

The STATE will make payments based on a monthly payment schedule. Each billing must consist of an invoice listing hours worked at the contract rate, the staff person completing the work, and include a progress report. No payment will be made until the Project Manager has reviewed the progress report and approved the invoice.

Victor Schock – Project Manager
Public Utility Analyst – North Dakota Public Service Commission
600 E Boulevard Ave, Dept 408
Bismarck, ND 58505-0480
vschock@nd.gov
701-328-3397

The STATE will not make any advance payments before performance by the CONTRACTOR under this contract.

Payment

1. Payment made in accordance with this Compensation section shall constitute payment in full for the services and work performed and the deliverables and work(s) provided under this Contract and CONTRACTOR shall not receive any additional compensation hereunder.
2. STATE will make every attempt to make payment under this Contract within thirty (30) calendar days after receipt of an approved invoice.
3. Payment of an invoice by STATE will not prejudice STATE's right to object to or question that or any other invoice or matter in relation thereto. CONTRACTOR's invoice will be subject to reduction for amounts included in any invoice or payment made which are determined by STATE, on the basis of audits conducted in accordance with the terms of this Contract, not to constitute allowable costs. At STATE's sole discretion, all payments shall be subject to reduction for amounts equal to prior overpayments to CONTRACTOR.
4. For any amounts that are or will become due and payable to STATE by CONTRACTOR, STATE reserves the right to deduct the amount owed from the payments that are or will become due and payable to CONTRACTOR under this Contract.

Travel

CONTRACTOR acknowledges travel costs are covered by the Contractual Amount and shall include travel costs in the monthly invoices submitted to STATE.

Prepayment

STATE will not make any advance payments before performance by CONTRACTOR under this Contract.

Payment of Taxes by STATE

STATE is not responsible for and will not pay local, state, or federal taxes. STATE sales tax exemption number is E-2001, and certificates will be furnished upon request by the purchasing agency.

Taxpayer ID

CONTRACTOR'S federal employer ID number is:

3. TERM OF CONTRACT

This Contract begins on the date the last party has fully executed the Contract, and compensation ends on July 31, 2018.

No Automatic Renewal

This Contract will not automatically renew.

Extension Option

STATE reserves the right to extend the Contract up to three times for an additional period of time not to exceed 12 months per extension.

Renewal Option

STATE may renew this Contract upon satisfactory completion of the initial Contract term. STATE reserves the right to execute up to three options to renew this Contract under the same terms and conditions for a period of twelve months each.

4. TIME IS OF THE ESSENCE

CONTRACTOR hereby acknowledges that time is of the essence for performance under this Contract unless otherwise agreed to in writing by the parties.

5. TERMINATION OF CONTRACT

Termination by Mutual Agreement

This Contract may be terminated by mutual consent of both parties, executed in writing.

Termination without Cause

STATE may terminate this Contract in whole or in part when it has determined that continuing the Contract is no longer necessary or would not produce beneficial results commensurate with the further expenditure of public funds.

Termination for Lack of Funding or Authority

STATE by written notice to CONTRACTOR, may terminate the whole or any part of this Contract under any of the following conditions:

- 1) If funding from federal, state, or other sources is not obtained and continued at levels sufficient to allow for purchase of the services or supplies in the indicated quantities or term.
- 2) If federal or state laws or rules are modified or interpreted in a way that the services are no longer allowable or appropriate for purchase under this Contract or are no longer eligible for the funding proposed for payments authorized by this Contract.
- 3) If any license, permit, or certificate required by law or rule, or by the terms of this Contract, is for any reason denied, revoked, suspended, or not renewed.

Termination of this Contract under this subsection is without prejudice to any obligations or liabilities of either party already accrued prior to termination.

Termination for Cause

STATE may terminate this Contract effective upon delivery of written notice to CONTRACTOR, or any later date stated in the notice:

- 1) If CONTRACTOR fails to provide services required by this Contract within the time specified or any extension agreed to by STATE; or
- 2) If CONTRACTOR fails to perform any of the other provisions of this Contract, or so fails to pursue the work as to endanger performance of this Contract in accordance with its terms.

The rights and remedies of STATE provided in this subsection are not exclusive and are in addition to any other rights and remedies provided by law or under this Contract.

6. FORCE MAJEURE

Neither party shall be held responsible for delay or default caused by fire, flood, riot, acts of God or war if the event is beyond the party's reasonable control and the affected party gives notice to the other party immediately upon occurrence of the event causing the delay or default or that is reasonably expected to cause a delay or default.

7. INDEMNITY

CONTRACTOR agrees to defend, indemnify, and hold harmless the state of North Dakota, its agencies, officers and employees (STATE), from and against claims based on the vicarious liability of the STATE or its agents, but not against claims based on the STATE's contributory negligence, comparative and/or contributory negligence or fault, sole negligence, or intentional misconduct. The legal defense provided by CONTRACTOR to the STATE under this provision shall be free of any conflicts of interest, even if retention of separate legal counsel for the STATE is necessary. An attorney appointed to represent the STATE shall first qualify as and be appointed by the North Dakota Attorney General as a Special Assistant Attorney General as required under North Dakota Century Code section 54-12-08. CONTRACTOR also agrees to defend, indemnify, and hold the STATE harmless for all costs, expenses, and attorneys' fees incurred if the STATE prevails in an action against CONTRACTOR in establishing and litigating the indemnification coverage provided herein. This obligation shall continue after the termination of this agreement.

8. INSURANCE

CONTRACTOR shall secure and keep in force during the term of this agreement and CONTRACTOR shall require from all subcontractors, prior to commencement of an agreement between Contractor and the subcontractor, to secure and keep in force during the term of this agreement, from insurance companies, government self-insurance pools or government self-retention funds, authorized to do business in North Dakota, the following insurance coverages:

- 1) Commercial general liability, including premises or operations, Contractual, and products or completed operations coverages (if applicable), with minimum liability limits of \$250,000 per person and \$1,000,000 per occurrence.
- 2) Automobile liability, including Owned (if any), Hired, and Non-Owned automobiles, with minimum liability limits of \$250,000 per person and \$1,000,000 per occurrence.
- 3) Workers compensation coverage meeting all statutory requirements. The policy shall provide coverage for all states of operation that apply to the performance of this Contract.

- 4) Employer's liability or "stop gap" insurance of not less than \$1,000,000 as an endorsement on the workers compensation or commercial general liability insurance.

The insurance coverages listed above shall meet the following additional requirements:

- 1) Any deductible or self-insured retention amount or other similar obligation under the policies shall be the sole responsibility of CONTRACTOR. The amount of any deductible or self-retention is subject to approval by the STATE.
- 2) This insurance may be in policy or policies of insurance, primary and excess, including the so-called umbrella or catastrophe form and shall be placed with insurers rated "A-" or better by A.M. Best Company, Inc., provided any excess policy follows form for coverage. Less than an "A-" rating shall be approved by the STATE. The policies shall be in form and terms approved by the STATE.
- 3) The duty to defend, indemnify, and hold harmless the STATE under this agreement shall not be limited by the insurance required in this agreement.
- 4) The State of North Dakota and its agencies, officers, and employees (STATE) shall be endorsed on the commercial general liability policy, including any excess policies (to the extent applicable), as additional insured. The STATE shall have all the benefits, rights and coverages of an additional insured under these policies that shall not be limited to the minimum limits of insurance required by this agreement or by the Contractual indemnity obligations of CONTRACTOR.
- 5) The insurance required in this agreement, through a policy or endorsement, shall include:
 - a) "Waiver of Subrogation" waiving any right to recovery the insurance company may have against the STATE;
 - b) a provision that CONTRACTOR'S insurance coverage shall be primary (i.e. pay first) as respects any insurance, self-insurance or self-retention maintained by the STATE and that any insurance, self-insurance or self-retention maintained by the STATE shall be in excess of the CONTRACTOR'S insurance and shall not contribute with it;
 - c) cross liability/severability of interest for all policies and endorsements;
 - d) The legal defense provided to the STATE under the policy and any endorsements shall be free of any conflicts of interest, even if retention of separate legal counsel for the STATE is necessary;
 - e) The insolvency or bankruptcy of the insured CONTRACTOR shall not release the insurer from payment under the policy, even when such insolvency or bankruptcy prevents the insured CONTRACTOR from meeting the retention limit under the policy.
- 6) CONTRACTOR shall furnish a certificate of insurance to the undersigned STATE representative prior to commencement of this agreement. All endorsements shall be provided as soon as practicable.

- 7) Failure to provide insurance as required in this agreement is a material breach of Contract entitling the STATE to terminate this agreement immediately.
- 8) CONTRACTOR shall provide at least 30 day notice of any cancellation or material change to these policies or endorsements.

9. WORKS FOR HIRE

CONTRACTOR acknowledges that all work(s) under this Contract is "work(s) for hire" within the meaning of the United States Copyright Act (Title 17 United States Code) and hereby assigns to STATE all rights and interests CONTRACTOR may have in the work(s) it prepares under this Contract, including any right to derivative use of the work(s). All software and related materials developed by CONTRACTOR in performance of this Contract for STATE shall be the sole property of STATE, and CONTRACTOR hereby assigns and transfers all its right, title, and interest therein to STATE. CONTRACTOR shall execute all necessary documents to enable STATE to protect STATE's intellectual property rights under this section. Notwithstanding, CONTRACTOR shall remain the owner of all intellectual property rights it possessed prior to this Agreement, as well as all modifications or adaptations made to that intellectual property during the Agreement ("CONTRACTOR Pre-Existing IP"). If any CONTRACTOR Pre-Existing IP is included as a deliverable hereunder, CONTRACTOR hereby grants the STATE a nonexclusive, royalty-free, world-wide right to use that Background IP as part of the deliverable with which it was included for the ordinary business purposes of the STATE.

10. WORK PRODUCT

All work product, equipment or materials created or purchased under this Contract belong to STATE and shall be delivered to STATE at STATE'S request upon termination of this Contract.

11. NOTICE

All notices or other communications required under this Contract shall be given by registered or certified mail and are complete on the date mailed when addressed to the parties at the following addresses:

PA Consulting Group
1700 Lincoln Street, Suite 1550
Denver, CO 80203

North Dakota Public Service Commission
600 East Boulevard Ave, Dept. 408
Bismarck, ND 58505-0480

Notice provided under this provision does not meet the notice requirements for monetary claims against the STATE found at North Dakota Century Code section 32-12.2-04.

12. CONFIDENTIALITY

CONTRACTOR shall not use or disclose any information it receives from STATE under this Contract that STATE has previously identified as confidential or exempt from mandatory public disclosure except as necessary to carry out the purposes of this Contract or as authorized in advance by STATE. STATE shall not disclose any information it receives from CONTRACTOR that CONTRACTOR has previously identified as confidential and that STATE determines in its sole discretion is protected from mandatory public disclosure under a specific exception to the North Dakota open records law, North Dakota Century Code chapter 44-04. The duty of STATE and CONTRACTOR to maintain confidentiality of information under this section continues beyond the term of this Contract.

13. COMPLIANCE WITH PUBLIC RECORDS LAW

CONTRACTOR understands that, except for disclosures prohibited in this Contract, STATE shall disclose to the public upon request any records it receives from CONTRACTOR. CONTRACTOR further understands that any records that are obtained or generated by CONTRACTOR under this Contract, except for records that are confidential under this Contract, may, under certain circumstances, be open to the public upon request under the North Dakota open records law. CONTRACTOR agrees to contact STATE immediately upon receiving a request for information under the open records law and to comply with STATE'S instructions on how to respond to the request.

14. INDEPENDENT ENTITY

CONTRACTOR is an independent entity under this Contract and is not a STATE employee for any purpose, including the application of the Social Security Act, the Fair Labor Standards Act, the Federal Insurance Contribution Act, the North Dakota Unemployment Compensation Law and the North Dakota Workforce Safety and Insurance Act. CONTRACTOR retains sole and absolute discretion in the manner and means of carrying out CONTRACTOR'S activities and responsibilities under this Contract, except to the extent specified in this Contract.

15. ASSIGNMENT AND SUBCONTRACTS

CONTRACTOR may not assign or otherwise transfer or delegate any right or duty without STATE'S express written consent. However, CONTRACTOR may enter into subcontracts provided that any subcontract acknowledges the binding nature of this Contract and incorporates this Contract, including any attachments. CONTRACTOR is solely responsible for the performance of any subcontractor. CONTRACTOR does not have authority to Contract for or incur obligations on behalf of STATE.

16. SPOILIATION – NOTICE OF POTENTIAL CLAIMS

CONTRACTOR shall promptly notify STATE of all potential claims that arise or result from this Contract. CONTRACTOR shall also take all reasonable steps to preserve all physical evidence and information that may be relevant to the circumstances

surrounding a potential claim, while maintaining public safety, and grants to STATE the opportunity to review and inspect the evidence, including the scene of an accident.

17. MERGER AND MODIFICATION

This Contract, including the following documents, constitutes the entire agreement between the parties. There are no understandings, agreements, or representations, oral or written, not specified within this Contract. This Contract may not be modified, supplemented or amended, in any manner, except by written agreement signed by both parties.

Notwithstanding anything herein to the contrary, in the event of any inconsistency or conflict among the documents making up this Contract, the documents shall control in this order of precedence:

- a. The terms of this Contract as may be amended;
- b. CONTRACTOR's written negotiated proposal dated May 30, 2017.
- c. All terms and conditions contained in any end user agreements (e.g. automated click-throughs, shrink wrap, or bonus wrap) are specifically excluded and null and void, and shall not alter the terms of this Contract.

18. SEVERABILITY

If any term of this Contract is declared by a court having jurisdiction to be illegal or unenforceable, the validity of the remaining terms is unaffected, and, if possible, the rights and obligations of the parties are to be construed and enforced as if the Contract did not contain that term.

19. APPLICABLE LAW AND VENUE

This Contract is governed by and construed in accordance with the laws of the STATE. Any action to enforce this Contract shall be adjudicated exclusively in the State District Court of Burleigh County, North Dakota. Each party consents to the exclusive jurisdiction of such court and waives any claim of lack of jurisdiction or forum non conveniens.

20. ALTERNATIVE DISPUTE RESOLUTION – JURY TRIAL

STATE does not agree to any form of binding arbitration, mediation, or other forms of mandatory alternative dispute resolution. The parties have the right to enforce their rights and remedies in judicial proceedings. STATE does not waive any right to a jury trial.

21. ATTORNEY FEES

In the event a lawsuit is instituted by STATE to obtain performance due under this Contract, and STATE is the prevailing party, CONTRACTOR shall, except when prohibited by North Dakota Century Code section 28-26-04, pay STATE'S reasonable attorney fees and costs in connection with the lawsuit.

22. NONDISCRIMINATION AND COMPLIANCE WITH LAWS

CONTRACTOR agrees to comply with all laws, rules, and policies, including those relating to nondiscrimination, accessibility and civil rights. CONTRACTOR agrees to timely file all required reports, make required payroll deductions, and timely pay all taxes and premiums owed, including sales and use taxes and unemployment compensation and workers' compensation premiums. CONTRACTOR shall have and keep current at all times during the term of this Contract all licenses and permits required by law.

23. STATE AUDIT

All records, regardless of physical form, and the accounting practices and procedures of CONTRACTOR relevant to this Contract are subject to examination by the North Dakota State Auditor, the Auditor's designee, or Federal auditors. CONTRACTOR shall maintain all such records for at least three years following completion of this Contract and be able to provide them at any reasonable time. STATE, State Auditor, or Auditor's designee shall provide reasonable notice.

24. EFFECTIVENESS OF CONTRACT

This Contract is not effective until fully executed by both parties.

CONTRACTOR

PA Consulting Group, Inc.

By: Matt Mooren

Title: Matt Mooren, Member of PA's Management Group

Date: June 21, 2017

STATE OF NORTH DAKOTA

Acting through its North Dakota Public Service Commission

By: Randy Christmann

Title: Randy Christmann, Chairman

Date: 6-27-17

By: Julie Fedorchak

Title: Julie Fedorchak, Commissioner

Date: 6-27-17

By: Brian Kroghus

Title: Brian Kroghus, Commissioner

Date: 6-27-17



NORTH DAKOTA PUBLIC SERVICE COMMISSION

Expert Assessment of Otter Tail Power
Company's ADP and CPCN Applications

RFP Number: 408.17.05.009

May 30, 2017



PA Regional Office:
PA Consulting Group
1700 Lincoln Street
Suite 1550
Denver, CO 80203
Tel: +1 720 566 9920
Fax: +1 720 566 9921
www.paconsulting.com

Prepared by: Matt Mooren

Version no: 1.0

Document reference: P033100

EXECUTIVE SUMMARY

The North Dakota Public Service Commission (NDPSC, or Commission) is evaluating Otter Tail Power Company's (OTP) applications for an Advanced Determination of Prudence (ADP) and a Certificate of Public Convenience and Necessity (CPCN) for its Merricourt wind project (Merricourt), and an ADP for its Astoria Station simple-cycle combustion turbine project (Astoria). The Commission is soliciting proposals to provide a thorough analysis of these applications, provide sponsoring testimony before the Commission on behalf of North Dakota's Ratepayer Advocacy Staff, and prepare pre- and post-hearing documents or potentially documents for purposes of settlement.

The applications relate to two proposed projects: the 150 MW Merricourt project and the 250 MW Astoria project. The two separate applications are being consolidated for purposes of hearing as they are interrelated, though the dockets will not be consolidated, according to the NDPSC. The Merricourt project is located in North Dakota, so there is a rebuttable presumption of prudence for that project.

The NDPSC must determine whether these projects meet the standard for the ADP and a CPCN. OTP developed a number of planning scenarios and modeled these projects using Strategist, a resource planning software tool that uses a load duration curve methodology to project the costs of a given resource portfolio. Based upon OTP's analysis and its resource plan submitted to the NDPSC, construction of the projects is the most economical solution for OTP's current and pending supply needs. PA has no preconceived conclusions regarding whether or not these projects should be approved. However, we have identified a number of issues and considerations that should be addressed in the review of OTP's public application. These issues and considerations include:

- The methodology that OTP used to evaluate the wind-gas option (Merricourt + Astoria) versus other alternatives such as construction of a new combined cycle¹, purchasing or contract with existing merchant generation, repowering existing assets, etc.;
- Whether the projected capacity factor assumption for the Astoria project is appropriate given it will dispatch into the MISO market when economic to do so;
- How the economic analysis is impacted by the Astoria project's projected 10-12% capacity factor and/or the forty year life assumption for the Merricourt project;
- Whether the addition of wind provides the appropriate mix of resources needed to serve OTP's North Dakota customers;
- Whether the planning scenarios used by OTP in their modeling appropriately reflect the range of outcomes given uncertainties regarding future technology costs, supply/demand conditions, fuel costs, infrastructure changes, and future regulations; and
- Whether the assumptions and approach OTP used for MISO market pricing, natural gas pricing, and congestion are reasonable with respect to the conclusions arrived at for Merricourt.

¹ We understand a peaking unit was the resource solution in 76 out of 78 scenarios in OTP's IRP, but are not clear on whether the model would have selected a peaking unit +wind combo over a combined cycle.

In order to address these issues, we propose an analytic review that includes:

- A detailed review of OTP's Strategist analysis, including the likelihood for requesting additional Strategist runs to be conducted by OTP;
- A review of the OTP IRP to the extent that the evaluation relies on findings from the IRP, including a determination of whether OTP considered a sufficiently robust universe of potential supply options to meet OTP's capacity needs, such as potentially existing, non-contracted resources in the region and/or potential repowering of regional assets;
- A review of the load forecast and power supply portfolio to determine the need for additional resources;
- An alternative analysis of Astoria's capacity factor using PA's proprietary stochastic dispatch optimization (i.e. volatility) model in conjunction with independently forecasting the MISO electricity market (see next bullet); and
- Evaluation of the curtailment and negative pricing risks that the wind facility may face in the MISO market using PA's hourly chronological dispatch model for the MISO market.

PA is highly qualified to assist the Commission in evaluating the request for ADPs and a CPCN. We work with policymakers and utilities on integrated resource planning and work extensively with utilities and merchant investors in the analysis of the MISO market, forecast of long term energy and capacity prices, and modeling the operating and financial performance of both fossil and renewable generation plants.

Figure EX-1. PA's Relevant Industry Expertise

MISO Wholesale Market Expertise	Integrated Resource Planning	Public Policy	Utility Regulation
<ul style="list-style-type: none"> • Market price forecasts • Natural gas price forecasts • Capacity market design • Production cost modeling of wholesale markets • Stochastic modeling of generation assets • Curtailment and congestion risk analysis 	<ul style="list-style-type: none"> • Long term resource acquisition • Solicitation evaluation • Capacity expansion planning • Retirement analysis 	<ul style="list-style-type: none"> • Legislative analysis • Position statements • Policy trends and impacts 	<ul style="list-style-type: none"> • Expert witness testimony • Independent evaluation • Compliance filings

PA looks forward to the potential of working with the Commission's Ratepayer Advocacy Staff to evaluate the OTP applications for two ADPs and a CPCN.

CONTENTS

EXECUTIVE SUMMARY	1
1 INTRODUCTION	5
1.1 Submitting Firm	5
1.2 Introduction to PA	5
1.3 Our Global Energy & Utilities (GEU) Practice	6
1.4 Why PA Consulting Group?	7
1.5 Conflicts of interest and our ability to serve	8
1.6 Organization of this Proposal	8
2 OUR UNDERSTANDING OF YOUR NEEDS	9
2.1 Evaluating the Robustness of the Strategist Analysis	10
2.2 Additional Analysis to Supplement Strategist	11
2.3 Evaluation of Additional Issues	12
2.4 Determination of Prudence and Public Necessity	12
3 EVALUATION OF THE PRUDENCE OF THE PROPOSED PROJECTS	14
3.1 Work Plan	14
3.2 Quality Assurance	18
3.3 Proposed Project Schedule	19
4 EXPERIENCE AND QUALIFICATIONS	20
4.1 Project Team	20
4.2 Team Member Bios	21
4.3 Firm Qualifications	23
5 COST PROPOSAL	29
5.1 Cost Proposal	29
6 REQUIRED ENCLOSURES & PROPOSED AMENDMENTS TO CONTRACT FORM	30
6.1 Purchase Service Agreement Deviations and Exceptions	30

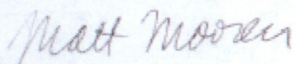
APPENDICES	31
A TEAM MEMBER RESUMES	32
B EXAMPLE PRE-FILED TESTIMONY	53
C SOLICITATION AMENDMENT #1	54

1 INTRODUCTION

1.1 Submitting Firm

PA Consulting Group, Inc. (PA) is pleased to submit this proposal to the North Dakota Public Services Commission (NDPSC, or Commission). Our firm address, contact details, and primary contact follow. Matt Mooren, a Member of PA's Management Group, is authorized to bind PA to this proposal.

Firm Name: PA Consulting Group, Inc.
Primary Contact: Matt Mooren
720-566-9944
Matt.Mooren@PAConsulting.com
Mailing Address: 1700 Lincoln Street
Suite 1550
Denver, CO 80203



Matt Mooren
Member of PA's Management Group

1.2 Introduction to PA

PA is a leading global management, systems, technology and strategy consulting firm. We are an independent utility and management consulting firm established more than 70 years ago, operating from 24 offices in the US, Europe, Gulf and Asia Pacific. Our clients include many of the largest utilities and government entities in the US who draw upon on the insights and implementation knowledge of PA's over 2,500 consultants.

PA combines in-depth industry knowledge with market-leading capability in order to help tackle challenges and achieve our clients' goals.

We have the practical experience to quickly get to grips with your business challenges, and the confidence to challenge conventional thinking to develop a response.

Our people are committed to working alongside your team to tackle challenges jointly, to deliver real, lasting impact. We leave your business with enhanced skills, tools and knowledge, better equipped to deliver the next set of initiatives.

Eight Sectors:

- Energy and utilities
- Defense
- Financial services
- Public sector
- Life sciences
- Transport and logistics
- Consumer products and manufacturing
- Healthcare



1.3 Our Global Energy & Utilities (GEU) Practice

PA brings deep energy industry expertise, with a focus on energy policy, regulation of markets and utilities, wholesale market structures and fundamentals, utility strategy, and utility operations. Whether we work for regulatory bodies, utilities and other load-serving entities, infrastructure investors, or other energy industry players, we put smart, experienced, professionals on the ground to work with your team to evaluate organizational, regulatory and financial opportunities and challenges. With over 300 consultants throughout the firm specifically supporting the utility and energy sector, our expertise enables PA to provide unparalleled assistance across the utility value chain. In recent years PA consultants have advised on a variety of utility rate and regulatory matters, and our analysis and recommendations are developed based on documented facts to provide a comprehensive independent view of high profile issues.

Figure 1: PA's Areas of Expertise in Energy and Utilities



Our proposed team of industry-leading experts will enable the Commission's team to draw upon expertise and best practices from both the US and internationally. We understand the issues facing both the NDPSC internally as well as the regulatory environment in North Dakota, having assisted numerous clients with similar regulatory filings related to prudency determinations, dispatch projections of renewable assets into the Midcontinent Independent System Operator (MISO) market, independent evaluator services, and other areas.

This combination of experience provides PA a unique understanding and viewpoint on the needs of the NDPSC, OTP's North Dakota customers, and other stakeholders.

1.4 Why PA Consulting Group?

PA has an extensive track record in advising clients on the valuation of generation assets and portfolios in MISO, modeling long-term hourly energy and annual capacity prices using a chronological hourly dispatch model, utility regulation and cost allocation, integrated resource planning, and regulatory support including expert witness testimony. We work with policymakers, utilities, energy infrastructure investors, and stakeholders on a variety of issues, including complex resource planning decisions.

We have an extensive track record of collaboration

In addition to our significant analytical and regulatory advisory experience, PA takes pride in our history of collaboration with our clients. We readily acknowledge that in virtually all cases, our client knows exponentially more than we do about their particular situation. We work hard at closely communicating and collaborating with our clients throughout an entire engagement, and making sure we are delivering exactly what is needed. It is rare that an engagement unfolds exactly as expected by either PA or our clients, and we strive to be flexible with regard to both the project scope and schedule to accommodate the inevitable twists and turns which arise.

We have extensive experience modelling the MISO market and projecting asset dispatch

PA has a robust, well-developed, and industry-tested fundamental modeling process, including its proprietary stochastic dispatch optimization, capacity compensation, environmental, renewable, and valuation models along with the use of production cost, transmission, and natural gas models that are operated by PA's subject matter experts and populated with PA proprietary data. Since 2011, we have supported more than 235 electric infrastructure purchases, sales, financings, or appraisals in every region in the contiguous United States, including over 295 GW of power generation. In MISO specifically, we have projected asset dispatch and operations to support the transactions or financing of over 25 GW of power generation assets, including wind, solar and biomass renewable generation.

We have extensive experience in utility integrated resource planning

PA has advised utilities on resource planning and have testified, provided strategic advice as well as modeling using a range of generally accepted resource planning modeling tools including Strategist, ProSYM, Promod, Aurora, and many internally developed proprietary models.

We have extensive experience in natural gas and wind generation assessment

PA has advised energy companies and investors on the projected markets and financial and operating assessment of over 200 wind and natural gas generation projects in North America since 2011, many of which are located in MISO.

We have extensive utility regulatory experience including experience testifying in regulatory hearings

PA is routinely engaged on a broad range of electric regulatory issues and understands the principles of regulation, the challenges that regulators have in implementing state policy, and the challenges of

balancing a number of competing objectives. For this prudence evaluation we will focus on collaborating with the Commission and staff to first inform the Commission on the economics and other aspects of OTP's application, and then support the Commission's preferred direction through direct testimony by PA expert witnesses as well as providing evidence and demonstratives to buttress the Commission's arguments.

1.5 Conflicts of interest and our ability to serve

PA has reviewed the provisions of RFP Number 408.17.05.009, and if selected will comply with all the provisions of the RFP. PA has not identified any potential conflicts of interests related to this RFP, and is not aware of any representation of organizations that are adverse to the NDPSC. There are no past or present civil or criminal legal investigations, or pertinent litigation and or regulatory actions that impact PA's ability to serve in the required capacity.

PA specifically notes that we have not worked for OTP in at least the past five years. PA will not work with OTP in the future on matters unrelated to this proceeding. Furthermore, the core team assigned to this effort will not work on any matters for OTP or its subsidiaries during this engagement without the prior written approval of the NDPSC.

1.6 Organization of this Proposal

The remainder of this proposal addresses our approach, work plan, and experience and qualifications.

- Section II presents our understanding of the project and our proposed approach to developing a recommendation requiring the prudence of the two projects.
- Section III presents our work plan and specific tasks that we propose to perform to evaluate the prudence of the projects.
- Section IV identifies the PA team and their respective roles related to completing this project. Short bios of each team member are provided and detailed resumes are included in the appendix to the proposal.
- Section IV also presents a sample of PA's relevant firm qualifications for completing this assignment highlighting experience related to analysis of the MISO market, integrated resource planning, and regulatory experience.
- Section V presents PA's cost proposal.

2 OUR UNDERSTANDING OF YOUR NEEDS

OTP is seeking an ADP and a CPCN for the 150 MW wind-powered Merricourt project, and an ADP for the 250 MW natural gas-fired combustion turbine Astoria project. The Merricourt project would be located in North Dakota, while the Astoria would be located in South Dakota near existing and planned gas pipeline and transmission infrastructure. The proposed projects are collectively intended to meet the long term energy requirements of the OTP integrated electric system across its service territories in Minnesota, North Dakota, and South Dakota. Drivers of the need for this project are the planned retirement of 140 MW Hoot Lake Coal plant in 2021 as well as the expiration of a 50 MW on-peak energy PPA, also in 2021. A summary of the two proposed projects is shown in Table 1.

Table 1. Projects Included in OTP's Requests for Advanced Prudence Determination and Certificate of Public Convenience and Necessity

Project	Generator Type	Location	Capacity (MW)
Merricourt	Wind	Merricourt, ND	150
Astoria	Combustion Turbine	Astoria, SD	250

OTP's application includes the utility's analysis supporting its conclusion that the projects - both individually and collectively - represent the least cost solution to the utility's long term power supply needs. The Company's economic analysis is primarily based upon the outputs of Strategist, the Company's resource planning software model.

An ADP is an effective process for managing the utility's risk associated with major investments or commitments associated with major generation projects. North Dakota statute provides a legal basis and authority for the North Dakota PSC to determine whether the ADP should be granted, and also distinguishes between resources located in the state and outside of the state. Similarly, a CPCN process allows the NDPSC to certify the need for the investment in a major generation project.

The North Dakota PSC will consider a number of factors in determining whether the new resources are in the best interest of North Dakota customers. These factors include:

The reasonableness of the Company's energy and demand forecasts

- What factors are involved in the Company's determination of the need for the project? Is that determination reasonable?

The projected revenues and costs of each proposed project

- Are the Company's cost projections for both projects reasonable?
- Has the Company sufficiently evaluated the projected MISO market revenues for each project, including accounting for potential curtailment of the Merricourt project and potential congestion impacts for both projects?

The Company's supporting analysis

- The robustness and reasonableness of the Company's supporting analysis, including how it addresses natural gas costs and plant utilization, will be a critical factor influencing the Commission's decision

In PA's initial review of the OTP application, we were not surprised that the conclusion from the Strategist modeling is that the proposed projects are the most cost effective new resources. (We have seen similar results in other analyses using Strategist.) The use of the Strategist model to evaluate the economics of a new resources that costs less than \$30/MWh is likely to lead to net benefits which are higher than the three most likely competing resources: gas-fired combustion turbines, gas-fired combined cycle plants, and utility-scale solar generation. It would likely take very low gas prices to make new gas-fired resources more cost effective under the relatively simple evaluation logic incorporated into load duration models and the Strategist algorithms.

PA has a number of concerns regarding the ability of Strategist to effectively incorporate the issues and complications associated with the MISO market and accurately project the impact of the expanded penetration of wind powered resources on the OTP integrated system. These issues include the following:

- Does the capacity factor of the Astoria project reflect realistic dispatch in the MISO market?
- Will negative pricing become a significant issue in North Dakota as wind and solar penetration increases in the MISO system?
- Is OTP securing the right mix of resources to meet capacity needs and ancillary services, as well as appropriately diversifying long-term risks?
- To what degree is the need for new resources to serve load growth based upon realistic expectations regarding electric demand associated with shale oil extraction?
- Is the need for new resources driven by different perspectives and assumptions regarding the economics of potentially retaining or refurbishing existing resources?
- Does the analysis appropriately reflect the benefits of OTP participating in the MISO market?

Though we have considered the multiple issues involved, PA does not have preconceived answers to these questions. In the remainder of this section we highlight our approach for addressing these issues.

2.1 Evaluating the Robustness of the Strategist Analysis

Given that Strategist is the primary tool used by OTP, we believe it is important to review the assumptions developed by OTP and determine their reasonableness with regard to a base case view as well as testing a range of possible outcomes given the inevitable uncertainties regarding the future evolution of power generation technologies, fuel costs, environmental regulations, and market structure. Therefore, we propose to evaluate the critical model inputs used by OTP in the different scenarios including:

- Energy and demand forecasts,
- Fuel price forecasts,
- Cost forecast for alternate generation expansion options,
- Assumptions regarding the costs of emissions,
- Production estimates from the wind projects,
- Transmission constraints at and near the proposed projects, and
- MISO market pricing inputs.

PA routinely models the MISO market and we not only have our own view of reasonable base case assumptions, but we are also aware of a number of different forecasts and sources for those critical input assumptions. Based upon our review of the OTP modeling as well as our experience with the MISO market and knowledge of other data sources, it is likely that we will request that OTP perform additional modeling using Strategist to test the robustness of OTP's conclusions.

2.2 Additional Analysis to Supplement Strategist

PA understands that different modeling approaches for resource planning have their own strengths and weaknesses. Our initial view is that there are limitations to Strategist with regard to evaluating the risks and benefits of different resource expansion plans, particularly expansion plans which involve intermittent resources and the operation of combustion turbines. Therefore, we propose to supplement the Strategist analysis that relies on a load duration curve with additional analysis using PA's hourly chronological dispatch model of the MISO market and stochastic dispatch optimization model to assess Astoria. We recognize that both approaches involve a model of a complex power system and assets within it, and that each approach has limitations. It is not our intent to turn the proceeding into an argument of which modeling approach is better. Our recommendation is that the chronological dispatch modeling of the MISO market and stochastic dispatch of Astoria will add additional insights and should be considered along with the results of Strategist.

2.2.1 Evaluation of the Combustion Turbine Capacity Factor

Our initial reaction is that the projected capacity factor for the combustion turbine may be high. This reaction is based upon our analysis of combustion turbines in MISO as part of our extensive modeling of generation in MISO to support client transactions. Consequentially our recommendation is to further evaluate the economics of the combustion turbine using a combination of our chronological and stochastic dispatch models. We understand that OTP has recognized a need for capacity. However, a different capacity factor could impact the relative economics of OTP's proposed portfolio of wind and gas options versus other options, and could therefore potentially incorrectly calculate the ratepayer savings compared to the base case.

2.2.2 Evaluation of Negative Pricing

The value of the power produced by the wind project is not determined by the levelized cost of the project that is input into the model, but by the revenues it will receive when it is dispatched into the MISO market. As the penetration of wind and other intermittent resources in the MISO market increase, it is important to understand the risk of negative pricing, which results from an excessive imbalance of local demand and local supply. Negative pricing risk can be evaluated in a chronological dispatch model of the MISO system but is typically not evaluated within Strategist.

2.3 Evaluation of Additional Issues

2.3.1 Resource Mix

Our understanding is that when determining prudence, North Dakota focuses on the present value of revenue requirements (PVRR) and a principle concern is affordable electricity for North Dakota customers. However, resource selection is not solely about least cost but also needs to consider “best fit”. Best fit can include a number of other factors and a key consideration is typically the evaluation of risk. Risk can take many forms including uncertainty about fuel prices, uncertainty about generator availability and output, and resource diversity. Some of this risk can be quantitatively evaluated with additional Strategist runs while there may be other metrics that are more qualitative. We note that the OTP application includes consideration of gas cost volatility and we will examine how those considerations may have impacted their conclusion regarding the preferred resource expansion plan.

2.4 Determination of Prudence and Public Necessity

North Dakota in statute 49-05-16 describes the process, procedures, and consequences of issuing an ADP. However, our reading of the statute suggests that there is little guidance as to the metrics for ruling that a resource is prudent but rather that is a matter left to the discretion of the Commission.

“The commission determines that the resource addition is prudent. For facilities located or to be located in the state the commission, in determining whether the resource addition is prudent, shall consider the benefits of having the addition located in this state.” [49-05-16 1.d.]

“There is a rebuttable presumption that a resource addition located in the state is prudent.” [49-05-16 7.]

Clearly, the statute requires a shifting of the burden of proof related to the wind project located within North Dakota. The utility system benefits of projects located in the state should consider whether the projects increase reliability of service and lower the cost of electricity. An in-state project could potentially lower the cost of electricity through decreased nodal prices. Non-utility benefits could include job creation, tax revenue, and economic development. We will look to the guidance of staff’s legal counsel as to whether non-utility benefits should be considered under the statute.

Similarly, in statute 49-03-01, North Dakota describes the requirements for obtaining a Certificate of Public Convenience and Necessity (CPCN). However, similar the Prudence statute, there is little guidance related to the process the PSC must take when evaluating a CPCN application. While we generally consider this to be a determination of whether or not OTP’s identification of the need for the Merricourt project is reasonable, we again will look to the guidance of staff’s legal counsel as to what specific metrics are required for the CPCN determination.

PA will also review with Staff’s legal counsel their interpretation of the standard of the rebuttable presumption, i.e., does the analysis required to demonstrate that a resource is not prudent differ from the analysis required to demonstrate that a resource is prudent.

We anticipate that our analysis will ultimately focus on the following questions in developing our recommendation regarding the prudence of the two projects.

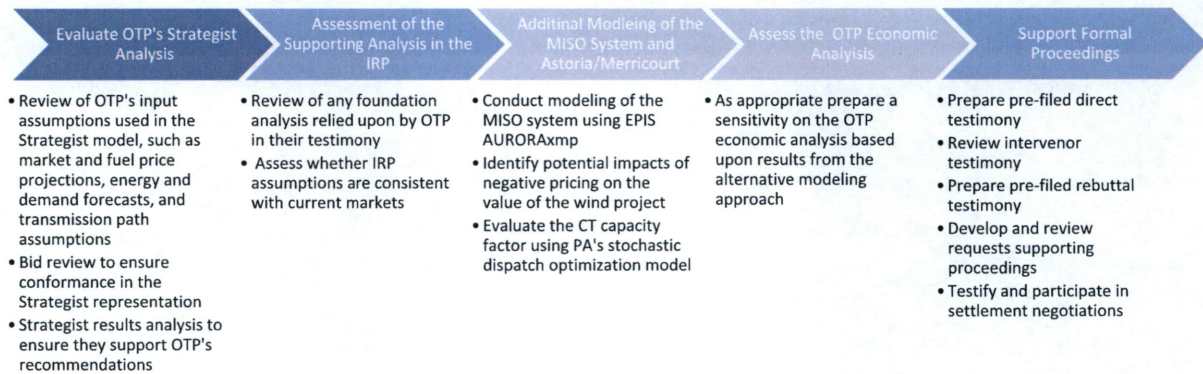
- Are the proposed resource additions needed to meet energy and capacity needs?
- If the resources are needed, are both projects needed to meet energy and capacity needs?
- Will the addition of the generation help or harm system reliability for North Dakota customers?
- Assuming that the new generation is needed, are the proposed projects the least cost additions?
- Is the analysis consistent with North Dakota statute NDCC 49-06-23 and excludes consideration of environmental externalities?

- Is OTP fit and technically, financially, and managerially able to develop and operate the two projects?
- What effect would approving these ADP and CPCN applications have on other electric utilities operating in North Dakota?

3 EVALUATION OF THE PRUDENCE OF THE PROPOSED PROJECTS

PA has reviewed the Company’s application for two ADPs and a CPCN, and proposes the following approach to evaluating OTP’s application.

Figure 2: PA’s proposed approach



3.1 Work Plan

Task 1: Kick-off Workshop

PA will conduct a project kickoff workshop to be held onsite at the Commission’s offices in Bismarck. The primary purpose of the Workshop will be to conduct detailed discussions with the Ratepayer Advocacy Staff regarding OTP’s Applications.

PA will facilitate discussions related to:

- The Commission Ratepayer Advocacy Staff’s initial impressions and potential concerns related to the Applications
- Review of past issues and precedents regarding determining prudence of new resources and CPCN filings
- PA’s proposed project Work Plan
- Identification of critical documents and data responses to review including prior dockets and discovery that has already occurred.

If possible, we would prefer to have an NDA in place prior to meeting so that PA will have access to the full OTP application prior to the meeting.

Task Product:

Workshop and agreement on Work Plan and schedule

Task 2. Evaluation of OTP’s Strategist Analysis

PA will conduct a comprehensive review of OTP’s submitted filings and the analysis supporting its application, including a detailed review of OTP’s Strategist modeling.

The Strategist review will consist of the following:

- A detailed review of the input assumptions used, including market and fuel price forecasts, OTP energy and demand forecasts, emissions pricing, regional supply assumptions, and transmission congestion considerations;
- A Project focused review to confirm the Strategist representation of the individual projects are reasonable; and
- A detailed review of the Strategist outputs to determine whether they support the Company's conclusions and recommendations.

To the extent that the input assumptions used in OTP's Strategist analysis differ meaningfully from PA's view of current assumptions, PA will identify areas of concern and discuss with Staff ways to address these concerns. Approaches include; 1) requesting that the Company provide updated Strategist analysis with revised input assumptions and 2) providing additional documentation regarding their assumptions.

Further, an important consideration in the review of the Strategist modeling will be to evaluate not simply what the analysis considered, but also what the analysis DID NOT consider. As discussed above, PA believes that Strategist has significant limitations regarding its ability to properly value both peaking and intermittent resources. The primary reason for this is the methodology of the model's dispatch algorithm. The Strategist model does not simulate the hourly chronological commitment and dispatch; rather, it uses a load duration curve methodology to project the operations of generating assets. While a load duration curve methodology is a more reasonable approach when valuing a truly base loaded resource such as a combined cycle plant, the methodology has material shortcomings when used to value peaking resources such as a combustion turbine or variable energy resources such as wind or solar generation. PA will evaluate the Company's conclusions regarding the value of the proposed resources in light of Strategist's limitations, and to the extent that PA identifies additional modeling scenarios which may more accurately capture the true value of the proposed resources, PA will recommend to the Advocacy Staff that it request those additional scenarios be modeled by the Company and the results shared with PA and the Commission.

We will also separately review the assumptions behind the load forecast as the load forecast is a critical parameter in the assessment of the need for new resources. Based upon our initial reading of the application our understanding is that a significant driver of load growth is assumptions regarding shale oil development. In particular we will evaluate that component of the load forecast. However, we will evaluate the forecast of all sectors.

Finally, PA will evaluate the estimated interconnection costs for both projects. PA understands that the Astoria project MISO interconnection studies began in February 2017 and are expected to be completed by the summer of 2017. PA will evaluate the resulting interconnection costs and compare them to OTP's estimated costs, and determine whether any variance will be significant to the determination of prudence for the Astoria project. For the Merricourt project, OTP has identified risk sharing mechanisms built into its contracting agreements for the project. PA will evaluate these risk mitigation mechanisms and determine whether they are sufficient to ensure a reasonable determination of prudence for the Merricourt project.

Task Products:

Critique of initial analysis and assumptions

Critique and review of load forecast assumptions

Validation of modeling given the model assumptions and limitations

Request for OTP to provide additional scenarios

Task 3. Evaluation of OTP's IRP as the Foundation for the Filing

The OTP applications for both projects makes numerous references to analysis conducted in the 2012 Baseload Diversification Study, the 2013 IRP, and the 2016 IRP. It is our understanding that while the IRPs were filed with the NDPSC, the NDPSC neither formally reviewed nor approved them. To the extent that the application for the CPCN and the ADPs relies on the IRP analysis, it is important to go back and evaluate any analysis in the IRP that is the foundation for the analysis in the current applications. The examination will consider whether the modeling assumptions and perspectives on resource options are valid to support an analysis in 2017 and the 2017 market conditions.

Similarly, PA will evaluate the basis for the Hoot Lake retirement decision, and whether that decision was reasonable from North Dakota's perspective. The retirement decision is a key driver for the determination of the need for OTP's proposed new resource and thus takes on key significance when evaluating the ADP and CPCN applications.

Task Product:

Identification of any foundation analysis based upon 2013 and 2016 IRPs

Evaluation of 2013 and 2016 IRP analyses to ensure that they are relevant for the current market conditions

Task 4. Analysis of MISO Market with a Chronological Dispatch Model and Astoria with PA's stochastic dispatch optimization model

PA will analyze the operating margins of comparably located combined cycle project, combustion turbine, and wind projects using a combination of our AURORAxmp hourly chronological system dispatch and stochastic dispatch optimization model.

PA will begin by developing a long-term fundamental MISO market forecast for fuel prices (natural gas, fuel oil and coal), electric energy prices, electric capacity prices, and emissions allowance prices for the appropriate pricing areas in which OTP's proposed projects are located. PA has a robust, well-developed, and industry-tested fundamental modeling process, including our proprietary capacity compensation, environmental, renewable, and valuation models along with the use of the AURORAxmp² production cost model and other commercially available models which are operated by PA experts and populated with PA data. PA will analyze Merricourt's operations and revenues from its dispatch within the chronological dispatch model while also assessing locational congestion and negative potential negative energy price outcomes in and around the facility.

We will then use those market price forecasts in our asset dispatch simulation model. PA has developed this model to simulate power generation dispatch that treats the prices of power and fuels stochastically. The model features a mean reverting jump diffusion (MRJD) process for spot prices. Further it uses a dynamic program implemented via an American Monte Carlo technique for dispatch, which occurs in four-hour blocks based on the stochastic behavior of intra-month fuel and intra-day power prices. Dispatch is performed against a probability array that captures the uncertainty of future prices, i.e. the model does not assume perfect foresight of future prices, and takes into account the physical operating limitations of power generation (i.e. start time, heat rate, VOM, minimum run times, etc.). The resulting output (operations and associated revenues and variable operating costs) represents the expected value of 1,000 individual simulations.

² Developed by EPIS, Inc.

It is our intent to use the model results to either confirm, or potentially create an alternative view of the economics of the wind and CT on a stand-alone basis as well as the combined portfolio versus the economics of constructing or purchasing an existing combined cycle project.

PA uses its model of the MISO system routinely and the modeling inputs and results are scrutinized by the financial community as well as strategic investors that already have significant positions in MISO generation. In the event, perhaps unlikely, that our analysis indicates that the wind project is not in the best interest of North Dakota ratepayers, then our independent modeling will serve as the basis for challenging the rebuttable assumption of prudence.

Task Product:

Analysis of the proposed projects based on an hourly production cost model of the MISO system and a stochastic-based asset dispatch simulation model for Astoria

Comparative analysis of the proposed projects versus a combined cycle project

Task 5. Review of Additional Risk Factors and Potential Benefits

One of the weakness of Strategist is that it does not address issues related to interconnection issues. PA has conducted extensive modeling of the MISO market and we expect to comment on the reasonableness of the additional risk factors as well as the potential reduced energy price volatility outlined by OTP.

Additionally, PA will work with our Independent Engineer subcontractor, Trent Markel, to evaluate and opine on the assumed 40-year economic life of the Merricourt wind project. PA is concerned that the 40-year assumption used by OTP may be inappropriately impacting the projected net benefits of the project. PA will seek an opinion from Mr. Markel related to the assumed life of the project, and if necessary, develop alternate calculations of the proposed Merricourt project's net benefits for the Staff's consideration.

Task Products:

Evaluation of interconnection issues

Evaluation of the economic life of the wind project

Task 6. Evaluation of Economics of the Proposed OTP Resources

PA will use the results of its activities in tasks 2 – 5 to individually evaluate the prudence of the two projects as well as to collectively evaluate their prudence. We will review our analysis and initial conclusions with the Ratepayer Advocacy Staff and develop a final recommendation and strategy for the responding to the two OTP applications. In developing our final recommendation, we will ensure the following issues and questions are addressed:

- Is OTP's proposed investment in the Astoria project reasonable, prudent and in the best interests of customers?
- Is OTP's proposed investment in the Merricourt wind project reasonable, prudent and in the best interests of customers?
- Is there a need for the projects? Are the proposed projects adequate to meet the need?
- Is OTP fit and technically, economically, and managerially able to develop and operate the projects?
- What is the effect on other public utilities providing similar service?

Task Products:

Recommendations regarding acceptance or rejection of the ADPs and CPN

Supporting documentation for recommendations

Task 7. Preparation of Testimony

While the testimony is yet to be developed we anticipate that the pre-filed testimony will address the following:

- Summary of findings and recommendations
- Review and Critique of OTP Modeling Assumptions, Methodology, and Results
- Findings from additional analysis developed by PA
- Criteria considered in developing the recommendation regarding the ADP and CPCN
- Findings on the need and cost effectiveness on a project by project basis and as a portfolio
- The basis of the testimony will be: 1) PA's detailed analysis of the OTP filing, 2) review and analysis of responses to interrogatories, and 3) the PA analysis conducted in Tasks 3 – 6.
- Depending on the procedural schedule, PA will also prepare rebuttal / sur-rebuttal testimony as required.

Task Products:

Direct Testimony

Rebuttal Testimony

Task 8. Support Formal Proceedings

PA will support the NDPSC throughout the formal proceedings related to the application for the ADPs and CPCN.

While it is difficult to project exactly what types of support will be required, PA anticipates the support could include:

- Responding to data requests and interrogatories
- Assisting with potential settlement negotiations
- Review of direct and rebuttal testimony filed by both the Company as well as any intervenors
- Other supportive functions as the proceedings progress.

PA will assist the Commission's Advocacy Staff counsel in preparing for cross examination of the Company's and other intervenor witnesses. As the proceeding moves forward, PA anticipates it may be possible the Commission will enter into settlement negotiations with the Company to reach a negotiated settlement. PA will support the Advocacy Staff during negotiations with analyses as necessary, review of any Company or other intervenor proposed modifications to any proposed Commission decisions, recommendations and support of any modifications the Commission may wish to propose, and other negotiation support as necessary.

Task Product:

Response to Data Requests

3.2 Quality Assurance

We understand the importance of having no errors in filed testimony and supporting exhibits and work papers. Consequentially, we have a detailed review process which accompanies our submission of testimony and other regulatory filings. This process starts with allocating sufficient time for the necessary review process both internally and by the client. Our internal review process involves using PA staff who are not involved with the core effort of the engagement. This QA team will be selected for their general knowledge of the issues at hand but no specific knowledge of the analysis or testimony; the team will conduct a detailed peer review of both the analysis and the testimony, including at a minimum:

- Confirmation of OTP filing data used in PA analysis
- Confirmation of PA calculations used to support conclusions and testimony
- Editing and proofreading of PA testimony

3.3 Proposed Project Schedule

Our understanding is that the Commission has seven months to rule on the ADP applications but that a procedural schedule has not been established yet. We are prepared to assist the Commission and its Staff in meeting all necessary deadlines. While we believe it is premature to begin to specify exact milestone dates, we anticipate discussing these milestones during the proposed project kickoff workshop, and very likely will need to revisit the project schedule frequently during the proceedings.

Table 1 Milestones

Milestone	Date
Contract Start	June 2017
Pre-Filed Testimony	
Rebuttal / Sur-Rebuttal	
Technical Hearings	

4 EXPERIENCE AND QUALIFICATIONS

Section 4.1 outlines PA's proposed project team and the level of effort and responsibilities for each of the team members, followed by short bios for each of the team members. Section 4.3 provides a sample of PA's relevant experience. Full resumes for each of the team members are provided in Appendix A.

4.1 Project Team

In addition to our proposed Project Manager, PA proposes to dedicate a core team to this effort. The core team will be supported as necessary by subject matter experts from across the PA organization. In addition to the PA team, we propose to include our independent engineering expert, Trent Markel. Our team members, contribution from each team member, and anticipated level of effort is shown in Table 2. The number of estimated hours for personnel assigned to accomplish the work can be found in section 5.1 Cost Proposal.

Table 2: PA Team Contributors and Level of Effort

Role	Name / Title	Contribution to Project
Project Manager	Jim Heidell Director	Prepare and submit testimony, ongoing coordination with the NDPSC staff, day-to-day project management
Core Team Member	Matt Mooren Member of PA's Management Group	Partner in charge, advisor for alternative approaches, and potential expert witness testimony
Core Team Member	Charles Janecek Principal Consultant	Review of OTP Strategist analysis, potential expert witness regarding production cost modeling and resource optimization
Core Team Member	Jesse Gilbert Principal Consultant	AURORA team lead, expert in MISO market modeling
Core Team Member	Geoff Burmeister Consultant Analyst	Historical locational marginal pricing research, modeling, and other analytic support
Core Team Member	Spencer Borison Analyst	Research, modeling, and other analytic support
Subcontractor	Trent Markel Independent Engineer	Engineering review of assumed life of wind project

Senior Advisor	Pieter Mul Principal Consultant	Expertise in MISO market rules
Support	Christopher Loeb Consultant	MISO locational market pricing and transmission congestion analysis

4.2 Team Member Bios

Jim Heidell

Director
(Regulatory and Financial Expert)

Mr. Heidell specializes in electric and gas utility regulation, utility finance, wholesale electricity markets, evaluation of renewable energy technologies and financial analysis of complex investments. Mr. Heidell assists clients with due diligence associated with acquisition of natural gas and electric utilities and wholesale energy market transactions. Mr. Heidell has prepared and submitted testimony in both regulatory proceedings and civil contract damages cases. Mr. Heidell also specializes in strategic analysis and evaluation of opportunities associated with renewable/alternative energy technologies. He has submitted testimony on resource planning in North Dakota as well as other jurisdictions and submitted testimony in federal courts relating to Sherco 3 cost allocations, among other financial issues.

Matt Mooren

Member of PA's Management Group
(Regulatory Policy Expert)

Mr. Mooren is an energy and utilities advisor who works across the value chain, including the natural gas, power, coal, renewable sectors and energy infrastructure (fuel-generation-transmission-customer). His 15+ years of consulting experience include working with utilities, private equity firms, competitive generators, global corporations, investment banks, financial advisors, and legal advisors on the associated economic opportunities and risks in the global energy markets. Mr. Mooren helps clients navigate through policy, regulatory, market structure, technology, and economic uncertainty to address their business strategy, merger and acquisition, financing, restructuring, litigation, and testimony support needs.

Charles Janecek

Principal Consultant
(Resource Planning Expert)

Mr. Janecek provides a unique blend of commercial consulting and utility planning experience to PA's clients. He has 20 years of experience in the electric power industry through previous positions with an investor-owned utility (IOU) and private consulting firms. As a senior planner with an IOU, he was integral to the process of soliciting, evaluating, and procuring more than 2 GW of generating resource additions to the IOU system, including over 750 MW of wind generation and 80 MW of solar resources. At PA, Mr. Janecek manages resource planning engagements, often focusing on renewable integration issues such as increased fuel and spinning reserve costs, gas storage costs, coal cycling costs, renewable energy standards compliance, and other client-specific issues. He has been an integral component in several energy storage engagements, ranging from procurement assistance to detailed valuations of proposed storage facilities. When advising clients involved in wholesale markets and asset transactions, Mr. Janecek applies experience gained analyzing and facilitating transactions for more than 500 assets. He has modeled every area of the U.S. and Canada, along with many individual control areas within the markets, to support asset valuations, strategic planning initiatives, regulatory proceedings, and litigation proceedings.

Geoff Burmeister

Consultant Analyst
(Analytic Support)

Mr. Burmeister is experienced in energy and environmental policy research and analysis, understanding how political, institutional, and organizational dynamics translate into policy outcomes, utility business and regulatory strategies, and competitive electricity market structures. He also has experience investigating nascent technologies and business models related to distributed energy resources and electric demand-side management. Mr. Burmeister holds a M.B.A and M.S. focusing on Environmental Policy from the University of Michigan, as well as a B.A. in Political Science and International Development from Tulane University.

Spencer Borison

Analyst
(Analytic Support)

Mr. Borison's work experience includes projects dealing with energy, policy, process improvement, and efficiency. He has internship experience on a variety of levels of government including at the city, state and federal levels. Mr. Borison received a B.A. in Political Science with minors in Business and Leadership from the University of Colorado-Boulder. He graduated Summa Cum Laude for his honors thesis focusing on the factors impacting adoption and implementation of Renewable Portfolio Standards across the United States.

Jesse Gilbert

Principal Consultant
(AURORA Market Expert)

Jesse Gilbert is a Consultant in PA's Global Energy and Utilities Practice. He has eight years' experience developing proprietary research and modeling solutions for the power, coal and natural gas industries as well as a strong background in fundamental power forecasting. Mr. Gilbert's work has focused particularly on environmental and economic considerations for the coal and gas generating fleet including extensive work with coal plant retirements, fuel economics and a number of environmental rules. He has worked closely with a wide-range of clients including power plant developers, investment banks, electric utilities and environmental groups to provide analytics and modeling solutions. Mr. Gilbert holds a Master's degree in economics from North Carolina State University and a B.A. in economics with a minor in Political Science from the University of Georgia.

Trent Markell, P.E.

Independent Engineer
(Technical Expert)

Mr. Markell is a registered professional engineer with over 23 years of experience in the engineering field. Trent has an extensive background in power generation, biofuels, and independent engineering services. He has provided technical evaluations and due diligence on over 37 GW of power generation facilities ranging from traditional coal to state of the art combined cycle facilities and renewable energy facilities. As an independent engineer, Trent has worked with lenders, developers, and sponsors to assess the risks and capabilities of power generation facilities all over the world. Trent has an MS in Mechanical Engineering from Union College and a BS in Mechanical Engineering from Rochester Institute of Technology and has prior engineering experience with major firms such as Mott MacDonald, R.W. Beck, Woodward Governor and General Electric.

Pieter Mul

Principal Consultant
(MISO Market Rules expert)

Mr. Mul advises clients on energy market fundamentals and asset value drivers. He has a decade of transactional and analytical experience in energy markets, with expertise in the economics of electricity markets and market design. Prior to joining PA, Pieter was a member of MISO's Independent Market Monitor evaluating market outcomes and identifying market manipulation. Pieter holds a BA in Economics from Davidson College.

Christopher Loeb, Ph.D.

Consultant Analyst
(Locational Marginal Pricing expert)

Dr. Loeb is an Analyst in PA's Global Energy & Utilities practice. He has experience in the design, development, production and evaluation of energy storage, alternative fuel production and water purification technologies. Dr. Loeb has experience in numerical modeling, process intensification, new technology evaluation and managing multi-disciplinary teams. He holds a B.S. in Chemical Engineering from the University of Wisconsin-Madison and a Ph.D. in Chemical Engineering from Oregon State University.

4.3 Firm Qualifications

PA has decades of strategic advisory and planning expertise with electric utilities, independent power producers, and regulatory agencies around the world and throughout the United States. Virtually every day, we model each of the three interconnected grids of the United States – the Eastern Interconnect, the WECC, and ERCOT – to produce long-term fuel and power price forecasts, power flows, and individual asset operations. Our market forecasts are widely used to support project financing and asset transactions across the U.S., as well as the development of utility strategic plans and regulatory proceedings. Our market experts are familiar with virtually every major power generating plant in the country, and our regulatory and capital investment advisors understand the complexities of electric utility regulation and investment decision-making as well as the associated stakeholder impacts.

We have provided several summaries of completed engagements that speak to our ability to provide the types of services requested by the Commission. These represent only a fraction of our experience; additional information and engagement summaries as well as letters of reference are available upon request.

4.3.1 Highlighted Qualification Demonstrating PA's Expert Witness Experience and Expertise

The following engagement highlights our recent experience in evaluating Xcel Energy's Enterprise Resource Plan for the Public Service Company of Colorado. This engagement was conducted on behalf of Southwest Generation Operating Company, LLC.

PA was twice retained by an independent power producer to provide independent expert testimony in Xcel Energy's resource planning regulatory docket in Colorado (in both 2012 and 2017) to enhance the client's future value opportunities. PA reviewed the utility's current and future resource needs to determine if the proposed resource plan would ensure reliability at the least cost to consumers. PA analyzed wind generation patterns and considered their potential impact on overall system reliability and cost. PA testified in the docket regarding methodological and assumption flaws that caused the utility to underestimate the intrinsic value flexible and efficient generation affords to the system and regulators to reconsider whether the utility was equipped to handle increasing amount of intermittent wind generation in an efficient and reliable way.

In particular, PA evaluated Xcel Energy's Flex Reserve requirement, which is a FERC approved product intended to help Xcel Energy manage sudden losses of wind generation due to changes in wind speed. PA's testimony argued that Xcel Energy is not planning to procure enough Flex Reserves to reliably manage downward wind ramping events, and argued why the Flex Reserve requirement should require faster ramp rates than currently considered by the utility. PA's testimony used actual Xcel Energy system wind data to demonstrate that maintaining system reliability during downward wind ramping events requires more than just planning for the magnitude these unplanned system events; it also requires accounting for the speed at which downward wind ramping events can occur. Xcel Energy's current methodology for determining the appropriate amount of Flex Reserves currently only takes into account the potential magnitude of such events. In addition to this analysis, PA also conducted a detailed review of Xcel Energy's Flex Reserve studies and identified several methodological issues that is likely causing Xcel Energy to under estimate the amount of Flex Reserves need on the system. One of the major flaws identified is that the Xcel Energy study only considers one year of historical wind generation data on the Xcel Energy system, despite the fact that Xcel Energy's own data demonstrates that there have been much larger loss of wind generation events outside of the data series considered in Xcel Energy's official studies. As a result, the Colorado Public Utilities Commission has ordered that Xcel Energy update its Flex Reserves study and file this updated study with Xcel Energy's 2019 ERP filing. The Commission ordered that this updated study must present a full analysis of all empirical wind data available at that time and shall include a back-cast of historical wind data versus only consider one year.

PA's expert testimony helped the client successfully renegotiate a contract with the regulated utility and improved the regulatory environment.

Expert witness: Matt Mooren

Please reference Appendix B for Example Pre-Filed Testimony.

Docket No. 16A-0396E Public Service Company – 2016 Electric Resource Plan

Client Reference:

Rob Witwer
General Counsel for Southwest Generation Operating Company, LLC
(303) 623-2786

4.3.2 Additional References

Caleb Steiner
Manager of Corporate Strategy
Hoosier Energy Rural Electric Cooperative, Inc.
812.876.0550

Christopher Fannella
Chief Financial Officer
Ironclad Energy Partners
603.292.3893

4.3.3 Selected Engagement Summaries

We have provided several summaries of completed engagements that speak to our ability to provide the types of services requested by the Commission. These represent only a fraction of our experience; additional information and engagement summaries as well as letters of reference are available upon request.

4.3.4 MISO Market Expertise

Independent Power Producer/Developer

Wind Portfolio Analysis

PA was retained by an independent power producer to provide buy-side support in connection with a wind portfolio located in MISO, ERCOT, and PJM. PA provided a report on the market assumptions and prices provided by the seller's market consultant, and the reasonableness of the seller's financial model. Additionally, PA projected the portfolio's revenues, including renewable energy credits. PA also conducted a 'fatal flaw' analysis, which examined the correlation between nodal/zonal power prices and wind generation. Through PA's support, the client was able successfully acquire the portfolio.

International Investor

Renewable Portfolio Analysis (MISO, PJM, SPP, Others)

PA provided strategic market insight and analysis in support of an investor's consideration of the acquisition of a large wind portfolio including existing and development projects located across the US. PA presented our view of the primary issues facing investors of wind power generating assets in PJM, SPP, MISO, WECC, ERCOT, Spain and the Netherlands. The presentation included a market overview of the various regions and focused on the primary risk factors to consider when assessing the future revenues of wind power generating assets. As part of the analysis, PA analyzed the opportunities and potential risks in contracting with local utilities in the regions for the output including the potential willingness to procure wind power under a PPA, projected renewable demand, projected opportunity cost, and exposure to additional renewable/environmental legislation, extreme commodity price movements, and other factors. PA's findings were presented to the client and included as part of their overall review of the investment opportunity.

International Investor

Renewable Asset Analysis (MISO)

PA provided strategic market insight and analysis in support of an investor's consideration of the acquisition of a wind facility located in the MISO power market. PA's evaluation included forecasting MISO energy, capacity, ancillary services, and REC prices, as well as conducting a detailed assessment of the facility's transmission situation. This assessment included a detailed evaluation of the Asset's congestion and curtailment risk. Based on PA's evaluation, the client was able to form its bidding strategy for the Asset.

Independent Power Producer/Developer

Asset Transaction Support (MISO, PJM)

PA was retained by an independent power producer to perform an independent appraisal of a 1,800 MW portfolio of natural gas-fired peaking assets located in MISO and PJM in connection with a \$500 million debt syndication. As part of the independent appraisal process PA performed a discounted cash valuation of the portfolio, including financial and physical natural gas and power contracts. PA also prepared an independent market expert report that articulated the major drivers of value and inherent risks and opportunities of the power markets. Through PA's support the client was able to successfully complete the debt syndication process.

Independent Power Producer/Developer

Renewable Portfolio Analysis (MISO, PJM, Quebec, SPP, Ontario, and ERCOT)

PA was retained by a large, international solar developer to support the acquisition of a wind portfolio with more than 900 MW of operating and development projects. As part of its work, PA helped the client understand the transmission and congestion risks associated with the operating and development portfolios. Additionally, PA worked with the client to understand the post-contract value of the operating projects and potential pricing. With PA's support, the client was able to announce the acquisition of the wind portfolio.

4.3.5 Integrated Resource Planning

Hawai'ian Electric Company

Power Supply Improvement Plans

PA assisted the Hawai'ian Electric Co. Power Supply team in the development of its Power Supply Improvement Plans following the Hawaiian Commission rejecting the Company's IRPs for each of the island systems. PA developed models of each of the islands' electric systems using the EPIS AURORAxmp hourly chronological dispatch model. We developed multiple scenarios for each island that incorporated different combinations of distributed and utility scale renewable generation to both meet and exceed renewable energy standards. The analysis also considered different retirement scenarios for existing thermal generation as well as issues of renewables curtailment due to transmission and generator constraints.

Midwest IOU

Regulatory Support

PA is developing regulatory arguments for a Midwest U.S. electric utility. The Midwest IOU's electric rates have increased at a faster pace than some of its regional peers. PA assessed the underlying factors contributing to the change in the utility's price of electricity as well as reliability, customer satisfaction, safety, emissions, and renewable compliance performance relative to national and regional peers. PA interviewed utility staff and analyzed controllable and non-controllable expenses, using FERC Form 1 data, to determine the causation of the relative change in cost of electric service. PA simplified the causation down to several factors, including the fact that the Midwest U.S. electric utility has completed a significant capital expenditure cycle while other regional electric utilities are entering into a period of significant capital expenditures. PA is providing on-going regulatory support.

Southwest US IOU

IOU Advisory Services

PA has been an energy economic advisor of a Southwest U.S. electric utility since 2011. The utility possessed a competitive generation business in Texas which created cash flow, earnings, share price, and credit rating risk to the utility's core business as a regulated electric utility. PA conducted a market opportunity and risk assessment of the Texas wholesale electricity market, as well as a valuation of the electric utility's regulated business and competitive generation assets. PA's work, including executive management and board communication, helped the utility decide to sell the competitive generation business and obtain regulatory approval. The sale simplified Southwest IOU's business and market position.

The electric utility faced federal environmental regulations and low natural gas prices which caused it to consider de-risking from coal within their portfolio of regulated power generation supply. PA helped develop a decision framework. PA then assessed customer impact of a myriad of potential environmental compliance, new build, replacement and acquisition alternatives with the objective of choosing a least cost/lowest risk path, while also considering stakeholder (political, regulator, shareholder, and intervener) requirements. PA's work assisted the Southwest IOU in the development of its strategic roadmap and subsequent steps to execute.

Cooperative/Municipality

Strategic Environmental Compliance, Negotiation and Resource Planning Support

PA was retained to assist a Midwestern cooperative in developing going forward strategic options for its generation and transmission system. The client was the target of New Source Review ("NSR") violations, and wanted to analyze how to optimize its assets (including retrofit/retirement decisions on two coal-fired facilities targeted under NSR). PA worked with the client over the course of 24 months (1) to develop consent decree negotiation strategy with the EPA by analyzing the cooperative's system under a variety of going-forward market and regulatory assumptions, and proposed consent decree limits; and (2) to analyze optimal compliance paths after finalization of the consent decree, including retrofit, retirement, and replacement capacity decisions. PA worked closely with the cooperative's executive management team to develop key findings and strategies, shape the messaging to cooperative members, and ultimately to deliver the findings before the cooperative's board to be voted on and acted upon.

Southeast US IOU

IOU Advisory Services

PA has been an energy economic advisor for a Southeast U.S. electric utility since 2008. The electric utility faced several challenges including the ownership of a competitive generation business, a shortage of regulated generation supply to meet customer demand, potential opportunities to expand customer base by serving additional municipality or cooperative electric demand, and potential opportunities from integration into the MISO wholesale electricity market- including strategies related to potential market rule and stakeholder changes from FERC Order 1000.

PA leveraged its regulatory, natural gas, power, coal, transmission, electric utility, and competitive generation business expertise to assess the utility's competitive landscape. The primary focus was on the regulations and fundamentals affecting the electric utilities, non-regulated generators, and associated transmission for Louisiana. PA facilitated several working sessions with the utility's executive management team and presented to the board of directors. PA's work assisted the utility in establishing a solid foundation for growth and then growing from that point. The utility has since reduced their competitive generation exposure, reduced their shortage of regulated generation to meet customer demand, and increased their customer base. The utility recently won the EEI award for shareholder growth.

4.3.6 Policy/Regulatory Support/Expert Witness Testimony

Hawai'ian Electric Company

Ten-year Renewable Energy Strategy for Regulated Utility

PA assisted the Hawai'ian Electric Co. Power Supply team in the creation of plausible scenarios for reaching ambitious renewable energy goals. The impacts of each scenario were assessed against the organization's mission, including such elements as rate payer costs, effect on the company's generation rate base, emissions reductions, and the ability to meet or exceed environmental regulations. Quick wins were identified which boosted the system efficiency and identified opportunities for capital investment. Long term actions were assessed and the critical path items identified to ensure the potential for their successful completion. The results of this analysis led to revised budgeting and reallocation of resources, the creation of a renewable energy development team, an expansion of O&M staff at a neutral cost to rate payers, and a revised unit retirement schedule. PA's final report served as a key supporting document in their rate case filing.

Invenergy

Minnesota Regulatory Support

PA submitted rebuttal testimony and appeared before the Minnesota Public Utilities Commission, on behalf of Invenergy Thermal Development LLC, regarding Xcel Energy's petition for Approval of Competitive Resource Acquisition Proposal and Certificate of Need. In addition to preparing rebuttal testimony, PA assisted the client and counsel with strategic analyses and demonstratives in support of direct testimony and cross examination of witnesses.

Independent Power Producer

Regulated Utility Renewable Resource Procurement

The California Public Utilities Commission (CPUC) requires the use of an Independent Evaluator to ensure that mandated annual Power Purchase Agreement offers are considered fairly and equitably. Since 2006, PA has served as an Independent Evaluator of renewable resource procurements for San Diego Gas & Electric (SDG&E). In particular, PA has served as IE for five of SDG&E's six Requests for Offer (RFOs) for utility-scale renewable contracts; five Renewables Auction Mechanism (RAM) solicitation; an RFP process to select an EPC contractor to design and build distributed solar generation at SDG&E substations, and the current All-Source RFO. As Independent Evaluator, PA's activities have included working with SDG&E to develop bid documents (including request for offers, PPAs, etc.), observing bid receipt and evaluation processes, independently evaluating bids and assessing bidder viability, and providing reports to the CPUC summarizing PA's opinion of the utility's conduct and the bids received. In addition to evaluating the RFOs and contracts coming from them, PA has also independently evaluated bilateral contracts and tax equity negotiations with several large wind and solar generation.

5 COST PROPOSAL

Our cost proposal is divided into two stages. The first stage covers the analysis to support the Commission's ADP and CPCN processes (Tasks 1-6). The second stage (Tasks 7-8) covers the support of the Commission's formal proceedings.

Based on the services in Tasks 1 through 8 above, PA proposes to support the Commission's decision on the Advanced Determination of Prudency on a fixed fee basis. PA's estimate of the professional fees for Tasks 1-9 is \$250,000, including estimated travel expenses of \$15,000.

Requests by the Commission for work in addition to those described in Tasks 1-8 above will be performed on a time and materials basis at the hourly rates provided in Table 3 below. Any such work conducted will be defined via a Scope of Additional Services, and incremental costs estimated and agreed to by the Commission prior to the commencement of the additional services. Travel expenses will be invoiced at cost, and meals and miscellaneous expenses while traveling overnight will be billed on a daily allowance basis based on IRS guidelines for domestic travel.

5.1 Cost Proposal

The budget by stage and hours is shown in Table 3. There are no additional charges for supplies and travel expenses will be invoiced at cost.

Table 3. PA Consulting Group's Cost Proposal

PA Team Member	Labor Category	Hourly Rate \$/hr	Determination of Prudency/CPCN	Formal Proceedings Support
Matt Mooren	Member of Management	575	15	16
Jim Heidell	Director	490	37	64
Jesse Gilbert	Principal Consultant	450	20	0
Charles Janecek	Principal Consultant	340	136	48
Pieter Mul	Principal Consultant	340	60	0
Christopher Loeb	Principal Consultant	245	44	32
Geoff Burmeister	Consultant Analyst	300	44	12
Spencer Borison	Analyst	225	76	32
Trent Markel	Subcontractor	400	40	0
Total Hours			472	204
Labor Budget			\$159,475	\$75,520
Travel			\$7,500	\$7,500
Total Budget			\$166,975	\$83,020

6 REQUIRED ENCLOSURES & PROPOSED AMENDMENTS TO CONTRACT FORM

6.1 Purchase Service Agreement Deviations and Exceptions

PA assumes that this work could be completed under the same contract terms recently accepted related to RFPs 408.17.02.006 and 408.17.04.008.

APPENDICES

A	TEAM MEMBER RESUMES	32
B	EXAMPLE PRE-FILED TESTIMONY	53
C	SOLICITATION AMENDMENT #1	54

A TEAM MEMBER RESUMES

Jim Heidell

Director



Jim Heidell specializes in electric and gas utility regulation, utility finance, wholesale electricity markets, evaluation of renewable energy technologies and financial analysis of complex investments. Mr. Heidell assists clients with due diligence associated with acquisition of natural gas and electric utilities and wholesale energy market transactions. Mr. Heidell has prepared and submitted testimony in both regulatory proceedings and civil contract damages cases. Mr. Heidell also specializes in strategic analysis and evaluation of opportunities associated with renewable / alternative energy technologies.

Primary expertise	Related experience	Qualifications
<ul style="list-style-type: none"> • Electric and natural gas utility regulation and finance • Analysis of wholesale electric markets • Renewable Energy Technologies • Asset valuation / M&A Advisor • Damages estimation for civil litigation 	<ul style="list-style-type: none"> • Strategic planning • Financial modeling of complex investments • Financial planning 	<ul style="list-style-type: none"> • 30-years' experience with electric & gas utilities and electricity markets • MBA University of Washington • MSE Engineering Economics, Stanford University • BSE, Civil Engineering, Tufts University • CFA

Primary expertise

Utility Regulatory Support – Prepare expert testimony in regulatory hearings related to resource acquisition, QF issues, rate impacts, marginal and embedded cost of service, and rate design. Developing marginal and embedded cost studies for regulated utilities.

Financial Analysis – Long-term modeling of utility finance. Analysis of major capital investments using a variety of tools to incorporate uncertainty and risk.

Analysis of Energy Markets – Develop energy and capacity forecasts for U.S. power markets to support: strategic investments by utilities and major energy companies, development of utility risk management strategies, and corporate strategies for generation asset acquisition and disposition.

Renewable Energy Technologies – Develop business plans, market positioning strategies, and financial analysis of renewable technologies including PV cell manufacturing, flywheels, and fuel cells along with renewable generation technologies including solar thermal, geothermal, wind, battery storage, and IGCC projects.

Asset Valuation / M&A Advisor – Provide valuation advice for acquisition of electric generation portfolios, single power plants, transmission projects, electric utilities, and gas distribution companies. Work also included review of wholesale and retail regulatory pricing mechanisms and analysis of associated risk.

Damages Estimation for Civil Litigation Testimony – Prepare expert witness testimony to support power contract litigation, property tax cases, power plant development agreements, and quantification of economic damages.

Key client achievements

CIVIL LITIGATION TESTIMONY & SUPPORT

Prepared an analysis of claims of economic damage associated with the performance of an anaerobic digester designed to provide gas for an electric generation project. Analysis included evaluation of performance, revenues and costs, and cost of capital used to discount projected future earnings. Prepared expert report and testified in jury trial in federal district court.

Developed an analysis of material and labor cost increases on EPC costs for a natural gas fired power plant located in New Mexico. The analysis was used to refute a claim that cost overruns were not reasonable in a cost plus EPC contract. The analysis demonstrated how much of the total project cost increases was associated with labor and material costs beyond the control of the general contractor.

Prepared an analysis of loss of margins at two coal plants during periods when there were alleged violations of EPA opacity emission limits. The analysis demonstrated that client did not receive any economic benefit associated with the periods of alleged violations.

Prepared an analysis of the commercial distributed solar sector in the 2010 – 2011 time frame and demonstration of the unreasonableness of the plaintiff's claims for economic damages associated with the defendant's decision not to pursue participation in an equity fund.

Prepared an analysis of the U.S. wholesale electric power markets in the 2008 – 2010 time frame to demonstrate why the plaintiff's decision to terminate construction of a coal fired power plant was due to cost increases in the EPC contract and not due to the changing natural gas prices and emission laws.

Prepared an estimate of lost margins associated with the extended outage of a Canadian nuclear reactor. The analysis included an estimate of what Ontario wholesale power prices would have been but-for the outage and estimates of the total damages including repair and inspection costs.

Prepared an Expert Report regarding rate making and financial policies of the Southern Minnesota Municipal Power Agency in conjunction with a contract dispute regarding a power contract and investments in new generation resources to serve full requirements customers.

Assisted expert witness by the preparation of a report on how a third party would value the Trans-Alaska Pipeline as part of a property tax dispute with the municipality of Anchorage.

Prepared an analysis of damages associated with claims for losses associated with the interruption of business of a Texas gas-fired power plant as a result of the rupture of a natural gas pipeline used to supply the power plant.

Prepared an analysis of the economic benefits that accrued to the defendant associated with the purported delay of implementation of measures to correct water pollution discharge violations associated with a power plant.

ANALYSIS OF RENEWABLE ENERGY INVESTMENTS

Prepared an Independent Market Expert Report to support the debt financing of BrightSource Energy's Ivanpah solar thermal projects with purchased power agreements with California investor owned utilities.

Prepared an Independent Market Expert Report to support the debt financing of Solona, a large solar thermal project with molten salt storage, with a purchased power agreement with an Arizona Public Service.

Prepared an Independent Market Expert Report to support the expansion of a CdTe PV manufacturing facility in Colorado including the analysis of the business plan and projection of long-term prices for the PV modules.

Prepared an Independent Market Expert Report to support the expansion of a c-Si PV manufacturing facility including the analysis of the business plan and projection of long-term prices for the PV modules.

Prepared an Independent Market Expert Report to support the expansion of a polysilicon manufacturing facility including the analysis of the business plan and projection of long-term prices for polysilicon and the associated raw materials.

Prepared an evaluation of the global market for concentrating solar power plants as of 2012 as part of a client analysis of a potential purchase of a solar mirror manufacturing company.

Prepared an evaluation of the U.S. solar PV market to support evaluation of a Japanese firm's potential expansion in the U.S. markets.

Assisted client with a bid into a utility's renewable energy procurement program. The analysis included an assessment of competitors and analysis of pricing to support the bid of a renewable energy resource into 2011 Entergy RFP for renewable resources.

Prepared long range forecasts of multiple wind portfolios with an emphasis on the valuation of post PPA revenues and the value of renewable energy credits.

Prepared an analysis of the market for future expansion of the wind business of a major U.S. wind developer based upon an assessment of the competitiveness of wind generation with gas fired generation.

Prepared a fair market value analysis of associated with the purchase of a minority position in a wind project located in Ontario, Canada.

Prepared an Independent Market Expert Report to support the debt financing of a geothermal power project located in the Pacific Northwest.

Prepared an Independent Market Expert Report to support the debt financing of the Beacon flywheel energy storage project in New York.

Prepared an Independent Market Expert Report to support the debt financing of the AES battery energy storage project in New York.

Development of an Independent Market Expert Report to support the financing of the Kemper IGCC plant including an analysis of the regulatory structures being relied upon to support cost recovery as well as wholesale electric prices to support wholesale power sales.

UTILITY REGULATORY SUPPORT

Analysis and testimony on behalf of Constellation Energy Group related to typical merger and acquisition conditions required by regulators in utility and non-utility transactions. Testimony related to the EDF / Constellation joint venture.

Testimony related the use and design of ratchet rates on behalf of Northern Indiana Public Service Company. Testimony related to the application of ratchets to the client's unique position and appropriate recovery of costs.

Analysis of the economics of an electric utility's interruptible rates including the value of interruptions versus the payments received by customers. Developed recommendations for pricing interruptible rate programs that were consistent with the utility's avoided costs and ISO markets.

Developed electric cost-of-service studies, rate design, and testimony to support Puget Sound Energy in multiple general rate cases in Washington. The engagements included addressing issues such as special rates for strategic customers with competitive options, line extension policies, and rates to address revenue attrition.

Developed natural gas cost-of-service studies, rate design, and testimony to support Puget Sound Energy in a general rate case in Washington.

Prepared marginal cost of service studies and testimony to support Montana-Dakota utilities in multiple Montana rate cases.

Assist Montana-Dakota Utilities in development of its integrated resource plan through analysis of options using the Strategist planning model.

Supported Montana-Dakota Utilities in answering a complaint in front of the South Dakota Public Utilities Commission regarding a wind generator requesting a contract under the provisions of PURPA.

Provided expert testimony related to Montana Dakota's proposed participation in the Big Stone II power plant. Prepared and delivered testimony provided in multiple hearings in North Dakota and Minnesota.

Prepared testimony on behalf of Hydro One Networks regarding rate shock and how to address necessary rate changes associated with the restructuring of the electric utility business in Ontario.

Developed an analysis of weather risk associated with the retail power sales of IPALCO. Effort was conducted as part of a comprehensive risk assessment conducted by AES. Models of the weather / load relationship were developed and then integrated with the rate structures and cost adjustment mechanisms to assess the utility's overall exposure to weather risk.

Advised Old Dominion Electric Cooperative on options for acquiring new generation in a depressed power market and incorporation of the analysis in their long-term resource planning.

M&A and BANKRUPTCY ADVISOR

Prepared an analysis of New Mexico Gas Company to support a prospective buyer. We assisted multiple clients with due diligence related to the acquisition of gas LDCs. Assisted the client with a review of the deal model including: assumptions about rate cases, assumptions regarding ROE, sales growth by rate class, and revenue by rate class. The engagement also included an assessment of the regulatory climate and potential conditions and costs associated with obtaining regulatory approval of the transaction.

Prepared a valuation of the Mountaineer Gas Company including the analysis of regulatory issues to support the debt financing associated with the purchase of the energy company.

Assisted an infrastructure fund in valuing power contracts and reviewed the regulatory model used in conjunction with establishing the price to bid for the acquisition of Northwestern Utility.

Prepared an analysis of Duquense Light to support an infrastructure fund's bid for the utility. The analysis included projections of growth opportunities through distribution & transmission investment, analysis of the POLR load obligation, and a review of key regulatory issues.

Developed a valuation model of Mirant including analysis of debt carrying capacity to assist a strategic player in the U.S. Power Industry determine whether to make an unsolicited offer to purchase Mirant.

Assisted an international oil company in development of modeling processes and assumptions to support a corporate effort to acquire a fleet of U.S. merchant generating assets.

Support a strategic player in valuing the Lake Road Generation Plant as part of their bid to acquire the asset in a competitive auction. Effort involved projection of future gross margins of the plant, analysis of the ISO-NE Forward Capacity Market, and analysis of transmission constraints.

Directed the valuation of the entire NRG portfolio on behalf of the bank creditors in the NRG bankruptcy hearings. The valuation work included advising on a range of types of generation assets in the U.S. as well as in Europe, South America, and the Asia-Pacific region. Advised on the fairness of offers for assets being disposed of by NRG.

Assisted creditors in the valuation of assets in the NEG bankruptcy including the options for completing unfinished gas-fired generation assets. Served as the interim finance manager for the Lake Road Generation facility.

Member of team that advised Calpine as part of the company's restructuring and plan of reorganization. Assignment included analysis of the Canadian portfolio, advising on the sale of generation assets, modeling of long-term turbine maintenance costs, and the valuation of complex power contract.

Assisted the lenders on valuation and strategy related to AES' turn-back of the Granite Ridge Power Plant to the lender group.

Advised the bank and lender group on valuation and strategy related to the bankruptcy of the Kendall Power Plant.

ASSET APPRAISALS

Prepared a valuation of a large eastern coal plant as a third party appraiser required in a transaction where the lessee wanted to exercise a buy-back provision in a sale lease-back agreement.

Prepared a valuation of a California cogeneration plant for the purposes of identifying the tax loss.

Completed an appraisal to support the transfer of the Trans Bay Cable from the development arm to a separate fund managed by the infrastructure fund. The appraisal addressed the California power markets, operations of the CA ISO high voltage transmission and a forecast of revenues given the FERC and CA-ISO regulatory schemes as part of the income approach. The appraisal also incorporated a comparable sales and replacement cost analysis.

Developed an appraisal of a nuclear power plant based upon discounted cash flow, replacement costs, and comparable sales as part of an effort to determine the fair market value under a lease agreement that contained a buy-back provision.

Completed multiple appraisals of the KeySpan generation assets on Long Island that were subject to a generation repurchase agreement with LIPA. The appraisals were part of the ongoing process for KeySpan to develop a strategy to address the LIPA repurchase option.

ELECTRIC GENERATION FINANCE SUPPORT

Market expert report for the Landfill Energy Systems, a national 66 MW portfolio of fourteen landfill gas power plants. The market expert report included a discussion of the key attributes of each of the power markets that the portfolio encompasses, long-term forecasts of wholesale electricity prices, and forecasts of gross margins.

Independent Market Expert Report to support the financing of the repowering and development of a fleet of combined cycle and simple cycle power plants in the ERCOT market. The independent market expert report was used to support the syndication of loans and obtaining debt ratings associated with investing over \$1 billion in the Barney Davis, Nueces Bay, and Laredo Energy Center facilities.

Independent Market Expert Report to support the financing of Sequent Power's purchase of the Wolf Hollow 730 MW combined cycle power plant located in ERCOT. The report was used to support the syndication and rating of over \$400M of primary and mezzanine debt. The report incorporated forecast of gross margins for both the

contracted and non-contracted portions of the facility as well as providing a detailed description of the ERCOT market conditions and key assumptions to the financial analysis.

Independent Market Expert Report to support the financing of Invenegy's purchase of the partially completed Grays Harbor 620 MW combined cycle power plant located in the Pacific Northwest. The report was used to support the syndication and rating of over \$100M of debt. The analysis included valuing both hedged and unhedged positions for the facility and conducting extensive due diligence regarding how NW power markets are likely to evolve and the role of independent power in a market dominated by vertically integrated public and investor-owned utilities.

Independent Market Report to support the refinancing of the Dynegy corporate revolver. The effort included analysis of multiple U.S. power markets, valuation of the fleet of generation assets and associated contracts, and review of regulatory conditions impacting the Company's ability to realize earnings in markets with competitive auctions to serve load.

Multiple forecasts of California power market prices including support of a bid for a cogeneration facility located in the San Francisco Bay area and sale of La Rosita.

Forecast of the New England power markets to support a bid for the First Light Generation Assets.

Forecast of the California and SPP power markets to support a bid for assets from the EIF portfolio.

Analysis of the ERCOT, PJM and MISO markets for multiple bids for merchant gas fired generation plants.

Development of multiple Confidential Information Memorandums to support the sale of power plants. CIMs included description of the wholesale power markets and summaries of the key attributes of the assets to be sold in auction.

Preparation of sale offering of the Audrain power plant in response to Ameren solicitation to acquire new resources. Effort included evaluation of likely competitors and the development of the bid strategy.

Advise on pricing for offering power contracts as well as the sale of gas-fired combined cycle power plant in the South-East. Pricing and sale price based upon projections of the value of the power plant as a merchant unit, assessment of potential competitors, and the analysis of transmission constraints.

ELECTRIC MARKETS RISK MODELING

Provided support to a bond insurance company to prepare an assessment of the distribution of income from a fleet of peaking power plants in the South-East. Analysis used to review the provision for loss reserves.

Supported a bond insurance agency in determining the probability that a fleet of Mid-West generation assets would generate insufficient cash to meet debt payments and reserve requirements.

Developed an Excel based model for a mid-west public utility to assist in developing annual targets for the amount of surplus generation capacity to be sold as merchant and in contracts of varying tenor. The model was integrated into the corporate financial model to assist in identifying the appropriate risk profile to support building the reserve fund and to delay future rate increases.

DSM ADVISORY SERVICES

Advised Con Edison on the status of electric decoupling and incentive mechanisms in the United States as part of the New York state initiative to reintroduce decoupling.

Advised a private equity fund on the status of demand side management in New England, likely projections of growth, and probability of successful implementation as part of an evaluation of long-term supply and demand conditions in the New England electric markets.

Worked with Montana-Dakota utilities regarding the incorporation of projections of demand side management potential into the utility's long-term resource plan.

Additional experience – Expert Testimony

Before the Arizona Corporation Commission, Direct Testimony of James A. Heidell, Docket No. E-01345A-16-0036 & E-01345A-16-0123 In the Matter of the Application of Arizona Public Service Company. Testimony on behalf of Energy Freedom Coalition of America on cost of service and rate design for rooftop solar customers.

Before the Public Utilities Commission of Nevada, Direct and Rebuttal Testimony of James A. Heidell, Docket No. 16-06006 In the Matter of the Application of Sierra Pacific Power Company, d/b/a NV Energy. Testimony on behalf of Northern Nevada Utility Customers on cost of service and rate design for rooftop solar customers.

Before the Public Service Commission of Maryland, Rebuttal Testimony Of James A. Heidell, Case No. 9173, Phase II In The Matter Of The Current And Future Financial Condition Of Baltimore Gas And Electric Company.

Before the Indiana Utility Regulatory Commission, Rebuttal Testimony in Northern Indiana Public Service Company's request to raise rates in Cause No. 43526. Testimony on behalf of the utility related to ratchets and other mechanisms appropriate to recover costs allocated to large energy using customer classes.

Before Public Service Commission of the State of North Dakota, Direct and Rebuttal Testimony in Montana Dakota Utilities Co., and Otter Tail Corporation; Advance Determination of Prudence, Big Stone II Generating Station Case Nos. PU-06-481 and PU-06-482. On behalf of Montana-Dakota Utilities. 2007 & 2008. On behalf of Montana-Dakota Utilities.

Before the Public Service Commission of the State of Montana, Direct and Rebuttal Testimony in Montana-Dakota's General Rate Case – Marginal Cost of Service Study, Docket No. D2010.8.82. On behalf of Montana-Dakota Utilities.

Before the Public Service Commission of the State of Montana, Direct and Rebuttal Testimony in Montana-Dakota's General Rate Case – Marginal Cost of Service Study, Docket No. D2007.7.79. On behalf of Montana-Dakota Utilities.

Before the Minnesota Public Utilities Commission, Direct and Rebuttal testimony on behalf of Montana-Dakota Utilities regarding a Certificate of Need for the Big Stone II Power Plant, Docket No. CN-05-619. On behalf of Montana-Dakota Utilities.

Before the Ontario Electric Board, Expert Report regarding the 2006 Electric Rate Distribution Handbook and Rate Mitigation, on behalf of Hydro One Networks, Inc. January 2005.

Before the Washington Utilities and Transportation Commission, Direct Testimony in 2004 General Rate Case Regarding Electric Cost of Service & Rate Design and Gas Rate Design, April 2004. On behalf of Puget Sound Energy.

Before the Washington Utilities and Transportation Commission, Direct Testimony in 2001 General Rate Case Regarding Electric Cost of Service & Rate Design, November 2001. On behalf of Puget Sound Energy.

Before the Washington Utilities and Transportation Commission, Testimony Regarding the Need for a Special Competitive Rate for Intel. Docket No. UE-960299, 1996. On behalf of Puget Power.

Before the Washington Utilities and Transportation Commission, Rebuttal Testimony in the Merger of Puget Power and Washington Natural Gas Regarding Electric Rates, Docket Nos. UE-95-1270 & UE-960185, 1995. On behalf of Puget Power.



Mr. Mooren is an energy and utilities advisor who works across the value chain, including the natural gas, power, coal, renewable sectors and energy infrastructure (fuel-generation-transmission-customer). His 15+ years of consulting experience include working with utilities, private equity firms, competitive generators, global corporations, investment banks, financial advisors, and legal advisors on the associated economic opportunities and risks in the global energy markets. Mr. Mooren helps clients navigate through policy, regulatory, market structure, technology, and economic uncertainty to address their business strategy, merger and acquisition, financing, restructuring, litigation, and testimony support needs.

Primary expertise	Related experience	Qualifications	Client list
<ul style="list-style-type: none"> • Energy policy and regulations • Power market economics and operations • Valuation of physical and financial assets 	<ul style="list-style-type: none"> • Gas, power, and coal market dynamics • Litigation support and expert testimony drafting • Regulated and de-regulated energy investment advisory • Merger, acquisition, and financing advisory • Contract negotiations 	<ul style="list-style-type: none"> • B.S. Industrial Engineering 	<ul style="list-style-type: none"> • Electric utilities such as Austin Energy, PNM Resources, Cleco, We Energies, LIPA and NYPA • Competitive generators such as Invenergy and Intergen • Investment banks such as Barclays, RBC, and Citi • Multiple private equity investors such as Highstar Capital, PGGM, and Macquarie

Primary expertise

Energy Policy and Regulations – Matt is experienced in energy policy review, analysis, and guidance. This includes interpreting how existing and potential federal and state policy-making and regulation affect the natural gas, power, coal, and renewable sectors within which regulated companies and assets operate.

Energy Market Economics and Operations – As a core contributor to the development of PA's energy market forecasting models since 2000, Matt maintains an intimate understanding of the fundamentals underlying natural gas, power, and renewable markets. Matt advises clients on the value that may be derived from within the operations of all North American energy markets, including those with regulated (vertically integrated electric utilities and gas utilities) and de-regulated (wholesale power markets) characteristics.

Valuation of Physical and Financial Assets – Matt has extensive experience valuing a wide array of physical and financial energy assets and energy organizations, with extensive experience valuing power generation assets and contracts in particular. Matt has valued over \$75 billion in power generating assets, including the analysis of hydroelectric, pump storage, wind, biomass, geothermal, battery storage, hybrid solar-thermal, cogeneration, nuclear, coal, and natural gas as well as power and fuel contracts, financial hedges, and trading books.

Key client achievements

Private equity firm – Mr. Mooren has been a primary lead for PA as the energy economic advisor of a global private equity firm since 2011. In this role, PA has assessed natural gas, coal, and cogeneration power generation assets for sale and located in New York, PJM, the Midwest ISO, the Carolinas, Southern, Florida, California, and Arizona-Nevada in over a dozen separate engagements- including the regulation, market structure, and market fundamental (including transmission) risks related to natural gas, power, coal, and

renewable sectors. PA has worked with the private equity firm's partner group, senior advisors, investment banking advisors and their credit committees, independent engineers, and legal advisors to help the client complete its due diligence and investment thesis for each opportunity. PA's work has helped the private equity firm close four separate transactions with a cumulative value in excess of \$2 billion. Matt regularly meets with the firm's executives to share its insight and discuss the energy markets, and has facilitated energy market training sessions for the firm's analysts.

Southeast IOU – Matt has led PA as the energy economic advisor for a Southeast U.S. electric utility since 2008. The electric utility faced several challenges including the ownership of a competitive generation business, a shortage of regulated generation supply to meet customer demand, potential opportunities to expand customer base by serving additional municipality or cooperative electric demand, and potential opportunities from integration into the MISO wholesale electricity market.

PA leveraged its regulatory, natural gas, power, coal, transmission, electric utility, and competitive generation business expertise to assess the utility's competitive landscape. The primary focus was on the regulations and fundamentals affecting the electric utilities, non-regulated generators, and associated transmission for Louisiana. Matt facilitated several working sessions with the utility's executive management team and presented to the board of directors. PA's work assisted the utility in establishing a solid foundation for growth. The utility has since reduced their competitive generation exposure, reduced their shortage of regulated generation to meet customer demand, and increased their customer base. The utility won the EEI award for shareholder growth in 2012.

Southwest IOU – Mr. Mooren has led PA as the energy economic advisor of a Southwest U.S. electric utility since 2011. The utility possessed a competitive generation business in Texas which created cash flow, earnings, share price, and credit rating risk to the utility's core business as a regulated electric utility. PA conducted a market opportunity and risk assessment of the Texas wholesale electricity market, as well as a valuation of the electric utility's regulated business and competitive generation assets. PA's work, including executive management and board communication, helped the utility decide to sell the competitive generation business and obtain regulatory approval. The sale simplified Southwest IOU's business and market position.

The electric utility faced federal environmental regulations and low natural gas prices which caused it to consider de-risking from coal within their portfolio of regulated power generation supply. PA helped develop a decision framework. PA then assessed customer impact of a myriad of potential environmental compliance, new build, replacement and acquisition alternatives with the objective of choosing a least cost/lowest risk path, while also considering stakeholder (political, regulator, shareholder, and intervener) requirements. PA's work assisted the Southwest IOU in the development of its strategic roadmap and subsequent steps to execute.

Competitive Generator – Matt has led PA as the energy economic advisor for a Western U.S. competitive generation owner since 2012. In CO, PA helped the competitive generation owner develop a re-contract negotiation strategy, drafted expert testimony, and testified before state regulatory commission. PA also analyzed a CO electric cooperative's supply mix and future electric rates- assuming the client's generators were part of the electric cooperative's generation portfolio- and presented its independent perspective to the cooperative's general manager. PA developed contract re-negotiation and generator divestment strategies for the competitive generation owner's NV assets.

Additional experience

M&A/Finance/Development- typically work with private equity firms- and their finance, legal, tax, and engineering advisors by communicating industry leading investment perspective and overseeing the creation of work products to help make transactions happen;

Business Strategy- typically hired by electric utilities or competitive generation owners to enhance stakeholder value by delivering industry perspective and work products to help them navigate through an uncertain political/regulatory, market structure, market fundamental, and energy economic environment; and

Restructuring/Litigation/Testimony- typically work with lawyers, on behalf of competitive generators or electric utilities, to create strong economic arguments and resolve disputes within regulatory, litigation, and bankruptcy processes.



Mr. Janecek provides a unique blend of commercial consulting and utility planning experience to PA's clients. He has 20 years of experience in the electric power industry through previous positions with an investor-owned utility (IOU) and private consulting firms. As a senior planner with an IOU, he was integral to the process of soliciting, evaluating, and procuring more than 2 GW of generating resource additions to the IOU system, including over 750 MW of wind generation and 80 MW of solar resources. At PA, Mr. Janecek manages resource planning engagements, often focusing on renewable integration issues such as increased fuel and spinning reserve costs, gas storage costs, coal cycling costs, renewable energy standards compliance, and other client-specific issues. He has been an integral component in several energy storage engagements, ranging from procurement assistance to detailed valuations of proposed storage facilities. When advising clients involved in wholesale markets and asset transactions, Mr. Janecek applies experience gained analyzing and facilitating transactions for more than 500 assets. He has modeled every area of the U.S. and Canada, along with many individual control areas within the markets, to support asset valuations, strategic planning initiatives, regulatory proceedings, and litigation proceedings.

Primary expertise	Related experience	Qualifications	Client list
<ul style="list-style-type: none"> • Integrated resource planning • Utility operations • Power market economics and operations • Valuation of physical and financial assets 	<ul style="list-style-type: none"> • Gas, power, and coal market dynamics • Litigation support and expert testimony drafting • Contract negotiations 	<ul style="list-style-type: none"> • B.S. Geology 	<ul style="list-style-type: none"> • Electric utilities such as Xcel Energy, City of Burbank Water and Power, Santee Cooper, Anaheim Public Utilities, Virgin Islands Water and Power Authority

Primary expertise

Integrated Resource Planning – Charles has led several integrated resource planning assignments. The assignments have ranged from detailed scenario planning, fundamental and stochastic-based production cost modeling, dynamic capacity expansion optimization, management and regulatory presentations, and stakeholder engagement support.

Utility Operations – Over the course of his career, Charles has been intimately involved with advising utilities on a wide range of utility operations. He has led solar and wind generation integration analyses, evaluating the impact these intermittent resources have on the operations and dispatch of the balance of system resources. Charles has evaluated the operations of pumped storage hydro resources for their ability to provide ancillary services to a given utility's system as well as the wider markets.

Power Market Economics and Operations – Charles has analyzed and facilitated transactions for more than 500 assets. He has modeled every area of the U.S. and Canada, along with many individual control areas within the markets, to support asset valuations, strategic planning initiatives, regulatory proceedings, and litigation proceedings.

Valuation of Physical and Financial Assets – Charles has conducted detailed dispatch projection analyses for assets located in regional transmission organizations and power markets, as well as bilateral, utility-based markets. He has analyzed hydroelectric, pumped storage, wind, biomass, geothermal, battery storage, hybrid solar-thermal, cogeneration, nuclear, coal, and natural gas as well as power and fuel contracts, financial hedges, and trading books.

Key client achievements

City of Burbank Water and Power – Mr. Janecek led the effort with BWP to quantify the uncertainties BWP faces as it considers the pending shutdown of the Intermountain Power Project. He guided BWP in developing portfolio scenarios for evaluation, then conducting stochastic production cost modeling to quantify the impacts that various resources will have on BWP and its ratepayers. BWP's IRP evaluated a compressed air energy storage (CAES) facility as a potential source of ancillary services for BWP, and Mr. Janecek provided analytical support for that evaluation as well.

Caribbean Island Utility – Mr. Janecek led the development of a comprehensive integrated resource plan for this island utility. A key component of the IRP was the development and production cost modeling of various resource portfolio scenarios. He collaborated with the client to utilize a structured framework for the development of those scenarios, providing a defensible and comprehensive approach toward defining the possible paths for the utility. He then performed production cost modeling to quantify the scenarios including analysis of the system energy and demand requirements, conservation and energy efficiency opportunities, potential fuel infrastructure requirements related to liquefied natural gas and potentially liquid petroleum gas (propane), projected penetrations of distributed solar generation, potential new supply construction of thermal and renewable resources, and potential impacts to the utility's transmission and distribution systems and associated upgrade requirements.

Midwest IOU – Mr. Janecek led several wind integration efforts, working with the IOU's Energy Supply, Commercial Operations, and Resource Planning groups. He performed specialized modeling analyses to quantify the costs for procuring and dispatching intermittent wind resources. He helped design a state-of-the-art wind generation forecasting system in coordination with the National Renewable Energy Laboratory and National Center for Atmospheric Research.

Additionally, Mr. Janecek conducted a multi-year study to identify expected O&M costs related to extensive cycling of coal-fired plants due to wind generation. The study quantified the number of significant ramping events for each coal-fired plant on the system and then applied a cost per cycle to estimate annual cycling costs. These costs were compared to the estimated costs of curtailing the expected wind generation in place of ramping down the coal units.

Commonwealth Utilities Company (CUC), Saipan. - Mr. Janecek managed the development of a new 20-year IRP covering 2015–2038. He worked with CUC system planners to create an energy supply RFP targeted at new supply construction vendors, seeking proposals for new supply options on Saipan. Upon receipt of those proposals, he worked with CUC to evaluate and shortlist the proposals for consideration in the IRP. The engagement also involved working with CUC throughout its stakeholder engagement process to identify community concerns relative to the IRP development and ensure that ultimately the IRP reflected those concerns.

A primary task in this IRP engagement was to parameterize and model each of CUC's generating units and power purchase contracts, as well as other system-level inputs. Production cost modeling was run for a base case model of the CUC system, as well as stochastic scenario modeling (20-year forecasts describing the range of expected values for fuel, fixed operations and maintenance (O&M), and variable O&M). Parameters of various demand-side management measures and demand response programs were evaluated in the scenario modeling.



Jesse is an experienced consultant with expertise in North American energy markets, environmental and energy regulations, and electric power sector modeling. He specializes in modelling and data analytics and has performed financial valuations, long-term fundamental power forecasting, and developed models to evaluate the economics of conventional and renewable energy assets. He also has extensive experience with modelling environmental regulations for thermal generating fleets.

Primary expertise	Related experience	Qualifications	Client list
<ul style="list-style-type: none"> • Analysis • Modelling • Power Forecasting • Environmental Regulations 	<ul style="list-style-type: none"> • Renewables • Coal • Electric power sector modelling • Capacity Markets 	<ul style="list-style-type: none"> • M.A. Economics, North Carolina State University • B.A. Economics, University of Georgia 	<ul style="list-style-type: none"> • Utilities: Hoosier, PSCNH • IPPs: Talen, Diamond, Panda, Indeck • IB: Citi, Goldman, JP Morgan, Wells Fargo

Primary expertise

Analysis – Quantitative and qualitative analysis

Modelling – Creating, verifying, and modifying excel-based models and tools; using and analysing results from fundamental power-sector models including extensive experience with AURORAxmp

Strategy – Market assessment, market forecasting, strategic cost-benefit analysis

Management – Deliverables management and client presentations

Key client achievements

Canadian Pension Plan –Support for acquisition of hydro generating assets in New England including a large pumped storage facility. Developed models to help client understand both energy and ancillary revenue potential for run-of-river and storage assets as well as potential penalty exposure under the ISO-NE pay-for-performance market.

Large merchant generator – Modelling of the ERCOT power market under various environmental scenarios to support asset refinancing. Included detailed modelling of the ERCOT Operating Reserves Demand Curve (ORDC) structure and its evolution over time under various conditions.

Large merchant generator – Developed a fundamental model to identify key investment opportunities for a large merchant power company investing in the Mexican Power market. Worked with client to examine areas of risk, understand the new liberalized power market structure in the Mexican market and develop an investment strategy targeting attractive opportunities in the market.

Private Client– Supported a re-contracting analysis for a client with a large peaking asset in the Southern U.S. Modelled future carbon regulations and the potential impact on the Southern power market and re-contracting potential for the peaking asset.

Large U.S. Railroad- Built a custom model to help client assess the impacts of coal-to-gas switching dynamics and to better understand the impact of the low gas price environment on coal consumption and ultimately rail deliveries.

Various U.S. Investment Banks – Electric power sector modelling support for proposed and existing energy assets including development of long-term fundamental power forecasts, capacity pricing models, RPS modelling and impact analysis from various environmental programs.

Additional experience

Various Speaking Opportunities – Recognized as an expert in environmental policy analysis and fuel dynamics with numerous opportunities to present research findings at industry conferences.

Research Publications– While a member of a leading energy data and analysis firm, personally published numerous white papers on topics including generation investment opportunities, impacts of environmental regulations, renewable energy development and fuel dynamics.

Coal Forecasting – Supported development of an in-house proprietary coal forecasting model for an energy data firm.

Power Forecasting – Responsible for developing a long-term fundamental power and capacity price forecast for a leading energy data and analysis firm to support market analysis and asset valuation for various investment banks and power companies.



Mr. Burmeister is an energy and environmental policy expert skilled in detailed research and analysis. He helps clients easily digest complex policies, regulations, and market structures, and guides analysis of their impact on the value of investments. He provides valuable insight on how political, institutional, and organizational dynamics translate into policy and business outcomes, and understands the nuances of regulatory and organizational frameworks and their application to energy operations. Beyond economic forecasting, Geoff contextualizes investment, operations, and strategy decisions with detailed risk and upside assessment to best inform clients' choices. Geoff helps energy investors navigate complex market, policy, and regulatory environments. He is conversational in French and Pulaar.

Primary expertise	Related experience	Qualifications	Client list
<ul style="list-style-type: none"> Wholesale power market dynamics Environmental policy and regulation Generator contracting and recontracting analysis Litigation and regulatory proceeding support 	<ul style="list-style-type: none"> Risk Analysis Economic forecasting Utility business, regulatory, and stakeholder engagement strategy 	<ul style="list-style-type: none"> MBA, Ross School of Business, University of Michigan MS, Environmental Policy, University of Michigan BA, Political Science and International Development, Tulane University 	<ul style="list-style-type: none"> Southwest Generation Operating Company Axiom Infrastructure PPL Bank of America Merrill Lynch

Primary expertise

Wholesale Power Market Dynamics - Geoff actively tracks and analyzes developments in wholesale energy and capacity markets, informing client decisions on price movements related to their investments and strategy.

Environmental Policy and Regulation – Geoff advises clients through quantitative and qualitative assessments of policy and regulatory impacts on power infrastructure, and how political dynamics at the federal, state, and local level translate into policy outcomes.

Generator Contracting and Recontracting Analysis – Geoff utilizes an investment thesis framework to assess the value potential and risks associated with power infrastructure investments in vertically-integrated markets.

Litigation and Regulatory Proceeding Support – Geoff applies a unique critical lens to proceedings and can condense complex analysis and arguments into a coherent strategy to best support clients' interests.

Key client achievements

Southwest Generation Operating Company – Regulatory proceeding support - PA provided expert testimony in a vertically-integrated utility Electric Resource Planning proceeding in support of reform to methodology used to determine the level of flexible capacity reserves that the utility must hold to manage variability in wind generation. Geoff performed legal and regulatory analysis in support of this expert testimony.

Infrastructure Fund: Buy-side support - PA provided buy-side support for a 480 MW portfolio of natural gas-fired generation assets in Ontario, Canada. Geoff led a detailed analysis of the market structure and policy and regulatory environment, and performed an assessment of the portfolio assets' recontracting prospects.

Unregulated Utility Subsidiary: Transmission investment support - PA provided strategic investment support on five merchant, high-voltage DC transmission lines under development across the US. Geoff spearheaded an overview of the merchant transmission market, analysis of risks related to development, contracting, and financing, and identification of investment best practices.



Spencer recently received a Bachelor of the Arts Degree in Political Science with minors in Business and Leadership from the University of Colorado Boulder. He graduated Summa Cum Laude for his honors thesis focusing on the factors impacting adoption and implementation of Renewable Portfolio Standards across the United States. He has internship experience on a variety of levels of government including the city, state and federal levels. His work experience includes projects dealing with energy, policy, process improvement, and efficiency. Spencer has a particular interest in renewable energy and hopes to use his professionally proficient Spanish level to work on projects in Mexico and Latin America in the future.

Primary expertise	Related experience	Qualifications	Client list
<ul style="list-style-type: none"> • Renewable Portfolio Standards • Spanish language proficiency • Volatility and Stochastic modeling 	<ul style="list-style-type: none"> • Interned for Congressman Perlmutter in 2015 evaluating the nuclear deal with Iran. • Created a baseline performance analysis for the State of Colorado in 2016. 	<ul style="list-style-type: none"> • Graduated Summa Cum Laude with Distinction from the University of Colorado Boulder with a Bachelor of the Arts in Political Science and minors in Business and Leadership in 2016. 	<ul style="list-style-type: none"> • Invenergy LLC • InterGen Energy Inc. • Tyr Energy Inc. • Puerto Rico Electric Power Authority • Axium

Primary expertise

Renewable Portfolio Standards – Received ‘Highest Honors’ for undergraduate thesis evaluating the factors impacting the adoption and implementation of these state policies.

Spanish Language – Studied in Barcelona, Spain and Cusco, Peru for 6 months, earning the ‘High Intermediate’ language proficiency level.

Key client achievements

Tyr Energy Inc. - Analyst.

Spencer led extensive analysis on market prices and asset performance in the PJM ISO to provide insights to the client that can guide future operations and investment strategies.

Axium - Analyst

Spencer worked on forecasting market metrics and asset performance for two power plants in Ontario, Canada to provide insights to the client that can guide future operations and investment strategies.

Invenergy LLC - Analyst

Spencer prepared market analysis and pricing forecasts for a client with assets in the NorthWestern United States. This insight can help the client in making decisions about future operations and investment strategies.

A registered professional engineer with over 25 years of experience in the engineering field, Mr. Markell has an extensive background in power generation, biofuels, and independent engineering services. As an independent engineer, he has a thorough knowledge of project design, contracting, construction, and operations and maintenance. He has lead and/or been involved in the review of technologies including, but not limited to: coal, combined and simple cycle, cogeneration, landfill gas, nuclear, hydro, geothermal, wind, solar, ethanol, cellulosic ethanol, biodiesel, gasification, waste to energy, and biomass. Mr. Markell has been involved with over 45,000 Megawatts ("MW") of power generation facilities and biofuels facilities with a combined capacity of over 2 billion gallons per year.

Primary expertise	Related experience	Qualifications
<ul style="list-style-type: none"> • Independent Engineering Reviews • Project Finance • Liquidated Damages Analysis • Contract Analysis • Steam Turbine Design • Construction Budgets and Schedules • Ethanol Plant Design • Construction Management • Power Plant Design • Performance Testing and Test Protocols • Gas Turbine Technology • Plant Operations and Maintenance • Turbine Control Systems • Expert Witness Services 	<ul style="list-style-type: none"> • Expert Witness • Renewable Energy – Wind, Solar, Hydro, Biomass, Other Renewable Technologies • Traditional Power – Coal, Natural Gas (Combined Cycle and Simple Cycle), Reciprocating Engines • Biofuels • Design – Steam Turbine Designs, Turbine Controls Retrofits 	<ul style="list-style-type: none"> • MS (Mechanical Engineering), Union College • BS (Mechanical Engineering), Rochester Institute of Technology • Member of the American Society of Mechanical Engineers • Professional Engineer (Colorado)

Primary expertise

Expert Witness

Engages by Eagle Valley Clean Energy as an expert witness of litigation involving a construction and performance dispute with the EPC Contractor, Wellons, Inc. vs. Eagle Valley Clean Energy

Engaged by the US Department of Justice as an expert witness for litigation involving a Section 1603 application for an open-loop biomass project, Meadwestvaco Virginia Corp. vs. United States

Engaged by the US Department of Justice as an expert witness for litigation involving a Section 1603 application for an open-loop biomass project, GUSC Energy, Inc. vs. United States

Engaged by the US Department of Justice as an expert witness for litigation involving a Section 1603 application for Fuel Cells, RP1 Fuel Cell, LLC and UTS SJ-1, LLC vs. United States

Engaged by the US Department of Justice as an expert witness for litigation involving a Section 1603 application for an open-loop biomass project, W.E. Partners II, LLC vs. United States

Provided testimony to the Colorado PUC regarding the potential acquisition of an aging combined cycle facility to be incorporated into the Colorado rate base.

Provided testimony to the Colorado PUC regarding the Clean Air Clean Jobs Act evaluating the retirement of 900MW of coal facilities in Colorado.

Engaged to provide expert witness support for litigation relative to an 800 ton per day, 22MW waste to energy project in Harrisburg, Pennsylvania. Case settled out of court.

Engaged to provide expert witness support for litigation relative to the construction of a 5 MGY biodiesel facility in Sante Fe Springs, California. Case settled out of court.

Traditional Power

Coal

Independent engineering review of a 300 MW pulverized coal plant in Panama including a detailed analysis of the performance, design, and O&M requirements.

Independent engineering review of a 160 MW pulverized coal unit in Colombia including a detailed analysis of the performance, design, and O&M requirements.

Independent engineering review of a 650 MW ultra-supercritical coal unit in Morocco with an emphasis on the evaluation of the plant performance.

Independent engineering review of a 1,000 MW supercritical coal unit in Malaysia.

Independent engineering review of construction modifications including verification of the specification and system performance testing of a 500 MW lignite plant in Ackerman, Mississippi utilizing Alstom CFB boilers. The project is a mine mouth facility.

Independent engineering review of a 50 MW waste to energy facility, landfill, and the mining of lignite to support the facility in Haiti.

Independent engineering review of the O&M for a 363 MW coal facility and potential repowering options located in Wales, UK.

Independent engineering review to support the Colorado Public Utilities Commission's review of Colorado's Clean Air, Clean Jobs legislation and the utilities' plan to retire 900 MW of coal facilities. Including a review of scrubber and NOx reduction retrofit options and installation costs.

Independent engineering review of a 300 MW pulverized coal unit in Springerville, Arizona including a detailed analysis of the performance, mechanical design, and material handling systems.

Annual Operations and Maintenance review of 280 MW pulverized coal facility in Roanoke Valley, North Carolina utilizing wet and dry scrubber units.

Technology review for the replacement of an existing coal facility in Ohio with an integrated coal gasification facility.

Technology review for a 200,000 ton per year coking facility utilizing Chinese technology for implementation in Colombia.

Natural Gas (Combined Cycle and Simple Cycle)

Independent Engineering review for a 1,000 MW combined cycle plant utilizing Siemens SGT6-8000H technology in Maryland.

Independent engineering review for a 1,000 MW combined cycle plant utilizing GE 7FA.05 technology in Dover, New York.

Independent engineering review of a portfolio of nine simple-cycle facilities with a combined capacity of approximately 250MW in California. These plants exported steam for enhanced oil recovery and utilized GE LM2500 and LM5000 technology.

Technology review and support for 2,600MW portfolio of combined cycle and simple cycle facilities located in California utilizing GE 7FA and Pratt & Whitney FT4 technologies.

Technology review and development support for a 100MW simple cycle facility to potentially utilize LM6000, LMS100, or TM2500 units near Panama City, Panama.

Independent engineering review of a 45MW cogeneration facility utilizing LM5000 technology in Binghamton, New York.

Independent engineering review of 60MW combined cycle facility utilizing GE Frame 6 technology in Castleton, New York.

Independent engineering review of a 120MW combined cycle facility providing 3 million gallons of desalinated water per year in Karachi, Pakistan.

Condition assessment and useful life evaluation of 213MW combined cycle facility utilizing W251AA technology in Brush, Colorado.

Independent engineering review to support the investment in a 1,000 MW combined cycle facility utilizing GE 7FA.05 technology in Dover, New York.

Annual Operations and Maintenance review for two combined cycle units with a combined capacity of over 500MW located in Freeport, Texas and Mankato, Minnesota.

Independent engineering review for the refinancing of a 300MW peaking facility utilizing GE 7FA technology in Aurora, Colorado.

Independent engineering review, construction monitoring, performance test monitoring, and the subsequent refinancing for a 325MW cogeneration facility in Freeport, Texas and a 375MW combined cycle facility in Mankato, Minnesota utilizing Siemens 501F technology.

Independent engineering review of a 570 MW combined cycle uprate located in Waco, Texas.

Independent engineering review of the construction of an 875MW combined cycle facility in Brampton, Ontario utilizing GE 7FB technology.

Independent engineering review of a 1,000MW combined cycle facility in Ontario, Canada utilizing Siemens 501F technology.

Independent engineering review of a 120MW cogeneration facility in King City, California utilizing GE 7EA technology.

Independent engineering review of a portfolio of landfill gas facilities utilizing various reciprocating engine technologies.

Construction monitoring and performance testing of a 1050MW combined cycle facility in Fairfield, Texas utilizing GE 7FA technology.

Construction monitoring and performance testing for two 725MW combined cycle facilities in Decatur, Alabama utilizing Siemens 501F technology.

Performance test monitoring for a 720MW combined cycle facility in Hudson, Colorado utilizing Siemens 501F technology.

Performance test monitoring for a 630MW combined cycle cogeneration facility in Columbia, South Carolina utilizing GE 7FA technology.

Independent engineering review, construction monitoring, and performance test monitoring of a 300MW peaking facility in Aurora, Colorado utilizing GE 7FA technology.

Annual Operations and Maintenance review of a portfolio of combined cycle projects owned and operated by Calpine.

Operations and Maintenance review of the MACH Gen facilities utilizing 501G technology.

Independent engineering review, construction monitoring, and performance test monitoring of nine (9) peaking facilities in California utilizing GE LM6000 technology.

Operations and maintenance review for 530MW of power facilities in and around Anchorage, Alaska utilizing various gas turbine technologies.

Independent engineering review of 150MW cogeneration facility in Fort St. John, British Columbia utilizing Westinghouse W251 technology.

Development support for a 100 MW simple cycle facility in Panama utilizing LMS100 technology.

Reciprocating Engines

Owner's engineering support of the development of two 500 kW facilities utilizing Caterpillar engines in St. Croix.

Independent engineering review of a 12 MW cogeneration facility located in New York, New York utilizing Caterpillar engines supporting the production of approximately 60 tons of ice per day.

Owner's engineering support of the development of an 18 MW facility utilizing Jenbacher engines in Newport News, Virginia.

Owner's engineering support for the development of a project in Panama to potentially use Jenbacher J920 engines.

Independent engineering review of a number of heavy fuel oil facilities in Saipan including a review of the technical performance and the O&M.

Independent engineering review of a portfolio of reciprocating engine facilities in California ranging in size of less than 1 MW to over 6 MW utilizing Jenbacher engines to burn biogas.

Renewable Energy

Wind

Independent engineering review of 228 MW facility utilizing Gamesa G80, G87, and G90 technology in Oaxaca, Mexico.

Independent engineering review of 100 MW facility utilizing Enercon E92 technology in Quebec, Canada.

Independent engineering review of 100 MW facility utilizing Vestas V82 technology near North Powder, Oregon.

Independent engineering review of 200 MW facility utilizing Gamesa G87 technology near Abilene, Texas.

Independent engineering review of 100 MW facility utilizing Vestas V82 technology near Austin, Minnesota.

Independent engineering review of 100 MW facility utilizing Vestas V100 technology near Payne, Ohio.

Independent engineering review of 200 MW facility utilizing Vestas V82 technology near Bloomington, Illinois.

O&M and technology review of 125 MW facility utilizing Clipper Liberty 2.5MW technology located in Cohocton, New York

O&M and technology review of 30 MW facility utilizing GE 1.5sle technology on the island of Maui, Hawaii.

O&M and technology review of 42 MW facility utilizing GE 1.5sle technology in Aroostook County, Maine.

O&M and technology review of 35 MW facility utilizing Clipper Liberty 2.5MW technology in Lackawanna, New York.

O&M and technology review of 57 MW facility utilizing GE 1.5sle technology in Washington County, Maine.

Independent engineering review and construction completion certification of 38MW facility utilizing Nordex N90 technology in Cambria County, Pennsylvania.

Independent engineering review of 73 MW facility utilizing Nordex N100 technology in Cambria County, Pennsylvania.

Independent engineering review of 51 MW facility utilizing Repower technology in Howard, New York.

Independent engineering review and construction monitoring of a 22 MW facility utilizing GE 1.6xle technology located in Glens Ferry, Idaho

Independent engineering review and construction monitoring of two 1.0 MW community wind facilities in California utilizing GE 1.5xle technology.

Independent engineering review of a 150 MW facility utilizing Vestas V90 technology in Alta, California.

Independent engineering review and construction monitoring for a 6 MW facility utilizing GE 1.5sle technology located in Aberdeen, Washington.

Independent engineering review of a 24 MW wind generation in Tehachapi, California utilizing Vestas technology.

Solar

Independent engineering review/site inspection of a portfolio of seven PV facilities ranging from 3MW to 6MW in North Carolina utilizing Astronergy modules and Eaton inverters.

Independent engineering review of a 5MW PV facility in Henderson, North Carolina utilizing Silvantis modules and SMA inverters.

Independent engineering review of a 5MW PV facility in Fair Bluff, North Carolina utilizing Silvantis modules and SMA inverters.

Independent engineering review of a 5MW PV facility in Shannon, North Carolina utilizing Silvantis modules and SMA inverters.

Independent engineering review of a 5MW PV facility in Chadbourn, North Carolina utilizing Silvantis modules and SMA inverters.

Independent engineering review of a 5MW PV facility in New Bern, North Carolina utilizing Canadian Solar modules and Eaton inverters.

Independent engineering review of two, 5MW PV facility in Newton, North Carolina utilizing Canadian Solar modules and inverters from Eaton and SMA.

Independent engineering review of a 5MW PV facility in Marshville, North Carolina utilizing Canadian Solar modules and SMA inverters.

Independent engineering review of a 5MW PV facility in Burlington, North Carolina utilizing Canadian Solar modules and Eaton inverters.

Independent engineering review of a 5MW PV facility in Warsaw, North Carolina utilizing Canadian Solar modules and Eaton inverters.

Independent engineering review of a 5MW PV facility in Randleman, North Carolina utilizing Trina modules and SMA inverters.

Independent engineering review of a 5MW PV facility in Monroe, North Carolina utilizing Canadian Solar modules and SMA inverters.

Independent engineering review of a 5MW PV facility in Willow Springs, North Carolina utilizing Trina modules and TMEIC inverters.

Independent engineering review of annual O&M for a PV (2.5 MW) facility in Casa Grande, AZ utilizing Suntech modules with inverters from Satcon and Advanced Energy.

Independent engineering review of a 75MW CPV facility utilizing Amonix technology to be located in South Africa.

Independent engineering review and construction monitoring of a 3MW PV facility utilizing Chinese technology located in Orange, Massachusetts.

Independent engineering review of a portfolio of PV (10MW) and LFG (12MW) facilities throughout the US.

PUBLICATIONS / PRESENTATIONS / PATENTS

"Managing Technical and Resource Risk" – presented at Infocast Project Finance Tutorial Fall 2013.

"Managing Technical Risk on Thermal Generation Projects" – presented at Infocast Project Finance Tutorial Fall 2012 and Spring 2013.

"Biomass: Risk Mitigation" – presented at Infocast Project Finance Tutorial: 2011

"Is a Power Plant Shortage Looming" – published Greentech Media 2010

"Natural Gas Poised for Bigger Development" – published Denver Business Journal 2010

"The Energy Puzzle – How the Utility Industry Can Put the Pieces Together" – published epOverviews 2010

"Turbine Control Retrofits: Why, How, What and When" – presented at Power-Gen 2003

"Quality Assurance of Surface Treatments by Analysis of Substrate Surface Line Traces" – Patent for GE 1993

Pieter Mul

Principal Consultant



Mr. Mul is a Principal Consultant in PA Consulting Group's Energy and Utilities Practice and advises clients on energy market fundamentals and asset value drivers. He has a decade of transactional and analytical experience in energy markets, with expertise in the economics of electricity markets and market design. Prior to joining PA, Pieter was a member of MISO's Independent Market Monitor evaluating market outcomes and identifying market manipulation. Pieter holds a BA in Economics from Davidson College.

Primary expertise

- Energy economics
- Market monitoring
- Market design
- Renewable project finance

Related experience

- Financial modeling
- Energy policy

Qualifications

- B.A. Economics, Davidson College

Client list

- Private equity firms
 - Utilities
 - Independent Power Producers
-

Primary expertise

Energy Economics – Pieter has more than 10 years of transactional and analytical experience in global power markets and possesses broad knowledge of its drivers and trends. Pieter advises clients on power market fundamentals and value drivers, market structure and the investment risks and opportunities of North American power markets within the contexts of merger and acquisitions, litigation and testimony, and strategic guidance.

Electricity Market Design – Pieter has subject matter expertise in the design and operations of wholesale electricity markets, and has frequently authored reports and testimony identifying market flaws and recommending improvements.

Electricity Market Monitoring – While at the independent market monitor for MISO, NYISO, ISO-NE and ERCOT markets, Pieter designed software for monitoring the operations and performance of regional electricity markets and identifying attempts at market manipulation.

Renewable Project Finance – Pieter has a deep understanding of renewable project finance and worked on legal transactions for a global law firm, with emphasis on tax equity wind projects in North America.

Key client achievements

Independent Power Producers – Pieter has led and supported dozens of PA engagements with utility and Independent Power Producer purchases, sales, and developments of power plants across North America. Pieter helps clients identify and understand investment risks and value drivers associated with their projects, including the potential impact of commodity, market structure and regulatory changes.

Utilities – Pieter has led numerous utility strategy engagements helping clients assess and value PPA recontracting opportunities in regulated markets.

Wind Developer – Pieter led a PA engagement with a wind developer that sought to quantify their exposure to PJM's Capacity Performance market construct. Through PA's analysis, the client was able to successfully arrange and price an indemnity with an insurer for the performance risk associated with their project.



Dr. Loeb is an Analyst in PA's Global Energy & Utilities practice. He has experience in the design, development, production and evaluation of energy storage, alternative fuel production and water purification technologies. Dr. Loeb has experience in numerical modeling, process intensification, new technology evaluation and managing multi-disciplinary teams. He holds a B.S. in Chemical Engineering from the University of Wisconsin-Madison and a Ph.D. in Chemical Engineering from Oregon State University.

Primary expertise	Related experience	Qualifications	Client list
<ul style="list-style-type: none"> • Renewable and alternative energy • Technology evaluation • Numerical modeling • Natural gas pipeline supply and analysis 	<ul style="list-style-type: none"> • Engineering technology consulting • Alternative fuel technology research • Market and business research • Power market modeling 	<ul style="list-style-type: none"> • Ph.D. Chemical Engineering • B.S. Chemical Engineering 	<ul style="list-style-type: none"> • Private equity firms • Utilities • Independent Power Producers

Primary expertise

Renewable and Alternative Energy – Chris has supported and led research and development projects related to renewable energy, alternative fuel production and energy storage. His research has focused on improving efficiency in fuel production, lowering energy requirements to produce desalinated water, and improving gas storage capacities in solid systems.

Technology Evaluation – Chris has experience in technology evaluation and multiple stages of development and analysis. During his time at Oregon State University, Chris helped with various oversight projects evaluating the progress of technology development and proposal writing for projects capable of progressing.

Numerical Modeling – Chris has performed numerical modeling to characterize complex engineering systems, cost analysis, performance evaluation/optimization and power market forecasting.

Natural Gas Pipeline Supply and Analysis – Chris has performed natural gas pipeline supply and constraint analyses to identify potential asset related constraints.

B EXAMPLE PRE-FILED TESTIMONY

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO

IN THE MATTER OF THE APPLICATION OF)
PUBLIC SERVICE COMPANY OF COLORADO)
FOR APPROVAL OF ITS 2016 ELECTRIC)
RESOURCE PLAN)

Docket No. 16A-0396E

ANSWER TESTIMONY OF MATTHEW MOOREN

ON

BEHALF OF

SOUTHWEST GENERATION OPERATING COMPANY, LLC

DECEMBER 9, 2016

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF COLORADO**

**IN THE MATTER OF THE APPLICATION OF)
PUBLIC SERVICE COMPANY OF COLORADO)
FOR APPROVAL OF ITS 2016 ELECTRIC)
RESOURCE PLAN) Docket No. 16A-0396E**

ANSWER TESTIMONY OF MATTHEW MOOREN

INTRODUCTION

1 **Q. PLEASE STATE YOUR NAME, BUSINESS TITLE AND BUSINESS ADDRESS.**

2 A. My name is Matthew Mooren. I am a Member of the Management Group at PA Consulting
3 Group, Inc. ("PA"). My business address is 1700 Lincoln Street, Suite 1550, Denver,
4 Colorado.

5 **Q. PLEASE SUMMARIZE YOUR QUALIFICATIONS.**

6 A. I have over 15 years of energy industry experience. I am a North American power and utilities
7 advisor at PA specializing in areas such as market analytics, resource planning, and investment
8 decision-making. I routinely advise clients on energy sector investments, helping them
9 understand and quantify the impact of market and regulatory uncertainty. I hold a B.S. in
10 Industrial Engineering from the University of Wisconsin-Madison. I have included a Statement
11 of Qualification as **Exhibit MM-1**.

12 **Q. PLEASE DESCRIBE PA CONSULTING GROUP AND ITS EXPERIENCE WITH
13 ELECTRICITY MARKETS?**

14 A. PA is an independent global consulting, technology and innovation firm employing
15 approximately 2,500 people from offices across the Americas, Europe, the Nordics, and the

1 Gulf. PA's experience in the U.S. energy industry is extensive, spanning two decades, and
2 includes providing clients with electricity market analysis and modeling. We have over 30 staff
3 in our downtown Denver, Colorado office that are focused on helping our clients understand
4 and quantify the impact of market fundamental, market structure and regulatory changes to
5 enhance decision-making in the energy sector.

6 **Q. ON WHOSE BEHALF ARE YOU TESTIFYING IN THIS PROCEEDING?**

7 A. I am testifying on behalf of Southwest Generation Operating Company, LLC ("Southwest
8 Generation").

9 Southwest Generation is an independent power producer headquartered in Denver, Colorado.
10 Southwest Generation owns and operates eight natural gas-fired power generating facilities
11 throughout the western United States, including three in Colorado of which two are currently
12 under contracts with Public Service Company of Colorado ("PSCo"). Two of the three
13 facilities, Arapahoe and Valmont, are co-located with PSCo-owned facilities.

14 Southwest Generation's Valmont simple-cycle power generating facility (located in Boulder)
15 provides 80 MW of summer-rated capacity. Valmont consists of two 40 MW General Electric
16 ("GE") LM6000 simple-cycle aeroderivative turbines. The Valmont facility can start up
17 quickly, within 15 minutes.

18 Southwest Generation's Arapahoe combined-cycle power generating facility (located in
19 Denver) provides 119 MW of summer-rated capacity. Arapahoe consists of two 40 MW GE
20 LM6000 natural gas aeroderivative combustion turbines, two heat recovery steam generators
21 with supplemental firing, one steam turbine and Selective Catalytic Reduction ("SCR")
22 emissions controls. The Arapahoe facility can start up quickly, within 15 minutes.

1 Southwest Generation's Fountain Valley simple-cycle power generating facility (located near
2 Colorado Springs) provides 240 MW of summer-rated capacity. Fountain Valley consists of
3 six 40 MW GE LM6000 simple-cycle aeroderivative turbines. Fountain Valley can start up
4 quickly, within 15 minutes.

I. PURPOSE OF TESTIMONY AND BACKGROUND

5 **Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY?**

6 A. The purpose of my testimony is to summarize my analysis and review of PSCo's 2016 Electric
7 Resource Plan ("2016 ERP"), the 2016 ERP's supporting documentation and the direct
8 testimony of PSCo's witnesses—specifically focusing on PSCo's studies of Flex Reserves on
9 the PSCo system.

10 **Q. CAN YOU PLEASE SUMMARIZE YOUR FINDINGS?**

11 A. Based on my analysis of PSCo's actual system wind data and the Flex Reserve requirements
12 studies, I conclude the following:

- 13 • The dataset underlying PSCo's Flex Reserve requirement only uses 12 months of
14 historical information. This dataset is insufficient to cover the full variability of wind on
15 the system, as it **excludes** large known downward wind ramping events outside of the
16 12 month timeframe. This is discussed in Section II.
- 17 • Based on my analysis of historical wind generation data, PSCo should revise its Flex
18 Reserves requirement to account for large events that have occurred on the system, but
19 that are not covered within the current studies. Accounting for these events would
20 increase the Flex Reserve requirement.

- 1 • PSCo should require that Flex Reserves be able to reach full load within 15 or 20
2 minutes versus the current 30 minute requirement, in recognition that the majority
3 (more than 90%) of large 30 minute downward wind ramping events can occur within
4 the first 15 to 20 minutes based on historical observations on the PSCo system. This is
5 discussed in Section III.

- 6 • Based on these analyses, I concluded that PSCo does not have enough 20 minute Flex
7 Reserves to maintain system reliability to address downward wind ramping events
8 currently, and will not have enough 20 minute Flex Reserves when the Rush Creek
9 wind facility comes online in 2018. At a minimum, the current PSCo system needs
10 between 92 MW and 433 MW of additional 20 minute Flex Reserves, and once Rush
11 Creek comes online PSCo will need between 207 MW and 618 MW of additional 20
12 minute Flex Reserves. This is discussed in Section IV.

13 **II. PSCO DOES NOT HAVE ENOUGH FLEX RESERVES TO RELIABLY MANAGE**
14 **DOWNWARD WIND RAMPING EVENTS**

15 **Q. WHAT ARE FLEX RESERVES?**

16 A. Flex Reserves are a supplemental reserve category designed to address downward wind
17 ramping events that are not caused by system curtailments.

18 **Q. WHAT ARE DOWNWARD WIND RAMPING EVENTS, AND WHAT ARE THEY**
19 **CAUSED BY?**

20 A. Downward wind ramping events represent a sudden loss of wind generation on the system.
21 There are a number of causes of downward wind ramping events, but the two principal reasons

1 are (i) a sudden loss of wind speed (i.e. the wind dies down), or (ii) a high wind speed event
2 (i.e. the wind is blowing too fast) that causes wind generation to trip offline.

3 These types of events present risks to maintaining reliability of the power system and the
4 electric service to the ratepayers within it.

5 **Q. WHY ARE WIND CURTAILMENTS NOT CONSIDERED DOWNWARD WIND**
6 **RAMPING EVENTS?**

7 A. A wind curtailment is the reduction of a wind facility's generation by a system operator to
8 levels below what the facility would otherwise be able to provide the system. In other words,
9 despite the fact the wind is blowing, the system operator is preventing the wind facility from
10 generating electricity. Curtailments improve system reliability by providing system operators
11 with a tool to appropriately balance generation with demand. In contrast, downward wind
12 ramping events are reductions in generation that are uncontrolled by system operators.

13 **Q. DO DOWNWARD WIND RAMPING EVENTS PRESENT A RELIABILITY RISK TO**
14 **POWER SYSTEMS?**

15 A. Yes. Downward wind ramping events can result in active power imbalances where the demand
16 for power is greater than the generation of power in real-time. In these types of situations, the
17 system operator must start up reserve generation to prevent system blackouts and/or
18 brownouts. Typically this reserve generation is composed of quick-start resources that are able
19 to respond to downward wind ramping events flexibly and efficiently.

1 **Q. DO DOWNWARD WIND RAMPING EVENTS PRESENT A SIGNIFICANT**
2 **RELIABILITY RISK TO THE PSCO SYSTEM SPECIFICALLY?**

3 A. Yes. Colorado is an international leader in wind generation. PSCo has one of the highest wind
4 concentration levels (defined as the percentage of installed wind capacity divided by system
5 peak demand) of any power system in the United States. In the summer of 2016, PSCo had a
6 wind concentration level of approximately 38.8% (2,566 MW of installed wind capacity¹
7 divided by 6,620 MW of system peak demand²). Moreover, PSCo plans to add an additional
8 600 MW of wind generation from the Rush Creek facility in 2018. All else equal, the higher
9 the wind concentration level the higher the reliability risk to the power system from downward
10 wind ramping events.

11 As Colorado continues its commitment to add wind and other forms renewable generation to
12 the system, it is important that the generation resource mix is configured in a way to maintain
13 system reliability. Flex Reserves will be an important system need to maintain system
14 reliability for Colorado energy customers.

15 **Q. HAS PSCO STUDIED THE NEED FOR FLEX RESERVES AND THE AMOUNT OF**
16 **FLEX RESERVES NEEDED?**

17 A. Yes. PSCo analyzed the need for flexible reserves to manage downward wind ramping events
18 and developed a reserve guideline in its 2011 Wind Limits Study (the “2011 Wind Study”) that
19 was filed on October 31, 2011, as Attachment 2.14-1 to the Volume II Technical Appendix of

¹ Installed wind generation capacity includes wind generation capacity that is owned or contracted by PSCo.

² 2016 system peak demand was obtained from the 2016 forecasted base summer native load peak demand in Volume 2 of the 2016 ERP (page 2-27).

1 PSCo's 2011 Electric Resource Plan in Docket 11A-869E. This reserve guideline was the
2 precursor to the current Flex Reserves requirement.

3 PSCo has released two additional studies examining the level of need for Flex Reserves: (i) the
4 30-Minute Flex Reserve on the Public Service Company of Colorado System (the "2016 Flex
5 Study"), filed on May 31, 2016, as Attachment 2.13-3 to Volume 2 of PSCo's 2016 ERP in
6 Docket 16A-0396E; and (ii) the An Expanded Study of 30-Minute Flex Reserve on the Public
7 Service Company of Colorado System (the "Expanded 2016 Flex Study"), originally filed on
8 June 20, 2016, as Attachment JTW-3 to the Supplemental Direct Testimony and Attachment of
9 John T. Welch in Docket 16A-0117E, and is also included as Attachment DTB-1 in the
10 Supplemental Direct Testimony and Attachment of Drake T. Bartlett, filed on November 15,
11 2016, in Docket 16A-0396E.

12 **Q. WHAT TYPE OF RESERVE GENERATION CURRENTLY QUALIFIES FOR FLEX**
13 **RESERVES?**

14 A. Flex Reserves can currently consist of (i) offline capacity that can start up quickly, (ii) excess
15 Contingency Reserve capacity, and (iii) greater than 10 minute ramp capacity from
16 online/unloaded generation.

17 However, from a system planning perspective, according to PSCo only offline capacity "*is*
18 *easily quantifiable without a detailed analysis of current system conditions which are*
19 *constantly in flux.*"³ As such, the Flex Reserve requirement is set by the amount of offline
20 capacity that can start up quickly.

³ Page 2 of the Expanded 2016 Flex Study.

1 **Q. HOW HAS PSCO'S VIEW OF THE AMOUNT OF FLEX RESERVES NEEDED**
2 **CHANGED BETWEEN THESE STUDIES?**

3 A. With the release of each study, the amount of Flex Reserves that PSCo claims it needs to
4 address downward wind ramping events has increased (See Table 1 for a summary of the
5 studies' findings):

- 6 • The 2011 Wind Study concluded (Page 14) that PSCo would need approximately 392 MW
7 of flexible reserves based on over 2,100 MW of installed wind generation capacity that
8 was expected to be on the system by the end of 2012.
- 9 • The 2016 Flex Study (Page 3) concluded that PSCo would need 708 MW of Flex Reserves
10 based on 2,566 MW of installed wind generation capacity on the system (the current
11 amount of wind on the PSCo system).
- 12 • The Expanded 2016 Flex Study (Page 8) concluded that PSCo would need (i) 824 MW of
13 Flex Reserves based on 2,566 MW of installed wind generation capacity on the system, (ii)
14 939 MW based on 2,974 MW of installed wind generation capacity on the system, (iii)
15 1,014 MW based on 3,174 MW of installed wind generation capacity on the system, and
16 (iv) 1,218 MW to 1,662 MW based on 4,174 MW of installed wind generation capacity on
17 the system.

1

Table 1: PSCo View of Flex Reserves Needed by Study

PSCo Study	Installed Wind Generation Capacity (MW)	Max Flex Reserves Required (MW)	Max Flex Reserves per Installed Wind Generation Capacity (%)
2011 Wind Study	2,100	392	18.7%
2016 Flex Study	2,566	708	27.6%
Expanded 2016 Flex Study	2,566	824	32.1%
Expanded 2016 Flex Study	2,974	939	31.6%
Expanded 2016 Flex Study	3,174	1,014	31.9%
Expanded 2016 Flex Study	4,174	1,218-1,662	29.2-39.8%

2 **Q. ONCE RUSH CREEK COMES ONLINE IN 2018, HOW MUCH INSTALLED WIND**
3 **CAPACITY WILL PSCO HAVE ON ITS SYSTEM?**

4 **A.** Approximately 2,974 MW.⁴

5 **Q. ACCORDING TO PSCO HOW MUCH FLEX RESERVES WILL THEN BE NEEDED**
6 **TO RELIABLY ADDRESS DOWNWARD WIND RAMPING EVENTS?**

7 **A.** Approximately 939 MW, or approximately 31.6% of the total installed wind generation
8 capacity on the system when Rush Creek comes online.

9 **Q. DO YOU AGREE THAT PSCO WILL NEED 939 MW OF FLEX RESERVES TO**
10 **RELIABLY MANAGE APPROXIMATELY 2,974 MW OF INSTALLED WIND**
11 **CAPACITY?**

12 **A.** No, I think this value is severely understated, and that PSCo needs Flex Reserves significantly
13 greater than 939 MW. This is discussed later in my testimony.

⁴ I calculated this value by taking the current wind capacity on the system (2,566 MW), subtracting the 192 MW of expiring wind PPAs, and adding in the 600 MW of Rush Creek. This totals 2,974 MW.

1 **Q. WHY DO YOU DISAGREE WITH PSCO'S ANALYSIS?**

2 A. I disagree with PSCo based on my analysis of PSCo's Expanded 2016 Flex Study. More
3 specifically, that study only analyzed a one year period from November 1, 2014 through
4 October 31, 2015, which I consider to be an insufficient duration of time. I am specifically
5 concerned that one year of data (i) does not provide enough diversity of unique downward
6 wind ramping events to develop the Flex Reserves requirement, and (ii) that it excludes
7 proportionally larger 30 minute downward wind ramping events that have occurred on the
8 PSCo system but fall outside of this 12 month time period.

9 **Q. SHOULD THE EXPANDED 2016 FLEX STUDY RELY ON A LONGER DATA SET**
10 **OF ACTUAL WIND GENERATION ON THE PSCO SYSTEM?**

11 A. Yes. I recommend that PSCo, at a minimum, use data from January 2012 through November
12 2016 – which would provide a more robust timeframe over which to assess wind variability.

13 **Q. CAN YOU EXPLAIN WHY A 12 MONTH PERIOD MAY NOT PROVIDE ENOUGH**
14 **DIVERSITY OF UNIQUE DOWNWARD WIND RAMPING EVENTS TO DEVELOP**
15 **THE FLEX RESERVE REQUIREMENT?**

16 A. Yes. In determining Flex Reserve requirement levels, the Expanded 2016 Flex Study
17 categorized all 30 minute wind generation down ramps over the study period into 100 MW
18 bins based on the wind generation at the start of the 30 minute downward wind ramping event.
19 The final Flex Reserve requirement is a polynomial function developed from the maximum
20 downward wind ramping event within each 100 MW bin. To sensitize for different levels of
21 installed wind capacity (and the assumed locational build of new facilities), PSCo adjusted the
22 historical data to account for differing assumed levels and location of installed wind. This
23 resulted in a unique polynomial curve to project Flex Reserves requirements for each scenario.

1 There were 15 scenarios considered. To demonstrate my concern, I am using Scenario 3 – the
2 3,174 MW of installed wind case.

3 The adjusted historical wind data for this Scenario 3 was sorted into 30 bins, based on the
4 amount of wind generating at the start of 30 minute downward wind ramping events. While 30
5 data points implies a diversity of events, in actuality, only 15 unique days and time periods are
6 reflected within the bins due to several ramping events occurring in rapid chronological
7 succession. For instance, the 2,100-2,400 MW wind generation bins had start times between
8 8:20 PM and 8:35 PM on November 18, 2014. This is a 15 minute time period, which indicates
9 that this is in fact one unique downward wind ramping event rather than four separate events.
10 See Table 2.

11 The fact that there is significant overlap in time periods within the 100 MW bins used to
12 construct the polynomial curve makes me concerned that there is not enough variation in the
13 12 month data set to appropriately reflect system conditions that PSCo may experience in the
14 future.

15 **Table 2: Examples of Overlap in 100 MW Bins Used in the Expanded 2016 Flex**
16 **Study for Scenario 3 (The 3,174 MW Case)**

Bin	Time at Start of Ramp	Time Frame Between Start of Observations
1000	1/6/15 0:40	15 minutes
1100	1/6/15 0:35	
1200	1/6/15 0:30	
1300	1/6/15 0:25	
2100	11/18/14 20:35	15 minutes
2200	11/18/14 20:30	
2300	11/18/14 20:25	
2400	11/18/14 20:20	

1 **Q. WHAT IS THE LARGEST ACTUAL 30 MINUTE DOWNWARD WIND RAMPING**
2 **EVENT THAT OCCURRED ON THE PSCO SYSTEM DURING THE EXPANDED**
3 **2016 FLEX STUDY PERIOD?**

4 A. The most extreme non-curtailment based 30 minute downward wind ramping event during the
5 November 1, 2014 through October 31, 2015 study period was 824 MW, which is also the
6 same amount of Flex Reserves that PSCo states it currently needs to adequately address
7 downward wind ramping events.

8 **Q. ARE YOU AWARE OF OTHER EXTREME 30 MINUTE DOWNWARD WIND**
9 **RAMPING EVENTS ON THE PSCO SYSTEM, IF SO PLEASE DESCRIBE?**

10 A. Yes, I am. For example, on February 25, 2012, PSCo experienced a 788 MW 30-minute
11 downward wind ramping event.⁵ At the time of this downward wind ramping event, PSCo had
12 1,736 MW of installed wind capacity on its system.⁶ Therefore, this downward wind ramping
13 event was equivalent to a 45.4% of the PSCo's system total installed wind capacity. I would
14 note this value of 45.4% is greater than PSCo's stated Flex Reserve requirement, as presented
15 in Table 1 of my testimony.

16 **Q. IF A SIMILAR PROPORTIONAL SIZE DOWNWARD WIND RAMPING EVENT**
17 **OCCURRED TODAY, WOULD PSCO'S FLEX RESERVE REQUIREMENT**
18 **PROCURE ENOUGH FLEX RESERVES TO MEET THE EVENT?**

⁵ I am aware of several other extreme 30 minute downward wind ramping outside of the Expanded 2016 Flex Study. For example, there was a 1,033 MW event on May 15, 2014 and a 1,214 MW event on March 11, 2016. However, I do not know if these events were caused by curtailment. Due to this uncertainty, I elected to exclude them from my analysis and instead rely on the February 25, 2012 event, which was an unexpected event not caused by curtailment.

⁶ I determined the amount of installed wind capacity on the system based on the 2011 Wind Study, Page 10.

1 A. No. As illustrated in Table 1, PSCo's Flex Reserve requirement covers only 31.6-39.8% of the
2 system's installed wind capacity, whereas the February 25, 2012 event represented 45.4% of
3 the system's installed wind capacity.

4 **Q. WHAT ARE THE POTENTIAL CONSEQUENCES OF NOT HAVING ENOUGH**
5 **FLEX RESERVES TO ADDRESS DOWNWARD WIND RAMPING EVENTS?**

6 A. As described earlier in my testimony, PSCo's system could experience brownouts or blackouts
7 and put the reliability of ratepayers' electric service in jeopardy due to active power
8 imbalances where the demand for power is greater than the generation of power in real-time.

9 **Q. BASED ON THIS FINDING, WOULD YOU CONSIDER PSCO'S FLEX RESERVES**
10 **REQUIREMENT SUFFICIENT TO SUPPORT MAINTAINING RELIABILITY ON**
11 **THE PSCO SYSTEM?**

12 A. No, I would not. If a downward wind ramping event similar to February 25, 2012 were to
13 occur with an installed wind capacity of 2,974 MW on the PSCo system, 1,350 MW of Flex
14 Reserves would be needed. This is 45.4% of 2,974 MW. However, based on the guidelines in
15 Table 1, PSCo would have at most 939 MW of Flex Reserves on the system.

16 **Q. WOULD THE DIFFERENT GEOGRAPHIC DISTRIBUTION OF WIND ACROSS**
17 **COLORADO IN 2012 VS 2018 POTENTIALLY MODERATE THE 1,350 MW**
18 **ALTERNATIVE REQUIREMENT IMPLIED BY THE FEBRUARY 25, 2012 EVENT?**

19 A. Yes. It is possible that the different geographic distribution of wind could moderate my
20 finding. However, it is prudent to err on the side of caution when planning for system
21 reliability.

1 Moreover, as indicated in footnote five (5) in my testimony above, there was a 1,214 MW 30
2 minute downward wind ramping event on March 11, 2016. While I do not know if a
3 curtailment was involved in that downward wind ramping event, if it was not due to a
4 curtailment, the percentage of negative wind ramp would have been 47.3%. This is a greater
5 percentage downward wind ramping event than the more conservative 45.4% basis I based my
6 alternative requirement on. As such, I am not convinced that geographic diversity of wind
7 facilities would fully moderate my finding.

8 **Q. HOW COULD PSCO CHANGE ITS FLEX RESERVE REQUIREMENT TO BETTER**
9 **MAINTAIN SYSTEM RELIABILITY IN THE EVENT OF AN EXTREME**
10 **DOWNWARD WIND RAMPING EVENT?**

11 A. PSCo could increase its Flex Reserve requirement to incorporate the impacts of extreme
12 downward wind ramping events that have actually occurred on the PSCo system (such as the
13 February 25, 2012 event), but that occurred outside of the Expanded 2016 Flex Study time
14 period. Using this event as an example, the amount of Flex Reserves currently needed on the
15 PSCo system would increase by approximately 411 MW. This would bring the Flex Reserve
16 requirement, once Rush Creek comes online in 2018, to approximately 1,350 MW.

17 **Q. DO YOU HAVE OTHER CRITIQUES OF PSCO'S FLEX RESERVES**
18 **REQUIREMENT?**

19 A. Yes, these are discussed in the next section of my testimony.

20 **III. PSCO'S FLEX RESERVE REQUIREMENT SHOULD REQUIRE FASTER RAMPING**
21 **RATES (I.E. 15-20 MINUTES) THAN IS CURRENTLY REQUIRED (I.E. 30 MINUTES)**

1 **Q. WHY ARE YOU CONCERNED ABOUT THE FLEX RESERVES RAMP RATE**
2 **REQUIREMENT?**

3 A. Maintaining system reliability during downward wind ramping events requires more than just
4 planning for the magnitude of these unplanned system events. It also requires accounting for
5 the speed at which downward wind ramping events can occur. While 30 minutes is a
6 reasonable timeframe to planning for the magnitude of downward wind ramping events, both
7 (i) PSCo's Expanded 2016 Flex Study data and (ii) historical experience on the PSCo system
8 shows that such events can happen in a much quicker timeframe. As my testimony
9 demonstrates in this section, a 15 or 20 minute ramping requirement for Flex Reserves would
10 better reflect the speed at which downward wind ramping events can occur.

11 **Q. WHAT IS THE CURRENT REQUIREMENT FOR RAMPING CAPABILITY FOR**
12 **FLEX RESERVES?**

13 A. In the Expanded 2016 Flex Study, PSCo states (Page 2) that "*Flex Reserve is comprised of*
14 *excess Contingency Reserve as well as online and offline generation available within 30-*
15 *minutes that is not already included in the Contingency Reserve calculation.*" This establishes
16 the requirement that all qualifying resources have the ability to ramp to full load within 30
17 minutes.

18 **Q. IS THIS REQUIREMENT CONSISTENT WITH PSCO'S HISTORICAL APPROACH**
19 **TO RAMP RATES FOR FLEXIBLE CAPACITY NEEDED TO ADDRESS**
20 **DOWNWARD WIND RAMPING EVENTS?**

21 A. No. In the 2011 Wind Study, PSCo had previously been using a 20 minute requirement. PSCo
22 states in the Expanded 2016 Flex Study (Page 9) that "*In the 2011 Wind Limits Study, the*
23 *Company only counted offline Flex Reserve capacity which could be online within 20 minutes.*"

1 Q. **WHY DID PSCO SHIFT TO A 30 MINUTE REQUIREMENT FROM A 20 MINUTE**
2 **REQUIREMENT FOR FLEX RESERVES?**

3 A. PSCo states in the Expanded 2016 Flex Study (Page 9) that the previous *“logic was that the*
4 *System Operator might take up to 10 minutes of the 30-minute wind generation down ramp to*
5 *recognize the ramp event, which would only leave 20 minutes to dispatch the offline Flex*
6 *Reserve capacity.”* However, today *“the System Operator typically has plenty of warning that*
7 *a wind generation down ramp is in progress before the start of the steepest 30-minute portion*
8 *of that ramp, so it appeared overly conservative to only credit offline capacity which can be*
9 *available within 20 minutes.”*

10 Q. **DID PSCO PROVIDE ANY EVIDENCE THAT THE SYSTEM OPERATOR HAS**
11 **IMPROVED ITS ABILITY TO IDENTIFY DOWNWARD WIND RAMPING EVENTS**
12 **FROM THE ONSET?**

13 A. No, but that is not my primary concern. As I demonstrate in my testimony below, even if the
14 system operator recognizes an event from the onset, the majority of the wind ramp down
15 during a 30 minute downward wind ramping event can occur within the first 15 to 20 minutes
16 of that event. In other words, even with improved forecasting and identification techniques, a
17 20 minute ramping requirement would still better serve the system.

18 Q. **DO YOU HAVE OTHER CONCERNS WITH PSCO’S JUSTIFICATION FOR**
19 **SHIFTING THE FLEX RESERVE REQUIREMENT SHIFTING FROM A 20 MINUTE**
20 **TO 30 MINUTE REQUIREMENT?**

21 A. Yes. While PSCo states in the Expanded 2016 Flex Study (Page 9) that it *“believes this change*
22 *from 20 minutes to 30 minutes is a more accurate metric of system flexibility,”* the purpose of
23 the Flex Reserves are to **not** to measure system flexibility. Rather, the purpose of the Flex

1 Reserves are to maintain system reliability during downward wind ramping events. Moving to
2 a 30 minute requirement (from a 20 minute requirement) decreases the probability of
3 maintaining system reliability by increasing the probability that Flex Reserves will not be able
4 to ramp in time to meet system needs.

5 **Q. WHAT DOES THE UNDERLYING WIND DATA USED IN PSCO'S EXPANDED 2016**
6 **FLEX STUDY TELL US ABOUT RAMPING NEEDS FOR FLEX RESERVES?**

7 A. As demonstrated in Figure 1, the underlying wind data used in PSCO's Expanded 2016 Flex
8 Study indicates that a 20 minute (or even 15 minute) ramp timeframe for Flex Reserves is more
9 likely to meet system needs than a 30 minute requirement.

10 I came to this conclusion by analyzing the modeled wind data underlying PSCO's Expanded
11 2016 Flex Study. The data indicates that within a 30 minute downward wind ramping event,
12 the majority of the loss of generation can occur very rapidly with the vast majority occurring
13 with the first 15 to 20 minutes of the ramping event. To demonstrate this, in Figure 1, I identify
14 10 examples (on 10 different days) where there was a large 30 minute downward wind
15 ramping event (of more than 450 MW) that occurred in a very quick timeframe.

16 Of the 10 examples:

- 17 • For all 10 examples, 89% or more of the 30 minute ramping event occurred within the
18 first 20 minutes of the event.
- 19 • For nine (9) examples, 90% or more of the 30 minute ramping event occurred within the
20 first 20 minutes of the event.
- 21 • For two (2) of the examples, 90% or more of the 30 minute total occurred within the first
22 15 minutes.

1 Within this data set, I identified all 30 minute downward wind ramping events greater than 450
2 MW. Once I identified these large downward wind ramping events, I calculated the percentage
3 of the full ramp that occurred within each five minute increment and identified 10 examples on
4 different days where a significant portion of the ramp occurred within the first 20 minutes. I
5 excluded from my analysis all days that PSCo indicated that curtailment was the cause of a
6 downward wind ramping event across all 15 scenarios that PSCo analyzed for Figure 5 in the
7 Expanded 2016 Flex Study, which was 17 different days.

8 **Q. IN ADDITION TO THE MODELED DATA IN THE EXPANDED 2016 WIND STUDY,**
9 **DID YOU ANALYZE ACTUAL PSCO SYSTEM WIND GENERATION DATA?**

10 A. Yes. I found the same trend in PSCo's historical wind generation data in the time period both
11 *prior to* and *after* the 12 month data series that PSCo used as the basis for its Expanded 2016
12 Flex Study. PSCo's Expanded 2016 Flex Study utilized data from November 1, 2014 to
13 October 31, 2015. To supplement this analysis, I analyzed PSCo's historical 5 minute system
14 wind generation data from January 1, 2013 to October 31, 2014, and from November 1, 2015
15 to November 22, 2016, which was provided by PSCo as part of its response to Discovery
16 Request SWG1-2 in this docket.

17 **Q. PLEASE DESCRIBE WHAT YOU FOUND IN THE JANUARY 1, 2013 TO OCTOBER**
18 **31, 2014 WIND GENERATION DATA.**

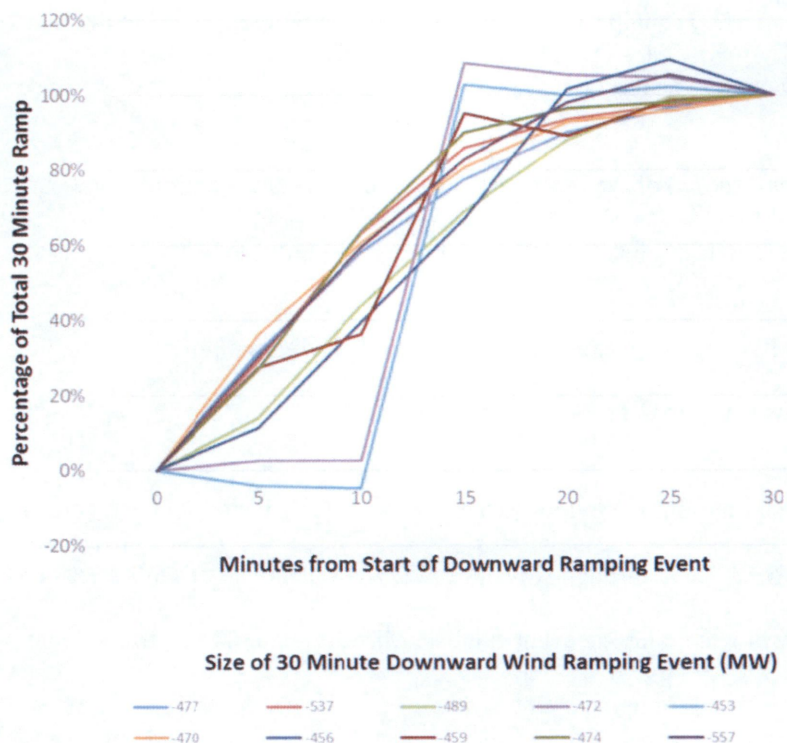
19 A. Similar to my analysis of the Expanded 2016 Wind Study data, I found several examples of 30
20 minutes large downward wind ramping events where the majority of the downward ramp
21 occurred in the first 15 to 20 minutes. In conducting this analysis, I used the same methodology
22 (described above) for my analysis of the Expanded 2016 Flex Study.

1 In Figure 2, I identify 10 examples (on 10 different days) where there was a 450 MW or larger
2 30 minute downward wind ramping event that occurred in a very quick timeframe. Of the 10
3 examples:

- 4 • For all 10 examples, 87% or more of the 30 minute ramping event occurred within the
5 first 20 minutes of the event
- 6 • In eight (8) examples, more than 90% of the ramp occurred in the first 20 minutes of the
7 event.
- 8 • For three (3) of the examples, 90% or more of the 30 minute total occurred within the first
9 15 minutes.
- 10 • In three (3) of the examples, the downward wind ramp for the 20 minute downward ramp
11 was larger than the 30 minute total.

12 Similar to the modeled data in the Expanded 2016 Flex Study, PSCo's historical wind
13 generation data from January 1, 2013 through October 31, 2014 demonstrates that 90% or
14 more of a large downward wind ramping event can occur in within the first 15 to 20 minutes of
15 a 30 minute downward wind ramping event.

3 **Figure 2: Examples of Fast Downward Wind Ramping Events Greater Than 450 MW from**
4 **January 1, 2013 and October 31, 2014 on the PSCo System**



4

6 **Q. PLEASE DESCRIBE WHAT YOU FOUND IN THE NOVEMBER 1, 2015 TO**
7 **NOVEMBER 22, 2016 WIND GENERATION DATA.**

10 A. Similar to my previous two analyses, I found several examples of 30 minutes downward wind
11 ramping events where the majority of the downward ramp occurred in the first 15 to 20
12 minutes of the event. For this time series, I used the same methodology as my previous two
13 analyses.

13 In Figure 3, I identify 10 examples (on 10 different days) where there was a 450 MW or larger
14 downward wind ramping event that occurred in a very quick timeframe. Of the 10 examples
15 highlighted:

- 1 • For all 10 examples, 89% or more of the 30 minute ramping event occurred within the
2 first 20 minutes of the 30 minute event.

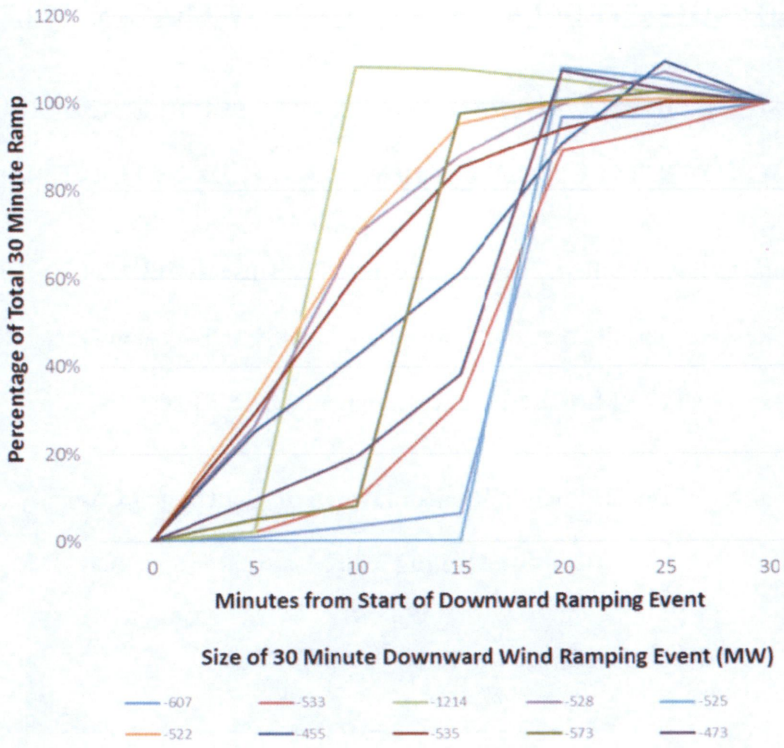
- 3 • In nine (9) examples, more than 90% of the ramp occurred in the first 20 minutes of the
4 30 minute event.

- 5 • For three (3) of the examples, 90% or more of the 30 minute total occurred within the first
6 15 minutes of the 30 minute event.

- 7 • In five (5) of the examples, the downward wind ramp for the 20 minute downward ramp
8 was larger than the 30 minute total.

9 Again, similar to my previous two analyses, PSCo's historical wind generation data from
10 November 1, 2015 through November 22, 2016 demonstrates that 90% or more of a large
11 downward wind ramping event can occur in within the first 15 to 20 minutes of a 30 minute
12 downward wind ramping event.

3 **Figure 3: Examples of Fast Downward Wind Ramping Events Greater Than 450 MW Between**
4 **November 1, 2015 and November 22, 2016**



4

6 **Q. WHAT DO YOU CONCLUDE BASED ON YOUR THREE ANALYSES OF PSCO**
7 **SYSTEM WIND GENERATION DATA?**

13 A. My three analyses indicate that within a 30 minute downward wind ramping event, the vast
14 majority of the downward ramp can occur in an extremely short (15 to 20 minute) timeframe.
15 Since the purpose of Flex Reserves, according to PSCo in the Expanded 2016 Flex Study (Page
16 2), is to “address large reductions of online wind generation” and we know that these large
17 reduction can occur very quickly, PSCo’s Flex Reserve requirement would be better served by
18 generation that can quickly start up within 20 minutes (or even 15 minutes) versus a slower and
19 less flexible ramping requirement of 30 minutes. In summary, a 20 minute (or a 15 minute)

1 requirement would **increase** the probability of maintaining system reliability over a 30 minute
2 requirement.

3 **IV. PSCO SHOULD PROCURE MORE AND FASTER RAMPING FLEX RESERVES**

4 **Q. HOW MUCH OF PSCO OWNED OR CONTRACTED FLEXIBLE CAPACITY**
5 **COULD POTENTIALLY MEET A 20 MINUTE FLEX RESERVE REQUIREMENT?**

6 A. According to PSCO in their Discovery Request Response to CPUC5-01(a), PSCO has 732 MW
7 of Flex Reserve capacity that could potentially qualify as Flex Reserves under a 20 minute
8 requirement (net of RMRG Reserve Requirements). See Table 3.

9 **Table 3: PSCO's View of Owned or Contracted Capacity Capable**
10 **of Meeting a 20 Minute Requirement**

Resource	Flex Reserve Capacity (MW)
Cabin Creek	320
Ft Lupton	89
Valmont 6	43
Alamosa	26
Fruita	14
Plains End	215
Fountain Valley 1-6	236
Sub-total	943
RMRG Reserve Requirement	(211)
Total Net of RMRG Requirement	732

1 **Q. UNDER A 20 MINUTE FLEX RESERVE REQUIREMENT, DOES PSCO**
2 **CURRENTLY HAVE ENOUGH OWNED OR CONTRACTED FLEX RESERVE**
3 **CAPACITY?**

4 A. No. Under a 20 minute Flex Reserve requirement, PSCO would be 92 MW to 433 MW short on
5 Flex Reserves.

6 As indicated in the Expanded 2016 Flex Study, PSCO currently needs 824 MW of Flex
7 Reserves. Based on the large downward wind ramping event on February 25, 2012, I calculate
8 that PSCO currently needs 1,165 MW of Flex Reserves.⁷ With only 732 MW of capacity that
9 PSCO believes is able to qualify under a 20 minute requirement, PSCO is currently 92 MW to
10 433 MW short of adequate supply. See Table 4 for a summary of these calculations.

11 **Table 4: Flex Reserves Needed to Meet a 20 Minute Requirement**
12 **with 2,566 MW of Installed Wind**

	PSCO's Expanded 2016 Flex Study (MW)	Alternative Large Ramp Methodology (MW)
Flex Reserve Requirement	824	1,165
20 Minute Flex Reserve Available	732	732
Flex Reserves Surplus/Shortage	(92)	(433)

⁷ This value is 45.4% of PSCO's current installed wind capacity of 2,566 MW.

1 **Q. UNDER A 20 MINUTE FLEX RESERVE REQUIREMENT WOULD PSCO HAVE**
2 **ENOUGH OWNED OR CONTRACTED FLEX RESERVES WHEN RUSH CREEK**
3 **ENTERS SERVICE?**

4 A. No. Under a 20 minute requirement, PSCo would be 207 MW to 618 MW short of adequate
5 Flex Reserves.

6 When Rush Creek comes online in 2018, PSCo will have approximately 2,974 MW of wind
7 generation on its system. Based on the guidelines in the Expanded 2016 Flex Study, PSCo
8 would need 939 MW of Flex Reserves. Under the alternative guidelines I developed in Section
9 II of my testimony, PSCo would need 1,350 MW of Flex Reserves. With only 732 MW of
10 capacity that PSCo believes can qualify under a 20 minute requirement, this would leave PSCo
11 short 207 MW to 618 MW. See Table 5 for a summary of these calculations.

12 **Table 5: Flex Reserves Needed to Meet a 20 Minute Requirement**
13 **with 2,974 MW of Installed Wind**

	PSCo's Expanded 2016 Flex Study (MW)	Alternative Large Ramp Methodology (MW)
Flex Reserves Requirement	939	1,350
20 Minute Flex Reserves Available	732	732
Flex Reserves Surplus/Shortage	(207)	(618)

14 **Q. DOES THIS CONCLUDE YOUR TESTIMONY?**

15 A. Yes.

Exhibit MM-1

Matthew Mooren Statement of Qualifications

Matthew Mooren

Member of PA's Management Group

Mr. Mooren is a power and utilities advisor who works across the value chain, including the natural gas, power, renewable sectors. Mr. Mooren builds upon his 15+ years of North American market analysis, resource planning, energy infrastructure investment, and related expertise to help utility, generation owner, energy investor, and other clients navigate market uncertainty and address their business strategy, merger and acquisition, financing, restructuring, litigation, and testimony needs.

Primary expertise

- Energy market analytics and forecasting
- Electric utility resource planning
- Energy infrastructure investment

Related experience

- Energy policy and regulations
- Power market economics and operations
- Valuation of physical and financial energy assets
- Energy contract negotiations

Education

- B.S. Industrial Engineering

Primary expertise

Market Analytics – As a core contributor to the development of PA's energy market forecasting models since 2000, Matt maintains an intimate understanding of the fundamentals underlying natural gas, power, and renewable markets. Matt advises clients on future resource plans (see below) and the value that may be derived from within the operations of all North American energy markets, including those with regulated (vertically integrated electric utilities and gas utilities) and de-regulated (wholesale power markets) characteristics.

Resource Planning – Matt is experienced in helping utilities develop resource plans, having led related engagements with electric utilities in New Mexico, Louisiana, and Indiana. Matt helps utilities construct resource plans which balance affordable and clean criteria while ensuring reliability is maintained and that the projected portfolio composition balances least cost and lowest risk outcomes for the customer under a variety of scenarios.

Energy Infrastructure Investment – Matt has extensive experience valuing a wide array of physical and financial energy assets and energy organizations, with extensive experience valuing power generation assets and contracts in particular. Matt has valued over \$75 billion in power generating assets, including the analysis of hydroelectric, pump storage, wind, solar, biomass, geothermal, battery storage, hybrid solar-thermal, cogeneration, nuclear, coal, and natural gas as well as power and fuel contracts, financial hedges, and trading books.

CERTIFICATE OF SERVICE

DOCKET NO. 16A-0396E

I hereby certify that on this 9th day of December, 2016, a true and correct copy of the foregoing **Answer Testimony of Matthew Mooren on Behalf of Southwest Generation Operating Company LLC** in PUC Docket No. 16A-0396E was e-filed with the Colorado Public Utilities Commission and served through the Certificate of Service maintained in the Colorado Public Utilities Commission e-filing system to registered users in accordance with applicable law.

Thomas Dixon	Thomas.Dixon@coag.gov	OCC
Brent Coleman	brent.coleman@coag.gov	OCC
Cory Skluzak	Cory.Skluzak@state.co.us	OCC
Chris Neil	Chris.neil@state.co.us	OCC
Tim Villarosa	Tim.villarosa@state.co.us	OCC
Ingrid Hassell	Ingrid.hassell@coag.gov	OCC
Chere Mitchell	Chere.mitchell@state.co.us	OCC
Randolph Starr	randy@starrwestbrook.com	Joint Cooperative Movants
Delvan D. Worley	dworley@holycross.com	Joint Cooperative Movants
Diana Golis	dgolis@holycross.com	Joint Cooperative Movants
Michael A. Westbrook	Mike@starrwestbrook.com	Joint Cooperative Movants
Diane S. Johnson	djohnson@yvea.com	Joint Cooperative Movants
Amy M. Watson	awatson@irea.coop	Joint Cooperative Movants
Patrick B. Mooney	pmooney@irea.coop	Joint Cooperative Movants
Gregg K. Kampf	gkampf@hfak.com	Joint Cooperative Movants
Thomas Walch	twalch@gvp.org	Joint Cooperative Movants
Alice K. Jackson	alice.k.jackson@xcelenergy.com	PSCo
William Dudley	Bill.Dudley@xcelenergy.com	PSCo
Robin Kittel	Robin.kittel@xcelenergy.com	PSCo
Chris Irby	Christopher.M.Irby@xcelenergy.com	PSCo
Gregory Sopkin	gsopkin@wbklaw.com	PSCo
Matthew Larson	mlarson@wbklaw.com	PSCo
Caitlin Shields	cshields@wbklaw.com	PSCo
Sage Tauber	Sage.tauber@xcelenergy.com	PSCo
Mari Deminski	mari.deminski@xcelenergy.com	PSCo
Debra S. Kalish	kalishd@bouldercolorado.gov	Boulder
Heather Bailey	baileyh@bouldercolorado.gov	Boulder
Matt Lehrman	lehrmanm@bouldercolorado.gov	Boulder
Jonathan Koehn	koehnj@bouldercolorado.gov	Boulder
Mary Bisset	bissetm@bouldercolorado.gov	Boulder
Lisa Tormoen Hickey	lisahickey@newLawgroup.com	Interwest
David M. Nocera	Dave.nocera@coag.gov	Staff Counsel
Michael Santisi	michael.santisi@coag.gov	Staff Counsel
Gene Camp	Gene.camp@state.co.us	Trial Staff
Sharon Podein	Sharon.poedin@state.co.us	Trial Staff

Rebecca Lim	Rebecca.Lim@state.co.us	Trial Staff
Paul Caldara	Paul.Caldara@state.co.us	Trial Staff
Paul Gomez	Paul.Gomez@coag.gov	Commission Counsel
Erin McLauthlin	Erin.McLauthlin@coag.gov	Commission Counsel
Ron Davis	Ron.Davis@state.co.us	Advisory Staff
Bob Bergman	Bob.Bergman@state.co.us	Advisory Staff
Keith Hay	Keith.hay@state.co.us	Advisory Staff
Joel Hendrickson	Joel.Hendrickson@state.co.us	Advisory Staff
James Lester	James.Lester@state.co.us	Advisory Staff
Ellen Howard Kutzer	Ellen.kutzer@coag.gov	CEO
Christopher M. Worley	Chris.worley@state.co.us	CEO
Lindsey Wedewer	Lindsey.wedewer@state.co.us	CEO
Barbara Boyd	Barbara.boyd@coag.gov	CEO
Michelle Brandt King	mbking@hollandhart.com	CEC
Emanuel T. Cocian	etcocian@hollandhart.com	CEC
Connie Scribner	CMScribner@hollandhart.com	CEC
Kayla L. Hall	KLHall@hollandhart.com	CEC
Adele C. Lee	ACLEe@hollandhart.com	CEC
Susan J. Eckert	Susaneckert.sellc@comcast.net	RMELC/CBCTC
Joseph M. Santarella Jr.	Jmsantarella.sellc@comcast.net	RMELC/CBCTC
Michael Hiatt	mhiatt@earthjustice.org	Vote Solar
Rick Gilliam	rick@votesolar.org	Vote Solar
Eleanor Greer	egreer@earthjustice.org	Vote Solar
Joel Minor	jminor@earthjustice.org	Vote Solar
Ellen M. Kelman	ekelman@laborlawdenver.com	IBEW
Erin A. Overturf	Erin.overturf@westernresources.org	WRA
Gwen Farnsworth	Gwen.farnsworth@westernresources.org	WRA
Penny Anderson	Penny.anderson@westernresources.org	WRA
Robin Quarrier	lawclerk@westernresources.org	WRA
Rob Harris	Rob.harris@westernresources.org	WRS
Mark D. Detsky	mdetsky@dietzedavis.com	CIEA
Gabriella Stockmayer	gstockmayer@dietzedavis.com	CIEA
Will Coyne	will@headwatersstrategies.com	CIEA
Julie A. Wolfe	Julie@dietzedavis.com	CIEA
Kevin Fox	kfox@kfwlaw.com	Sustainable Power
Scott Dunbar	sdunbar@kfwlaw.com	Sustainable Power
Richard L. Fanyo	rfanyo@polsinelli.com	Climax
Rose Tinnell	rtinnell@polsinelli.com	Climax
C. Cook	ccook@duffordbrown.com	Climax
Vincent P. Calvano	vincecalvano@gmail.com	CoSEIA
Rebecca Cantwell	rcantwell@coseia.org	CoSEIA
Judith M. Matlock	Judith.matlock@dgsllaw.com	Invenergy
Matt Hartford	Matt.hartford@dgsllaw.com	Invenergy
Greg Leuchtmann	gleuchtmann@invenergylc.com	Invenergy
Claybourne Clarke	Clay.clarke@coag.gov	Air Division
Chris Colclasure	Chris.colclasure@state.co.us	Air Division
Barbara Boyd	Barbara.boyd@coag.gov	Air Division

/s/ John Putnam

C SOLICITATION AMENDMENT #1

STATE OF NORTH DAKOTA
PUBLIC SERVICE COMMISSION
600 E. BOULEVARD AVE. DEPT. 408
BISMARCK, ND 58505-0480

SOLICITATION AMENDMENT NUMBER 1

May 12, 2017

Solicitation Number: 408.17.05.009

Title: Otter Tail Power Company

Advanced Determination of Prudence Case No. PU-17-140 and

Advanced Determination of Prudence Case No. PU-17-141 and

Certificate of Public Convenience and Necessity Case No. PU-17-143

Deadline for Receipt of Proposals: *May 30, 2017 2:00 p.m. (CT) Note date change*

Solicitation Issued: May 1, 2017

Section 1.04 Return Mailing Address and Deadline for Receipt of Proposals established the date of May 29, 2017 as the day the proposals are due at the Commission. However, May 29, 2017 is Memorial Day and the Public Service Commission will be closed; therefore the date to receive proposals will be changed to **Tuesday, May 30, 2017 at 2:00 p.m. (CT).**

Section 1.06 Deadline for Receipt of Questions and Objections established a Deadline for Submission of Questions and Requests for Clarification. The responses, including any necessary amendments, are as follows:

1. Question: Does the Advocacy Staff expect the dockets for Astoria and Merricourt to be consolidated or does Staff envision filing separate testimony in each docket?

Response: The dockets will not be consolidated. The cases will be consolidated for purposes of hearing. This means that we would expect the ability to file one set of testimony that covers all cases, but within the testimony each identified issue should be clear as to which case or cases it is applicable to.
No amendment necessary.

2. Question: Does Advocacy Staff anticipate the consultant being able to request that Otter Tail perform additional Strategist model runs?

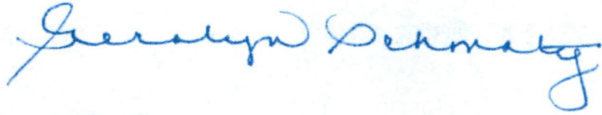
Response: Yes
No amendment necessary

3. Question: Although Otter Tail has filed separate dockets, the application describes the two resources as being modeled in tandem as a replacement for Hoot Lake. Does Staff seek to analyze the ADP both individually and collectively?

Response: Yes
No amendment necessary

Bidders are instructed to acknowledge receipt of and compliance with this amendment by signing below and returning the Solicitation Amendment Acknowledgement page with your solicitation response.

Questions regarding this amendment must be submitted in writing to the Procurement Officer.



Geralyn Schmaltz
Procurement Officer
E-mail: gschmaltz@nd.gov
Telephone: 701-328-4076
TTY Users call: 7-1-1

AMENDMENT ACKNOWLEDGEMENT

Solicitation Number: 408.17.05.009

Title: Otter Tail Power Company


Advanced Determination of Prudence Case No. PU-17-140 and

Advanced Determination of Prudence Case No. PU-17-141 and

Certificate of Public Convenience and Necessity Case No. PU-17-143

Solicitation Amendment Number: 1

By my signature below, I hereby acknowledge receipt of and compliance with this amendment.

COMPANY NAME PA Consulting Group, Inc.
SIGNATURE 
PRINTED NAME Matt Mooren
TITLE Member of PA's Management Group
DATE 5/15/2017



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Corporate headquarters

123 Buckingham Palace Road
London SW1W 9SR
United Kingdom
+44 20 7730 9000

United States headquarters

45th Floor, Chrysler Building
405 Lexington Avenue
New York, NY 10174
USA
+1 212 973 5900

paconsulting.com

For more information about
PA in the USA, please visit
paconsulting.com/us

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