NorthWestern® Energy
Delivering a Bright Future

January 17, 2014

Ms. Kate Whitney
Montana Public Service Commission
1701 Prospect Avenue
P.O. Box 202601
Helena, MT 59620-2601

RE: Docket No. D2013.12.85
PPLM Hydro Assets Purchase
PSC Set 2 Data Requests (036-058)

Dear Ms. Whitney:

Enclosed for filing is a copy of NorthWestern Energy's responses to select data requests as listed below from PSC Set 2. A hard copy will be mailed to the most recent service list in this Docket this date. The Montana Public Service Commission and the Montana Consumer Counsel will be served by hand delivery this date. These data responses will also be e-filed on the PSC website and emailed to counsel of record.

PSC-044(a)
PSC-049

Should you have questions please contact Joe Schwartzenberger at 406 497-3362.

Sincerely,

Nedra Chase

Nedra Chase
Administrative Assistant
Regulatory Affairs

NC/nc
CC: Service List

CERTIFICATE OF SERVICE

I hereby certify that a copy of NorthWestern Energy's responses to select data requests in PSC Set 2 which are data request numbers PSC-044(a) and PSC-049 in Docket D2013.12.85, the PPLM Hydro Assets Purchase, has been hand delivered to the Montana Public Service Commission and to the Montana Consumer Counsel this date. They will be e-filed on the PSC website and served on the most recent service list by mailing a copy thereof by first class mail, postage prepaid. They will also be emailed to counsel of record.

Date: January 17, 2014

Nedra Chase

Nedra Chase
Administrative Assistant
Regulatory Affairs

Docket No D2013.12.85
Hydro Assets Purchase
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PSC-044

Regarding: Hydros Potential for Ancillary Services
Witness: Stimatz, part a

a. Are the Hydros capable of providing any ancillary services other than "spinning reserves"?

b. What type of work is associated with "developing [NWE's] resource optimization function" (JDH-27:18-19)

RESPONSE:

a. (Response provided January 17, 2014.)
The Hydros are primarily run-of-river facilities. As noted in the Prefiled Direct Testimony of John D. Hines on page 27 and the Prefiled Direct Testimony of Joseph M. Stimatz on page 12, the Hydros are able to provide spinning reserves (subject to hydrological and operating conditions). NorthWestern has not yet determined whether the Hydros are capable of providing other ancillary services, so the provision of ancillary services other than spinning reserves was not considered in the analysis.

b.

PSC-049

Regarding: PowerSimm
Witness: Dorris

Please provide the following information regarding the PowerSimm model and Ascend Analytics:

a. Who are the principals at Ascend Analytics and what are their backgrounds related to electric utility resource planning and cost modeling?

b. When was the PowerSimm model developed and how long has it been in commercial use?

c. What other electric utilities currently use the PowerSimm model and how do they use it?

d. To the extent possible, please describe the primary functional differences between PowerSimm and models such as PROMOD, EGEAS, MIDAS, and Strategist?

e. What are the primary limitations of the PowerSimm model with regard to estimating NorthWestern's long-term electricity supply portfolio costs?

RESPONSE (January 17, 2014):

a. **Gary Dorris, PhD – President**

Dr. Dorris has pioneered innovative solutions for energy portfolio planning, risk management, and asset valuation for over two decades. His expertise with large-scale physical and financial risk modeling has proved his company, Ascend Analytics, and its resource planning and portfolio management solution to be indispensable to over 50 energy companies throughout the US and Europe. Industry leaders have appealed to Dr. Dorris for his delivery of expert testimony regarding resource planning, risk management, energy procurement, trading practices, asset valuation, market power, rate design, and emissions trading.

He has also provided independent expert reports to support utility acquisition of rate based generation assets and the financing of merchant generation of over $5 billion in electric generating assets. Prior to founding Ascend, he served as CEO for e-Acumen, a 60-person energy consultancy and software analytics firm. Dr. Dorris holds a Ph.D. in applied economics and finance from Cornell University, a BS in mechanical engineering, and a BA in economics with Magna Cum Laude distinction, also from Cornell University.

PSC-049 cont'd

Charles Tooman – Senior Managing Director

Charles Tooman is the Senior Managing Director of Services & Consulting. He has broad experience assessing, developing, and implementing comprehensive business and risk management programs for the largest utilities and merchant energy companies in the world. Much of his work is aimed at aligning the business strategy and enterprise risk management objectives of his clients, given challenges in global energy markets. Key considerations in his work include knowledge of leading practices and standards in risk management from rating agencies, oversight organizations, and regulatory groups. Additional insight in areas that impact risk management practices as well as business strategy – including changes in a variety of regulatory standards, energy and related market factors, and credit and capital allocation considerations – also supplement his delivery capability. Specific client work has focused on enhancing risk management and strategic decision-making through the development and implementation of innovative and "fit for purpose" business processes, risk and business policies, strategic plans, and corporate governance frameworks. He is National Futures Association Series 3, Commodity Trading Advisor certified, holds a Lean Certification from the University of Cardiff, and is a member of PRMIA's Subject Matter Expert (SME) Advisory Working Group: Change Management & Strategy.

Dr. Sean Burrows, Chief Technology Officer:

Dr. Burrows has thirteen years of energy analytics experience developing technology solutions and software for energy trading and risk management. Dr. Burrows leads the application of PowerSimm. He has focused on the development of innovative techniques for optimizing energy portfolios based on both physical and financial structures. Dr. Burrows has lead commercial development and implementations projects covering a large range of activities from solving complex statistical models to managing extremely large databases. Dr. Burrows holds a Ph.D. and M.S. from University of Wisconsin and a B.S. from Cornell University.

Vena Kostroun, Senior Vice President of Development:

Mr. Kostroun has fifteen years experience in developing high-end analytic and software tools for energy trading and risk management. He has previously worked as Senior Consultant at Nexant, Inc. where he led software development of PRYM for asset valuation and physical risk management of generating assets. Prior to Nexant, he served as technical lead and manager of the AcuPower analytics team at e-Acumen, Inc. Mr. Kostroun also has experience in energy risk management and asset valuation. Mr. Kostroun is Ph.D. ABD in physics from the University of California – Berkeley and holds a BS in physics from Cornell University with Cum Laude distinction.

PSC-049 cont'd

Dr. Keith Aubin, Senior Director of Development:
Dr. Aubin has over eight years of financial and scientific research and development experience. He has been nationally recognized as a scientist and inventor. With previous experience ranging from portfolio theory to rocket science to nanobiotechnology, Dr. Aubin's main interest is in the application of advanced mathematics to complex problems. Prior to working for Ascend, Keith held a position at MIT Lincoln Laboratory as a systems and architecture analyst. He holds a M.S. and Ph.D. in Applied Physics from Cornell University and a B.S. in Physics and a B.S. in Applied Mathematics from the University of Rhode Island.

b. PowerSimm has been developed since Ascend's founding in 2002. It has been in commercial use for approximately nine years.

c. Ascend's clients include: AES, NRG Energy, American Electric Power, Tennessee Valley Authority, RWE Power, PSEG Energy Holdings, Pacific Gas & Electric Company, InterGen, Dayton Power & Light, Riverside Public Utilities, Puget Sound Energy, Tri-State Generation & Transmission, MarkWest Energy Partners, Tacoma Power, Sempra U.S. Gas & Power, Texas Power, and Tucson Electric Power. Details of the use of Ascend software by individual clients are confidential. However, Ascend's clients almost uniformly use the simulation engine and dispatch routines core to PowerSimm.

d. Based on client feedback and our own modeling experience, Ascend has developed a matrix comparing PowerSimm to competing solutions. EGEAS and Strategist are capacity expansion models that use load duration curves. The inherent limitation of load duration curve models stems from their inability to capture hourly portfolio attributes such as start-up, shut-down, unit flexibility, and ancillary services. MIDAS and PROMOD are traditional production cost models dispatching generation to load or market prices on an hourly time step. EGEAS, Strategist, MIDAS, and PROMOD all are deterministic models incapable of systematically including risk into the portfolio selection process. Because these models were architected almost 20 years ago, their computational performance is staggeringly slow relative to the performance realized in PowerSimm. Because of the similarities between a) EGEAS and Strategist as load duration curve models and b) MIDAS and PROMOD as production cost models, we have consolidated our feature comparison matrix into three columns as shown on the Attachment accompanying this response.

PSC-049 cont'd

e. PowerSimm, like any model, has limited ability to predict future conditions such as weather, hydro flows, market prices, and generation outages. PowerSimm also requires diligence and effort to produce the appropriate validation of simulations that are necessary for robust resource planning decision analysis.

Automatic Resource Selection				
Capability	**Ascend Power Simm**	**EGEAS/ Strategist**	**MIDAS/ PROMOD**	**Comment**
Selection of a deterministic "best plan" to minimize capital and variable costs (revenue requirements)	√	√	X	Automatic resource selection minimizes the NPV of revenue requirements by selecting the optimal expansion resource.
Selection with the top 10 plans	√	√	X	PowerSimm Planner resource selection module provides the top 10 plans for resource selection where MIDAS and PROMOD provide none.
Automatic resource selection with retirement and capacity expansion options	√	√	X	PowerSimm and Strategist can look at expansion of CT to CC as a multi-phased project.
Selection of a deterministic "best plan" to multiple objective functions or planning constraints	√	X	X	PowerSimm Planner supports capacity expansion planning under multiple objective functions and planning constraints
Selection of an optimal plan over multiple simulations of future conditions of fuel prices and weather/load/renewable generation conditions	√	X	X	The optimal plan for over multiple simulations of future conditions of market prices and weather, load, renewables is considered a best in show plan with the optimal plan performing best over a broad range of conditions.
Selection of optimal plan with consideration of market price risk	√	X	X	PowerSimm Planner supports selection of optimal resource plans with consideration of the risk and the ability to directly monetize risk.
Selection of optimal plan with consideration of uncertainty in renewable energy, weather, and load	√	X	X	PowerSimm Planner simulates weather and renewables and load as a function of weather and thus captures the dynamic relationship with uncertainty between weather, load, and renewable generation. The production cost models use random firing or a fixed generation pattern and the load duration curve models randomly spread production across all periods.

Thermal Dispatch				
Capability	**Ascend**	**EGEAS/ Strategist**	**MIDAS/ PROMOD**	**Comment**
Deterministic asset optimization of 8760 hrs./yr. for thermal with ancillary service operating constraints	√	X	√	PowerSimm and the production cost models have well developed dispatch routines. Ascend's dispatch routine has the capability to model physical assets in more detail.
Sub-hourly operations	√	X	X	PowerSimm can go down to 1 minute intervals.
Combined cycle asset modeling with duct firing	√	X	√	PowerSimm and the production cost models have multi-point heat rate curves.
Combined cycle asset modeling under multiple unit configurations dependent on online resources	√	X	X	PowerSimm has a linked resource module that enables a 2x1 CC with duct to operate as a CT or CC configurations of 1x1, 1x1 with duct, 2x1, and 2x1 with duct dependent on unit availability.
Automatic upload of generation asset characteristics	√	X	√	Upload of thermal asset characteristics from Excel spreadsheet templates.
Stochastic dispatch optimization	√	X	X	Ascend uses a distributed computing environment for stochastic asset optimization.
Fuel switching and fuel blending	√	X	√	PowerSimm has richer functionality on fuel switching and blending but both production cost models have this capability.

Renewable Resource Modeling				
Capability	**Ascend**	**EGEAS/ Strategist**	**MIDAS/ PROMOD**	**Comment**
Capture the fundamental relationship between load and renewable generation	√	X	X	PowerSimm simulates weather and then load and renewable generation as it relates to weather and load.
Energy Storage	√	X	X	PowerSimm captures the dynamics of energy storage in detail.

Portfolio Management and Hedging				
Capability	**Ascend**	**EGEAS/ Strategist**	**MIDAS/ PROMOD**	**Comment**
Simulation of forward and forecast market prices	√	X	X	PowerSimm simulates forward market prices with a robust stochastic process and the other models do not.
Simulation of weather	√	X	X	PowerSimm simulates weather as a fundamental risk driver to load and renewable generation and other models do not.
Simulation of load as a function of weather	√	X	X	PowerSimm simulates load as a function of weather and captures uncertainty in load with accuracy and the other models do not.
Simulation of renewables as a function of weather	√	X	X	PowerSimm preserves the relationship between renewable generation and weather.
Value of hedging oil forwards or options	√	X	X	
Distinction of physical and financial hedging	√	X	X	
Commodity price risk management and impact on electric rates	√	X	X	
View of alternative hedging strategies on energy supply cost risk	√	X	X	

Regional Economic Modeling				
Capability	**Ascend**	**EGEAS/ Strategist**	**MIDAS/ PROMOD**	**Comment**
Multi-market modeling over multi-state area to determine LMP prices	X	X	X	
Detailed modeling of transmission system	√-	X	X/√-	

User Friendliness				
Capability	**Ascend**	**EGEAS/ Strategist**	**MIDAS/ PROMOD**	**Comment**
Intuitiveness and flexibility of user interface	√	√-	√-	PowerSimm has a transparent and easy to use interface that supports a broad set of portfolio management needs
Reporting	√	√-	√-	PowerSimm applies an on-line analytic platform (OLAP) cube to support quick and easy access of the data