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MEMORANDUM

January 24, 2014

To: Montana Public Service Commission

Re: Adequacy Assessment of NWE Application to Purchase Hydroelectric Facilities

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In January 2014, the State of Montana Public Service Commission (PSC or Commission) engaged Evergreen Economics (Evergreen) to assist Commission staff in reviewing analysis conducted by NorthWestern Energy (NWE) in support of its bid to acquire 11 hydroelectric generation facilities from PPL Montana. The scope of tasks to be performed by Evergreen by January 24 include:

A. **Analyze NWE's Application:** Provide the PSC with a preliminary analysis of the scope of key inputs and assumptions of NWE's portfolio analysis; investigate the mechanics of the PowerSimm model, the structural relationship between inputs and outputs, and the model's capacity to evaluate alternative resource scenarios and assist Commission staff in gaining an understanding of PowerSimm.
B. **Assess the Adequacy of NWE's Application:** Provide the PSC a written assessment of the adequacy of NWE's December 20, 2013 application in terms of its use of PowerSimm to provide the PSC with an adequate analysis of long term supply costs for an adequate set of alternative portfolio strategies.

This memorandum presents the results of Evergreen Economics' preliminary review and analysis of NWE's application for the purchase of the PPL hydroelectric generation facilities. Evergreen relied on reports provided by NWE to complete the assigned tasks. Consistent with the contract between the PSC and Evergreen Economics, Evergreen Economics did not obtain licenses to the PowerSimm program in order to run models or to replicate NWE's modeling efforts.

A. Summary of NWE's Application and Use of PowerSimm

In this section, we present the results of our initial review of NWE's application for the purchase of the PPL hydroelectric generation facilities and associated documents. To assist Commission staff and the Commission in gaining a better understanding of those aspects of the application related to PowerSimm modeling, this section focuses on the following:

1. Review of NWE's inputs and assumptions used to conduct the three alternative portfolios over the planning horizon.
2. Describe NWE's use of PowerSimm to analyze the alternative portfolios

A.1. Review of NWE Inputs and Assumptions

The NWE/PowerSimm model is developed using a set of key inputs and assumptions that define the expected revenues and costs of hypothetical resource portfolios. Inputs into the 2013 RPP modeling framework fall into the following categories, which Evergreen discusses in more detail below:

- Price Projections for Natural Gas, Coal, and Electricity
- Carbon Costs
- Electricity Generation Cost
- Other Economic Inputs (Inflation, Weighted Average Cost of Capital)

Below is a review of these inputs and assumptions.

Forward Price Projections
Forecasts of electricity and underlying commodity prices are required to determine future revenues from alternative hypothetical resource portfolios as well as the costs of operating the generation facilities. Prior to modeling the three alternative portfolios, PowerSimm was used to forecast natural gas and electricity prices.

Natural Gas Price Forecast
In the Pacific Northwest, a unit of natural gas is the typical marginal unit of electricity production; as such, it is a key determinant of electricity prices. NWE follows this convention and uses natural gas prices as a primary input for electricity price forecasting in PowerSimm as well as estimating costs of production from gas-fired generation facilities.

To forecast gas prices, historical spot prices for natural gas and forward natural gas price curves are input into the PowerSimm model along with historical weather, load and generation data. PowerSimm then uses this information to develop multiple randomized simulations of future gas price scenarios based on variations in supply and demand for electricity related to underlying weather conditions. This differs from previous RPPs in which NWE developed specific price cases to evaluate different potential scenarios.

Compared with the 2013 Northwest Power and Conservation Council's (NPCC) medium case gas price scenario and the 2013 Energy Information Administration's (EIA) reference case gas price scenario, the PowerSimm mean forecast is approximately equal for the first ten years of the planning horizon (2014–2024), but falls below these comparison forecasts for each year after 2024.

Carbon
NWE incorporates a carbon penalty into its projection of future electricity prices as a proxy for a national tax imposed as part of future regulations of greenhouse gases. NWE's RPP assumes this carbon tax would begin in 2021.

The net value of a megawatt hour (MWh) of electricity produced from a hydroelectric facility is equal to the market price of electricity minus the variable cost of hydro generation, which is zero or close to zero. In the NWE analysis, the market price of energy for most hours of the year is set by the generation cost of an efficient natural gas plant, which is usually the marginal supply resource during simulations of the regional electricity market. If a carbon policy that includes a tax or other cost on the right to emit carbon is implemented in the region, then cost of electricity generated in an efficient natural gas facility will include this cost, since gas generation typically produces .5 to .6 metric tons of carbon for each MWh of electricity generated. A tax on carbon will be reflected in the market price of electricity. Consequently, the value of electricity produced from a hydroelectric facility will reflect the cost of carbon that would have been emitted by the avoided generation resource, in this case an efficient gas plant.

Since the marginal generating resource for the market is not assumed to change across the three portfolios considered, the NWE analysis assumes the same electricity price forecast for each of the three portfolios. In other words, the value of any new generation is assumed to be the same for each portfolio and will reflect the carbon tax when in effect. However, for the combined-cycle portfolio, the additional value due to the impact of a carbon tax on market prices will be directly offset by the impact of the carbon tax on combined-cycle generation costs. For the hydroelectric portfolio, the portion of revenue associated with the carbon tax is not offset by the cost of carbon—since none is emitted—and, therefore, represents greater return to the producer.

NWE based its carbon penalty on the EIA Annual Energy Outlook GHG15 case.[1] The EIA GHG15 case assumes a carbon penalty of $15 per metric ton beginning in 2015, increasing by 5 percent each year thereafter. NWE used the EIA projection to develop a carbon penalty, which begins in 2021 at $20.11 per metric ton and increases by 5 percent per year. The carbon tax acts as a "Flat Market Adder," which is an estimate of the impact of the carbon penalty on the average electricity market price.

NWE developed the CO2 price projection outside the PowerSimm model and used it as an input in PowerSimm-based portfolio analyses. PowerSimm assumes a triangular distribution for each year of CO2 prices based on the yearly price representing the mean of the distribution, with zero (i.e., no carbon tax) representing the lower limit of the distribution and double the annual value representing the upper limit of the distribution.

Electricity Price Forecast

NWE developed projections of on-peak and off-peak electricity prices based on multiple randomized simulations based on historical spot prices of electricity and forward price curves, as well as the historical relationship between natural gas and electricity. NWE incorporates the carbon tax into the electricity price forecast beginning in 2021.

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[1] EIA. Annual Energy Outlook. April 2013. http://www.eia.gov/forecasts/aeo/table_e1.cfm

For the first two years of the planning period, NWE's electricity price forecast is approximately equal to the 2013 NPCC electricity price projection (based on delayed implementation of a federal CO2 tax). NWE's price forecast then falls below the NPCC forecast from 2016 to 2021, at which point the carbon penalty enters into the NWE price forecast. The two forecasts are approximately equal for 2021. However, from 2021 to the end of the planning period, the NWE forecast is consistently below the NPCC forecast. A similar relationship exists between NWE's 2013 RPP forecast and NWE's 2011 RPP forecast.

Coal Price Forecast

NWE incorporates a forecast of coal prices into the cost of operation of the Colstrip generation facility; however, there is no discussion of how this forecast was developed or how it compares to other forecasts.

Cost of Electricity Generation

Inputs considered in the portfolio analysis (see 2013 RPP, Table 5-8) include the nameplate capacity, capital costs, fixed O&M costs, variable O&M costs and heat rate by generation resource. NWE does not provide sources of the cost information for the hydro or other generating assets.[2] The RPP is also not clear as to whether the costs associated with the hydro facilities (shown in Table 5-8) enter the portfolio analysis as fixed values or as stochastic values drawn from a distribution developed from historical cost data. This distinction matters because the estimates of the "risk premium" presented in Volume 1, Chapter 6 show that the hydro portfolio has a substantially lower-risk premium than the other two portfolios. If the projections of costs for the hydro portfolio are based on fixed values (i.e., are deterministic), this likely explains at least some of the difference in the risk premium between the alternative portfolios.

Inflation

The PowerSimm analysis assumes a 2.1 percent inflation rate, which NWE applies to the forecast of electricity prices beginning in 2020 and continuing through the end of the projection. The inclusion of inflation accounts for the absence of forward price curves this far in the future. NWE also applies the inflation rate to estimates of costs for 2014 to develop estimates of costs for future years. Again, it is unclear if the costs enter the model as fixed values or as draws from a probability distribution.

Weighted Average Cost of Capital (WACC)

NWE assumes a WACC of 7.14 percent. The WACC is an estimate of the rate of return a third-party buyer would have to pay on the capital used to purchase the assets. NWE computed the 7.14 percent

[2] Joseph Stimatz testimony includes projected annual costs for the hydro facilities, seemingly obtained from PPL. It is unclear if these are the same costs that were included in the portfolio analysis conducted in PowerSimm.

rate based on a weighted average of the cost of equity and the cost of debt required to complete the purchase (Testimony of Brian B. Bird, p39):[3]

Source of Capital	Allocation	Cost / Return on Investment	Weighted Cost
Debt	52%	4.5%	2.34%
Equity	48%	10.0%	4.80%
		Rate of Return	7.14%

NWE uses the 7.14 percent WACC to discount future costs and revenues in its calculations of net present value (NPV) for each portfolio. The value of the discount rate has a substantial impact on the NPV calculation. The larger the WACC, the more that NWE discounts future costs and revenues in the NPV calculation. Table 1 presents a summary of the inputs for the PowerSimm used by NWE and Ascend Analytics.

Table 1: Inputs Considered by NWE in the Three Portfolios

Input	Description	Comments
Natural Gas Price Forecast	Generally regarded as the marginal price of producing electricity	Gas price forecast for 2013 RPP below 2011 RPP forecast; is about equal to both the 2013 EIA and 2013 NPCC's forecast through the first 10 years of the planning horizon and below both forecasts in the latter 10 years.
Electricity Price Forecast	Based on historical relationship with natural gas prices, historical spot prices and forward price curves	Includes "Flat Rate Adder" carbon penalty of $13.52/MWh beginning in 2021 and growing by 5 percent per year thereafter; 2013 RPP is below the 2011 RPP forecast and 2013 NPCC forecast.
Carbon Price Adjustment	Serves as a proxy for a potential penalty imposed as part of greenhouse gas regulation at some point in the future	The cost of thermal generating resources may include a carbon penalty in the future. 2013 RPP assumes this penalty will begin to be implemented in 2021 at a price of $20.11 growing 5 percent per year.
Coal Price Forecast	The estimated price of coal used to develop the cost of generation at the Colstrip plant	No explanation of how the coal price forecast was developed is provided.
Resource Operation and Cost Information	The resource operation characteristics such as nameplate capacity and heat rate as well as capital and operation costs of generating facilities	Resource operation and cost information is provided for alternative generation facility scenarios; however, the source of this information or how it was derived is not provided. Cost information is not provided for the current portfolio.
Inflation	Persistent increase in the general price of electricity and operating costs	2.1 percent per year. Used to scale current generating costs and commodity prices after 2020.
WACC	Weighted Average Cost of Capital. The rate of return a buyer will have to pay for capital to purchase assets	7.14 percent. The WACC is used as the discount rate for present value calculations.

Source: Analysis by Evergreen Economics of information provided by NWE

[3] There is some degree of ambiguity between the Stimatz testimony, which characterizes the 7.14 percent as the WACC that a third-party purchaser would likely pay for capital, and the Bird testimony, which characterizes the 7.14 percent as the WACC specific to NWE.

A.2. Use of PowerSimm to Analyze the Alternative Portfolios

The application of PowerSimm to model and compare the impact of alternative resource portfolios in NWE's 2013 Application included the following important capabilities:

Stochastic Modeling: Stochastic analysis enables the model to explicitly capture the impact that uncertainty in key inputs has on the value of each portfolio. The stochastic approach used in PowerSimm measures the value of alternative portfolios across a wide range of simulated future scenarios. Each scenario represents a unique combination of alternative model assumptions about commodity prices, weather, electric demand, market electricity prices and renewable resource generation. By simulating the operation of the NWE system across each scenario, the results can be captured as a probability distribution of the total costs of each portfolio and the net resource position, as well as more detailed summary operating statistics such as plant generation. PowerSimm computed estimates of the probability-weighted average of total costs, as well as the "risk premium" (defined as the expected value of all costs above the mean) using the probability distributions developed for each portfolio.

Structural Correlation between Uncertain Input Variables: In representing uncertainty in important model inputs, PowerSimm captures important correlations and structural relationships between input variables. For example:

- Commodity price forecasts are constructed from currently available futures prices for commodities.
- Variability in weather is modeled as the key driver of electric load, wind generation, hydro generation and spot gas prices.
- Electric load, wind generation, hydro generation and gas prices are, in turn, modeled as the key driver of electricity market prices.

Modeling Commodity Price Scenarios: A key feature of PowerSimm is that it more realistically captures the year-to-year dynamics of commodity prices over the time horizon of a specific scenario, rather than fixing the commodity price at specified "medium," "high," or "low" price trajectories for the entire study period. The forward price curves used in the model are consistent with the prices observed in current spot and futures markets for each commodity. The future price "paths" used in the model are produced by solving a system of simultaneous equations that (1) capture the uncertainty in commodity prices that is inherent in futures prices and (2) preserve the relationships between contract months, as well as other commodities, consistent with historical observations. In addition, the future paths used in the PowerSimm simulations preserve the mean-reversion behavior (i.e., that "spikes" in commodity prices do not typically persist, but tend to return over time to values closer to the average) exhibited in historical price paths.

Modeling Electricity Market Prices: Projections of electricity market prices are produced by simulating the operation of generating resources in the mid-Columbia region over the 20-year planning horizon. This regional simulation, which NWE has validated by "backcasting" results and

comparing to actual observed historical market prices, provides market prices used to simulate NWE system dispatch decisions. The first step in the regional simulation is to estimate electric load, which is a key driver of regional electricity prices. The load simulation uses a statistical approach known as a structural state-space model that estimates electricity demand (the dependent variable) as a function of seasonal demand patterns, daily and hourly time-series patterns, and weather (the independent variables). This approach also generates estimates of uncertainty in the demand simulation, as a direct output of the statistical model. Given the load forecasts and simulations of future gas prices, market prices are developed by simulating the operation of the regional electricity generation system, factoring in

- amount and availability of different generation resources;
- economic dispatch order of the resources;
- imports and exports;
- unplanned unit outages; and
- transmission outages.

Modeling CO2 Prices: Including a CO2 price in the analysis is important in representing the potential for regulatory action or legislation controlling the emission of CO2 in the future. PowerSimm incorporates a price on CO2 that reflects the EIA GHG15 (greenhouse gases priced at $15 per metric ton) scenario for baseline projection, consistent with NWE planning practice. To model uncertainty, PowerSimm uses a "triangle" distribution centered on GHG15, and ranging from $0 per ton to two times the annual EIA GHG15 scenario price. The CO2 price is not included in PowerSimm until 2021, reflecting the expectation by NWE of the timing of actual implementation of a carbon policy in the Pacific Northwest.

The CO2 price is added to the projected market price of electricity, which is based on the heat rate of the marginal resource in the region—gas-fired generation. Since carbon directly impacts both the market price of electricity and the operating cost of carbon-emitting generation, the CO2 price is considered a critical uncertainty in the analysis.

Validation of Model Inputs: The PowerSimm application to support the 2013 RPP for NWE contains extensive validation of the following simulated forecasts:

- Commodity prices: Prices for commodities such as natural gas and coal are calibrated to both the averages and uncertainty reflected in forward (futures) contracts for each commodity. In addition, the commodity simulations are tested to ensure a realistic correlation to market electricity prices, and to ensure that the time series of forecast prices demonstrate realistic reversion to the mean behavior.
- Weather: Weather simulations are validated against historical weather patterns to ensure that variability in maximum dry bulb temperatures across the year is consistent with historical experience.

- Electric load: Electric loads are modeled at the monthly, hourly and daily load profile level, and the simulations are compared to historical confidence intervals for each time span. Simulated electric loads are also validated against weather simulations to ensure that the historical relationship between load and weather is preserved.
- Electric spot market prices: Simulated market prices are validated to ensure that simulated results for historical periods match actual historical electricity prices, both in terms of mean values and in the range of uncertainty. As with electric loads, the calibration is performed for monthly and hourly time intervals, and for daily load profiles.
- Gas spot market prices: Simulated gas prices are validated to ensure that monthly variability is consistent with the range of variability in historical gas prices.
- Renewable generation: The simulation produces estimates of monthly variability in both wind output and hydroelectric generation. This variability is tested against the historical variability observed in the output of these resources.

Production Simulation: For each scenario, which represents a unique combination of uncertain model inputs such as temperature, electric load, gas prices and market electricity prices, PowerSimm performs a simulation of the operation of NWE's electricity generation system. The simulation is run for all years of the 20-year horizon under the assumptions defined by the specific scenario. The key characteristics of the simulation include:

- Hourly operational analysis: The simulation uses an hourly time step level of detail to capture the flexibility of generation resources in response to changes in load or plant outages.
- Market-based dispatch: Resources such as thermal plants in which the output level can be controlled ("dispatchable" resources) are dispatched to maximize resource profitability—that is, they are generally operated when the market price of electricity exceeds the variable operating costs of the resource.
- Renewable generation: Renewable resources such as hydro and wind are not dispatched based on market prices, but rather provide the total generation, as well as seasonal and daily generation profiles, available under the hydroelectric and wind conditions specific to the scenario.

Comparison of Alternative Portfolios: In comparing alternative portfolios to produce the 2013 Plan, PowerSimm evaluated each portfolio option over the same set of alternative scenarios. Generating the results across all scenarios produces a probability distribution of costs for each portfolio for each year of the simulation, as well as a probability distribution of estimates of net present value across all years. The distribution of results for each portfolio can be compared to the distributions of results for the other portfolios. The portfolios can also be summarized and compared in terms of expected value and risk premium. The expected value of costs for each portfolio is the probability-weighted average cost of operating the NWE system across all scenarios considered in the analysis. The risk premium is the probability-weighted average of costs above the expected value (mean value). That is, the risk

premium is defined as the average cost across all scenarios where the estimated cost is greater than the mean of all scenarios. For both the expected value and the risk premium calculations, the final results are summarized in terms of net present value across the 20-year planning horizon.

Detailed Outputs: A full system dispatch for each portfolio is performed for each year of each scenario, and at an hourly time step. These results can then be rolled up to annual summaries, by adding results over all hours within the year (or breaking out into high-load or low-load periods). Expected values are computed by calculating the probability-weighted average of the results across all scenarios developed for the evaluation. The primary detailed reports include:

- Net Position Report: Contains the annual generation of each generating resource, total load obligations, and net position between total system generation and load.
- Generating Stations Report: Contains detailed dispatch results for each generation resource, including generation output, capacity factor, fuel consumed, revenue, and key operating cost elements (fuel, emissions, variable O&M).
- Portfolio Supply Costs Report: Includes annual portfolio-level results for market purchases, power sales, fixed costs and operating costs for each portfolio evaluated used in the study.

B. Adequacy of NWE's Application

Based on our review of the documents provided by NWE, we believe the application and supporting documents fall short of providing the PSC with all of the information necessary to evaluate NWE's application, including information required by the Administrative Rules of Montana. This section provides an Adequacy Assessment, which evaluates the degree to which the three portfolios and the information relied on to conduct the portfolio analysis provide sufficient information for the Commission to find that the application is in the public interest. This section focuses on the following:

1. Clarifications on key inputs
2. Sources of electrical generation cost inputs
3. Adequacy of the three portfolios as a set of feasible alternatives

B.1. Clarifications on Key Inputs

Carbon

The future cost of carbon emissions, an externality not currently taxed at the State or Federal level, has a positive and materially significant impact on the value of hydroelectric assets relative to generation assets that do emit carbon. NWE's carbon price assumptions are in line with internal carbon pricing used by other investor-owned utilities (IOUs) for operational and planning purposes. We believe the Commission would benefit from a discussion of NWE's view on the risk associated with investing in carbon-emitting generation, including recent decisions and/or public statements by

the company that are consistent with the carbon tax assumptions used in the 2013 Resource Procurement Plan (RPP).

The Carbon Disclosure Project (CDP) recently released results from its annual disclosure process in 2013,[4] which find that most companies covered in its report expect some form of regulatory approach to addressing climate change in the future. Furthermore, "many major publicly traded companies operating or based in the United States have integrated an 'internal carbon price' as a core element in their ongoing business strategies". CDP states that utility and energy companies in particular are the most likely to employ internal carbon pricing schemes for strategic decision-making. The CDP noted that prices for carbon penalties covered a wide range from US $6-$60 per metric ton of carbon and cited $20 per ton as the average carbon price among utilities in North America.

Weighted Average Cost of Capital (WACC) Assumed in the Analysis

The WACC is an estimate of the rate of return a third-party buyer would have to pay on the capital used to purchase the assets. NWE assumes a WACC of 7.14 percent computed as the weighted average of the cost of equity and the cost of debt required for completing the purchase of the hydro facilities (Testimony of Brian B. Bird, p39). While we do not find the 7.14 percent value of the WACC to be unreasonable, it is 0.78 percentage points (78 basis points) below the discount rate of 7.92 percent used in NWE's 2011 RPP. All else constant, a lower discount rate results in higher calculated NPV. A brief discussion of the conditions (seemingly in the bond and equity markets) that led to this reduction between 2011 and 2013 would be beneficial.

B.2. Sources of Electrical Generation Cost Inputs

Costs considered in the analysis (see Table 5-8 of the 2013 RPP) include capital costs, fixed O&M costs, variable O&M costs and heat rate. NWE does not provide sources of the cost information for the hydro or other generating assets, making it difficult to assess if these costs are reasonable.[5] The RPP is also not clear as to whether the costs associated with the hydro facilities enter the portfolio analysis as fixed values or as stochastic values drawn from a distribution developed from historical cost data. This distinction matters because the estimates of the "risk premium" presented in Volume 1, Chapter 6 show that the hydro portfolio has a substantially lower risk premium than the other two portfolios. If the projections of costs for the hydro portfolio are based on fixed values (i.e., is deterministic), this may explain at least some of the difference in the risk premium between the alternative portfolios.[6]

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[4] CDP. *Use of Internal Carbon Price by Companies as Incentive and Strategic Planning Tool.* December 2013. https://www.cdp.net/CDPResults/companies-carbon-pricing-2013.pdf

[5] Joseph Stimatz testimony includes projected annual costs for the hydro facilities, seemingly obtained from PPL. It is unclear if these are the same costs that were included in the portfolio analysis conducted in PowerSimm.

[6] It is also not clear if the costs associate with the CCCT and current portfolios enter the analysis as fixed. However, the costs associated with these generating resources are likely less uncertain than the costs associated with the hydro facilities.

B.3. Adequacy of the Three Portfolios as a Set of Feasible Alternatives

The 2013 Resource Procurement Plan (RPP) submitted by NWE evaluates three alternative portfolios: (1) NWE's current portfolio as a base case, (2) a refined version of the preferred *combined cycle combustion turbine* (CCCT) option from the 2011 RPP, and (3) the acquisition of PPL's hydroelectric facilities. The 2013 RPP states, "These three scenarios bracket the full range of portfolio compositions contemplated in the 2011 plan."[7] NWE, however, provides no supporting documentation showing how these three portfolios bracket the full range of the 60 portfolios considered in the 2011 RPP.[8]

Administrate Rule of Montana (ARM) 38.5.8228 (2.c and 2.d) states:

c. *Testimony and supporting work papers describing the resource and stating the facts (not conclusory statements) that show that acquiring the resource is in the public interest and is consistent with the requirements in 69-3-201 and 69-8-419, MCA, the utility's most recent long-term resource plan (as modified by (2)(a)), and these rules;*
d. *Testimony and supporting work papers demonstrating the utility's estimates of the cost of the resource compared to the cost of each alternative resource the utility considered and all relevant functional differences between each alternative*

We do not believe the application or supporting documents provide all of the facts and related information necessary for the PSC to reach the conclusion to approve the acquisition of the hydro facilities into the rate base. This is not to say that we believe that the hydro facilities should not be added to the rate base, but rather that NWE is asking the Commission to make such a determination based on conclusory statements and not on the comparative cost information from the alternative scenarios, required in ARM 38.5.8228.

We do not believe that NWE needs to conduct a thorough portfolio analysis in PowerSimm on each of the alternative portfolios considered in the 2011 RPP in order to provide the PSC with the information required in ARM 38.5.8228. However, we do believe it is necessary for NWE to either conduct analysis in PowerSimm on a small number of additional alternative portfolios or describe in detail why considering such additional portfolios would not be competitive against the hydro portfolio and, therefore, need not be considered.

The additional alternative generation technologies that we believe NWE should address in its application and/or 2013 RPP include:

Simple Cycle Combustion Turbine (SCCT): The operating costs of SCCT generation are likely too high for it to be an alternative to the acquisition of the hydro facilities for meeting baseload demand. However, one or more SCCT could be part of a portfolio that also includes additional baseload generation from sources such as coal, wind, gas or biomass, with the SCCT

[7] Electricity Supply Resource Procurement Plan, December 2013, Vol. 1, Chapter 1, page 1-3, paragraph 3

[8] See Volume 1, Chapter 5 of the 2011 RPP for descriptions of the 60 portfolios.

serving to meet future peak demand with owned capacity. The 2013 RPP states that there is limited capacity available in its gas pipelines to supply a peaking generator, especially as gas loads to customers peak during winter. It is unclear whether such supply constraints will need to be resolved with or without the acquisition of the hydro facilities.

Supercritical Coal: A supercritical coal plant operates the steam cycle at a higher temperature than traditional subcritical plants, resulting in greater efficiency in electricity production and lower CO2 emissions per MWh of electricity produced. While supercritical coal may be a potential option for baseload duty, it is not without risks associated with permitting (both federal and state), possible future carbon taxation and construction costs.

Integrated Gasification Combined Cycle (IGCC): In IGCC generation, a carbon-based feedstock such as coal and/or biomass is gasified and the resulting gas is used as the fuel for a CCCT generator. The 2011 RPP notes that this type of generation *strictly for energy production* is rare in the U.S. and that the level of CO2 (about 0.8 tons) produced per MWh of generation, which while below the level of a traditional coal plant, is still greater than a gas CCCT generator.

Wind: NWE has invested heavily in wind generation. At about a 39 percent capacity factor, Montana has a substantial wind resource. Capital costs for wind generation is about $1,500 per installed kW, which is lower than for hydro. Moreover, like hydro, wind is a non-carbon-emitting resource with low variable cost. Nevertheless, among the potential impediments for additional wind generation may be siting, transmission, reliability of load, and combining with a source peak-load generation.

Woody Biomass: As is noted in the 2011 RPP, combustion of woody biomass may be able to play an important role in providing NWE with sustainable electrical generation. While the potential scale of biomass-generated electricity is well below that of the hydro acquisition, the 2011 RPP notes estimates of sufficient fuel to supply a 15 MW to 20 MW generator in each of five sawmills located within NWE's service territory. Depending on how one accounts for carbon emissions, biomass generation may or may not be considered carbon-neutral.

ARM 38.5.8228 is clear that it is not sufficient for NWE to simply conclude that acquisition of the hydro facilities is in the public interest without further explanation. We believe that NWE should either (a) demonstrate through portfolio analysis that purchase of the hydro facilities is better for ratepayers than pursuing investments in these alternative sources of electrical generation, or (b) clearly explain why purchase of the hydro facilities results in a better outcome for ratepayers (i.e., is in the public interest) than investment in these alternative technologies.

Finally, we again want to emphasize that the administrative rule is clear: the application to acquire the hydro facilities must be supported by work papers demonstrating NWE's estimates of the cost of the hydro facilities compared to the cost of each alternative resource the utility considered, and all

relevant functional differences between each alternative. From our review of the 2013 RPP, application for the hydro purchase, and associated testimony and exhibits, we do not believe NWE provides the Commission with the clear, concise information required in ARM 38.5.8228. Specifically, we believe that for each alternative portfolio, NWE should provide a similar NPV analysis as Mr. Stimatz provided for the hydro acquisition in Exhibit 1 of his testimony. The NPV analysis of each of the portfolios would be a complement, not a substitute, for the analysis NWE conducted using PowerSimm.