BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF SOUTH DAKOTA

IN THE MATTER OF THE COMPLAINT OF ENERGY OF UTAH, LLC AND FALL RIVER SOLAR, LLC AGAINST BLACK HILLS POWER INC. DBA BLACK HILLS ENERGY FOR DETERMINATION OF AVOIDED COSTS	**EL18-038**

DIRECT TESTIMONY AND EXHIBITS

OF

AMANDA M. THAMES

ON BEHALF OF

BLACK HILLS POWER, INC.
D/B/A BLACK HILLS ENERGY

May 7, 2019

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I. WITNESS INFORMATION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A: My name is Amanda M. Thames and my business address is 7001 Mt. Rushmore Road, Rapid City, South Dakota.

Q: BY WHOM ARE YOU EMPLOYED AND IN WHAT CAPACITY?

A: I am employed by Black Hills Service Company, LLC, a wholly-owned subsidiary of Black Hills Corporation ("BHC"), which provides centralized services to the companies within the BHC corporate family, including Black Hills Power, Inc. d/b/a Black Hills Energy (referred to as "Black Hills" or the "Company"). I am currently employed as a Senior Resource Planning Analyst in the Resource Planning Department.

Q: BRIEFLY DESCRIBE YOUR EDUCATIONAL BACKGROUND AND YOUR CURRENT DUTIES AND RESPONSIBILITIES.

A: I am a graduate of the University of North Dakota in Grand Forks, North Dakota, with a Bachelor of Science Degree in Industrial Technology. I began my career with BHC in 2012 in the Resource Planning Department as a Resource Planning Analyst. In March of 2016, I was promoted to a Resource Planning Analyst II. Most recently, in March of 2019, I was promoted to my current position of Sr. Resource Planning Analyst. In my current role, I provide support to BHC's electric utility subsidiaries by providing analytical assistance and strategic business support specific to the adequacy of electric energy and capacity and the costs of that energy and capacity to serve our customers' needs in the jurisdictions of South Dakota, Wyoming, Montana and Colorado.

Q: ON WHOSE BEHALF ARE YOU TESTIFYING?

A: I am testifying on behalf of Black Hills Power Inc. d/b/a Black Hills Energy.

II. PURPOSE OF TESTIMONY

Q: WHAT IS THE PURPOSE OF YOUR TESIMONY?

A: The purpose of my testimony is to provide the South Dakota Public Utilities Commission (the "Commission") with a description of Black Hills' avoided cost modeling, which I accomplished in response to Fall River Solar, LLC's ("Fall River") request for an avoided cost price and a Power Purchase Agreement ("PPA") for its proposed 80 MW solar facility. In doing so, I will identify the modeling software that Black Hills utilized in determining its avoided costs and explain why this software was utilized. I will also describe the basic steps involved in the modeling effort. I will identify the key inputs and assumptions within Black Hills' production cost model and address how avoided energy costs and avoided capacity costs were calculated. Finally, I will identify what was included in Fall River's avoided cost rate for avoided transmission costs.

III. EXHIBITS

Q: ARE YOU SPONSERING ANY EXHIBITS AS PART OF YOUR TESTIMONY?

A: Yes, I am.

Q: PLEASE DESCRIBE THOSE EXHIBITS?

A: I am sponsoring the following exhibits.

1. Exhibit AMT-1: A table of all of the supply resources in Black Hills' portfolio (whether utility owned or contractual) and considered as available resources within Black Hills' avoided cost model.
2. Exhibit AMT-2: The load and resource balance that was accomplished as part of the avoided cost modeling provided in March 2019.

3. Exhibit AMT-3: Comparison of costs of system dispatch with and without Fall River's 80 MW QF as an available resource, as provided in March 2019.
4. Exhibit AMT-4: Levelized Avoided Cost as provided in March 2019.
5. Exhibit AMT-5: The load and resource balance that was accomplished as part of the avoided cost modeling provided in August 2018.
6. Exhibit AMT-6: Comparison of costs of system dispatch with and without Fall River's 80MW QF as an available resource, as provided in August 2018.
7. Exhibit AMT-7: Levelized Avoided Cost as provided in August of 2018.
8. Exhibit AMT-8: The load and resource balance that was accomplished as part of the avoided cost modeling provided in April 2018.
9. Exhibit AMT-9: Comparison of costs of system dispatch with and without Fall River's 80MW QF as an available resource, as provided in April 2018.
10. Exhibit AMT-10: Levelized Avoided Cost as provided in April 2018.

IV. AVOIDED COST MODELING SOFTWARE

Q: WHAT MODELING SOFTWARE DID BLACK HILLS USE IN DETERMINING ITS AVOIDED COSTS?

A: Black Hills utilized ABB Enterprise Planning and Risk software to complete all of the Fall River avoided cost modeling. I will refer to that software throughout my testimony as "Planning and Risk."

Q: WHAT IS PLANNING AND RISK?

A: ABB's Enterprise Software Package has a number of different modules available that can assist with utility resource planning, cost modeling, and risk analysis. The Planning and Risk module is a production cost modeling tool, which can be used to determine a utility

system's energy and capacity costs, while taking into account different assumptions and inputs, including but not limited to items such as forecasted load, available supply resources, unit availability and forecasted market prices.

Q: WHAT DO YOU MEAN BY PRODUCTION COST MODELING?

A: At a high level, a production cost model simulates the hourly operation of the energy supply resources available to serve a utility's load and can further be used to forecast the associated hourly costs of serving system load. For purposes of this case, that hourly modeling is accomplished over the 20 year QF contract period. The production cost model forecasts the hourly cost of producing energy from utility owned generation and/or contracted resources, while considering whether the resource is fixed (referred to as "must-run") or dispatchable in nature. Based on the utility's load forecast, the model simulates a load for every hour and compares the marginal cost of the utility-owned generation and market prices and then economically dispatches the available generation resources to serve system load. The model also captures the associated production and purchased power costs associated with the forecasted dispatch. Production cost modeling can be used to look at the costs of serving system load with and without a proposed QF project.

Q: WHY DID BLACK HILLS USE PLANNING AND RISK TO PERFORM ITS AVOIDED COST MODELING IN THIS CASE?

A: Black Hills utilized Planning and Risk, as it is part of the same Enterprise Software that Black Hills uses when it prepares resource plans (including those prepared on behalf of affiliated energy companies) and its budgets. In addition, Planning and Risk provides an efficient way to model the costs associated with serving total system load. Finally, as I

will describe further below, Planning and Risk provides an efficient platform from which to determine the costs that the utility would avoid by adding the QF to its resource portfolio.

V. THE MODELING PROCESS

Q: CAN YOU GENERALLY DESCRIBE THE STEPS WHICH YOU TOOK WHEN USING PLANNING AND RISK TO MODEL BLACK HILLS' AVOIDED COSTS?

A: The first step in the modeling process is to identify the key inputs and assumptions that will be used within the Planning and Risk model, and enter those inputs and assumptions into the model. Once the inputs and assumptions have been entered into the model, the production cost model uses those inputs and assumptions to dispatch the resources economically to serve system load. The results of the modeling are then exported into Excel, and the results are checked for accuracy and reasonableness. This process is completed with all of the utility's existing and planned resources to provide a baseline assessment of the cost of serving Black Hills' system load (without QF). This process is repeated, but in the second run, the proposed QF is included as an additional resource available to serve Black Hills' system load (with QF). The results of the two modeling runs are compared, and the difference in the two represents the avoided cost.

Q: IN THE SECOND MODEL RUN (WITH QF), HOW IS THE QF RESOURCE TREATED WITHIN THE MODEL?

A: The QF resource is treated as a must-run resource and is dispatched to serve system load, regardless of economics, in a fashion that mirrors the QF's production profile.

Q: WHY IS THE QF TREATED AS A MUST-RUN RESOURCE FOR ALL HOURS IN THE PRODUCTION PROFILE?

A: The QF is treated as a "must-run" resource consistent with the QF production profile because the utility does not have operational control of the resource and must-take all of the energy produced, regardless of load requirements, marginal cost or market price during all times when that QF is producing energy.

Q: UNDER WHAT PORTFOLIO CONDITIONS COULD FALL RIVER BE DELIVERING ENERGY TO BLACK HILLS AND WHAT COSTS ARE CONSIDERED IN EACH SCENARIO?

A: There are three portfolio conditions in which Fall River could be delivering energy to Black Hills. In the first situation, the portfolio would otherwise be short energy to serve its hourly system load and would otherwise be making hourly market purchases (referred to as the "Short Case"). In this situation, Black Hills' avoided cost is represented by the forecasted price of any avoided hourly market purchases. In a second situation, the model demonstrates that Black Hills has adequate resources to serve its hourly system load, but can back-down or reduce its own dispatchable generation resources to compensate for any QF energy delivered to the system. In this situation, Black Hills' avoided cost is the marginal costs associated with any "backed-down" resource(s). In a third situation, Black Hills has adequate resources, at minimum generation levels, to serve its total system load and due to operational or contractual limitations, Black Hills cannot back down resources to an extent that it can accommodate the QF's energy production. Because supply resources are operating at minimum levels, due to operational or contractual limitation, and cannot be backed-down any further, no costs are avoided.

Q: HOW DOES THE MODEL IDENTIFY WHEN RESOURCES CANNOT BE BACKED DOWN ANY FURTHER?

A: Any conventional generating resource that has operational limitation or constraints on its ability to vary in output has an assigned minimum and maximum generation amount which is entered into the model. These minimum and maximum generation amounts essentially establish a ceiling and a floor on the amount of generation from the generating resource that can be provided in any given hour.

Q: DID BLACK HILLS' OVERALL MODELING APPROACH CHANGE BETWEEN THE TIME IT PROVIDED INITIAL INDICATIVE AVOIDED COST PROVIDED TO FALL RIVER IN APRIL 2018 AND THE AVOIDED COST PRICING PROVIDED TO FALL RIVER IN MARCH OF 2019?

A: No, it did not.

VI. KEY ASSUMPTIONS WITHIN BLACK HILLS' AVOIDED COST MODEL

Q: PLEASE IDENTIFY THE KEY ASSUMPTIONS USED WITHIN BLACK HILLS' MODEL?

A: The key assumptions used in the production cost model include: (1) an econometric, weather normalized load forecast for both system peak demand and energy; (2) variable costs associated with the utility's owned resources; (3) attributes of the utility's owned generation resources (e.g. heat rate, ramp rate, unit minimums and maximums, and fuel type); (4) contractual purchases and sales; (5) unit availability; and (6) forecasted commodity prices including natural gas, oil, purchased power, and coal. These key assumptions are described in more detail below.

Q: YOU INDICATED THAT ONE OF THE KEY ASSUMPTIONS IS AN ECONOMETRIC, WEATHER NORMALIZED LOAD FORECAST FOR

SYSTEM PEAK DEMAND AND ENERGY, PLEASE EXPLAIN WHAT THAT MEANS?

A: Because we are looking to determine the costs of serving Black Hills load with and without the QF, the model needs to include a forecast of the utility's anticipated system load over the QF contract period. In order to forecast system load, Black Hills considers historic load, historic weather, historic economic variables, forecasted normalized weather, and forecasted economic variables in order to forecast monthly peak demand and energy values throughout the QF contract period. These values are used to develop regression models that provide a more realistic and sophisticated forecast of the Company's anticipated demands and load growth by incorporating the effects of economic variables and normalized weather. Additionally, the anticipated effects of energy efficiency, line losses, and known and measurable large customer load forecasts are included in the system-level monthly peak demand and energy values.

Q: HOW DOES THE MODEL USE THE LOAD FORECAST?

A: The forecasted monthly system demand and energy is entered into the model for the QF contract period. The model uses an hourly 8760 system load shape to allocate the monthly system demand and energy values to an hourly level. This load shape is based on a historical hourly average load and is applied to each year of the QF contract period to determine the necessary resources to meet each hour's load.

Q: HAVE YOU PROVIDED A SUMMARY OF THE RESOURCES THAT ARE AVAILABLE FOR DISPATCH WITHIN BLACK HILLS' MODEL?

A: Yes, a table identifying Black Hills' supply resources (whether contractual or utility owned resources) is included as AMT-1. The table identifies the resource by name and maximum and minimum generating capacity, as applicable.

Q: YOU INDICATED THAT FORECASTED COMMODITY PRICES SUCH AS NATURAL GAS, PURCHASED POWER AND COAL ARE ALSO KEY MODELING ASSUMPTIONS, PLEASE IDENTIFY THE SOURCE BLACK HILLS USES FOR COMMODITY PRICING?

A: Generally, the Company uses forecast prices for natural gas and purchased power that are taken from an ABB's seasonal reference case. ABB's seasonal reference case is published semi-annually in the fall and spring. The avoided cost pricing provided to Fall River in August of 2018 and March of 2019 included the ABB 2018 Spring Reference Case for natural gas and purchased power prices among its key assumptions. The coal price forecasts which Black Hills uses are internally generated values based on the operating costs of the Wyodak Coal mine.

Q: WHAT NATURAL GAS FORECAST AREA WAS UTILIZED?

A: Black Hills utilized forecasted monthly natural gas prices for Colorado. This forecast incorporates a natural gas price forecast for Colorado from ABB's Reference Case for natural gas fired resources. Basis differential and transportation costs were added to ABB's Colorado Forecast to reflect the delivered price of natural gas.

Q: WHICH REFERENCED POWER MARKET PRICING AREA, WITHIN THE ABB FORECAST, ARE USED WITHIN BLACK HILLS' MODELING?

A: Two power market pricing areas are used within Black Hills' modeling for power prices: those include the Colorado-West pricing area and Palo Verde, Arizona hub.

Q: PLEASE EXPLAIN HOW THESE FUEL AND PURCHASED POWER PRICES ARE UTILIZED IN THE MODELING?

A: The forecasted fuel and purchased power prices are entered into the model to provide fuel and purchased power prices for the overall resource portfolio. These prices assist in providing the basis for the variable costs which will be attributable to Black Hills' owned generation resources and also provide the platform for hourly comparisons with power (market) prices. The model uses all of this information in determining an economic dispatch of the generation portfolio.

Q: YOU IDENTIFIED VARIABLE COSTS ASSOCIATED WITH UTILITY-OWNED GENERATION RESOURCES AS ANOTHER KEY ASSUMPTION UTILIZED BY THE MODEL, WHAT ARE SOME EXAMPLES OF VARIABLE COSTS AND HOW ARE THEY USED WITHIN THE MODEL?

A: Some examples of variable costs other than fuel are ammonia, water, chemicals, lime, lime freight, ash haul and other types of re-agents. The price associated with these types of variable costs are used by the model when determining the overall system costs and economic dispatch of the resources.

Q: YOU INDICATED THAT CONTRACTUAL PURCHASES ARE ONE OF THE KEY ASSUMPTIONS ENTERED INTO THE MODEL, PLEASE DESCRIBE HOW THEY ARE USED IN THE MODEL.

A: In addition to Black Hills' owned generation resources, Black Hills has certain pre-existing contractual obligations to purchased energy and capacity. These contractual purchases obligations are "take or pay" purchase power contracts. Because Black Hills has the obligation to pay for the full amount of the contract, regardless of need or load

requirements, the model treats these resources as "must-run" in its dispatch. The costs of any "take or pay" resource(s) will impact total system costs and can contribute to, or result in, the utility being "long" on resources without the ability to back-down resources or avoid costs.

Q: YOU IDENTIFIED CONTRACTUAL SALES AS A KEY ASSUMPTION WITHIN THE MODEL, PLEASE DESCRIBE HOW CONTRACTUAL SALES ARE RELEVANT TO MODELING AVOIDED COST.

A: In certain circumstances, Black Hills has a contractual obligation to serve the load of another entity. In these limited circumstances, the amount of the sales obligation is included within the load forecast and provides an opportunity to be served by available power supply resources, including the QF.

Q: HOW ARE THE ATTRIBUTES OF THE UTILITY'S OWNED GENERATION RESOURCES (E.G. HEAT RATE, RAMP RATE, MINIMUM AND MAXIMUM GENERATION LEVELS, AND FUEL TYPE) AND INFORMATION RELATING TO UNIT AVAILABILTY USED WITHIN THE AVOIDED COST MODEL?

A: These are all factors that the model must consider when determining the economic dispatch of Black Hills' generation portfolio. By way of example, a generating unit's heat rate, ramp rate, and fuel type can all play into operational considerations and constraints on the ability to "back-down" a unit and what the minimum generation level might be. Similarly, the model must consider the reality of unit outages for maintenance (unit availability) in forecasting the economic dispatch of the resources and thereafter the costs associated with serving the system load both with and without the QF.

Q: WHAT HAPPENS AFTER THE INPUTS ARE UPLOADED INTO THE PLANNING AND RISK MODEL?

A: The model calculates the hourly dispatch of Black Hills' supply portfolio for every hour of the 20 year QF contract period. Using forecasted purchased power costs, the model economically dispatches Black Hills' supply resources, all while considering any must-run obligations. In doing so, the model assesses the load and resource balance for each hour within the QF contract period and also identifies the three potential supply portfolio scenarios described above, including (1) the Short Case: Black Hills is short on energy supply resources to serve its load; (2) the Long Case: Black Hills has adequate energy supply resources as compared to its forecasted load, but can reduce its generation; and (3) the Long 2 case: Black Hills has adequate energy supply resources, even at minimum generating levels, as compared to its forecasted load and cannot further reduce its generation due to operational or contractual constraints.

Q: HOW IS FALL RIVER'S QF RESOURCE CONSIDERED WITHIN THE MODELING?

A: The process set forth above is actually run using two different scenarios: the first scenario includes the hourly dispatch of the utility's resource portfolio without Fall River over the entire QF contract period (without QF). The second scenario includes Fall River's solar facility as a "must-run" resource, as described above (with QF). The availability of Fall River's solar facility is based upon its production profile. The system cost output of both scenarios is compared to determine avoided costs.

Q: DOES THE MODELING THAT BLACK HILLS PEFORMED PROVIDE ANY CONSIDERATION OF AVOIDED CAPACITY?

A: Yes, it does.

Q: PLEASE EXPLAIN HOW THE MODELING CONSIDERS THE ISSUE OF AVOIDED CAPACITY?

A: Black Hills' load and resource balance determines whether there are capacity shortfalls during the QF period. As shown in Exhibit AMT-1, Black Hills only has intermittent seasonal capacity shortfalls in its annual peak month of July during certain years of the QF contract period. The results of the load and resource balance are imported into the production cost model, and the model procures firm energy contracts to satisfy the seasonal shortfalls. Specifically, the model procures a 6 X 16 firm energy product, which is priced at AZ- Palo Verde, but adds a firm capacity premium of 20%. Where the Fall River project reduces firm energy purchases that would otherwise have been required, they receive credit for avoidance of the purchases in the same fashion and based on the same market pricing.

Q: DID YOU APPLY AN ACCREDITED CAPACITY FACTOR TO THE FALL RIVER PROJECT WHEN DETERMINING THE CAPACITY CONTRIBUTION?

A: Yes, I used a 63% accredited capacity factor.

Q: CAN YOU EXPLAIN WHAT AN ACCREDITED CAPACITY FACTOR IS AND WHY IT WOULD BE APPLIED IN THIS SITUATION?

A: The accredited capacity factor is applied to variable generation resources for reliability planning purposes, in this case the Fall River solar facility. This is the amount of capacity that is accepted for reserve margin planning purposes within a load and resource balance.

Q: WHAT IS THE SOURCE OF THE 63% ACCREDITED CAPACITY FACTOR THAT YOU APPLIED TO THE FALL RIVER PROJECT?

A: The 63% accredited capacity factor is the same factor used for variable solar resources in an Integrated Resource Plan that was filed on November 30, 2018 for Black Hills' affiliate Cheyenne Light, Fuel and Power Company.

Q: WHAT IS THE PRACTICAL IMPACT OF APPLYING A 63% ACCREDITED CAPACITY FACTOR TO THE FALL RIVER PROJECT WHEN PROVIDING CONSIDERATION FOR AVOIDED CAPACITY?

A: The application of a capacity factor limits the amount of the capacity credit provided to Fall River to compensate for the fact that Fall River's generation output is dependent on the availability of the sun.

Q: HOW IS THE PROCESS DESCRIBED ABOVE TRANSLATED INTO AN AVOIDED COST PRICE?

A: The modeling results for each of these scenarios, with and without the QF, are exported into Excel for avoided cost calculations. The results include total hourly system costs consisting of fuel and other variable costs, market purchases, and contractual costs. The difference of the annual cost of each scenario (with and without the QF) is divided by the amount of energy supplied by Fall River and results in an avoided cost of energy.

Q: DID BLACK HILLS INCLUDE ANY CONSIDERATION FOR AVOIDED TRANSMISSION COSTS WHEN DETERMINING ITS AVOIDED COST RATE?

A: Yes, transmission costs are included for the avoided cost of transmission as it relates to avoided market purchases.

Q: WHAT COMPONENT OF THE AVOIDED COST IS FOR AVOIDED TRANSMISSION COSTS?

A: Black Hills $24.95 per MWh avoided cost included a levelized cost of avoided transmission of $0.15 per MWh.

Q: WHAT AVOIDED COSTS RESULTS HAS YOUR MODELING PRODUCED IN RELATION TO THE FALL RIVER PROJECT?

A: I have run three models for the proposed Fall River solar project. The first was in April of 2018 and included the Fall 2017 ABB Reference Case. This modeling also included 52MW of SD Sun as a utility owned resource. The modeling resulted in a $17.02 per MWh avoided cost price. I ran a second model in August of 2018. That model included the Spring 2018 Reference Case and reduced the production available from the SD Sun resource from 52MW to 20MW. This resulted in a 20 year levelized avoided cost of $21.77 per MWh. Most recently, I ran a model which eliminated SD Sun as an available resource. No other changes were made from the August 2018 modeling and this resulted in a 20 year levelized avoided cost of $24.95 per MWh.

Q: DO YOU ANTICIPATE ANY ADDITIONAL MODELING?

A: Yes. Consistent with the testimony of Kyle White, Black Hills anticipates supplementing prior modeling to address the fact that, previously, certain forecast pricing was not inflated prior to applying a discount factor and also to update the appropriate discount factor.

Q: DOES THIS CONCLUDE YOUR TESTIMONY?

A: Yes, it does.

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EL18-038

STATE OF SOUTH DAKOTA)
)SS
COUNTY OF PENNINGTON)

I, Amanda M. Thames, being first duly sworn, on oath state that I am Sr. Resource Planning Analyst for Black Hills Service Company, LLC, which is an affiliate of the Respondent, Black Hills Power, Inc. d/b/a Black Hills Energy, in this proceeding, whose Direct Testimony and Exhibits were prepared by me or under my supervision. I am providing this testimony on behalf of Black Hills Power, Inc., and certify that the contents of the enclosed Direct Testimony and Exhibits are true and correct to the best of my knowledge, information, and belief.

Amanda M. Thames

Subscribed and sworn to before me this 7 day of May, 2019.

Notary Public Kylie Griffith
My Commission Expires December 19, 2019