

**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 EXHIBIT

OF

JAMES MCMAHON

ON BEHALF OF

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

May 7, 2019

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I. INTRODUCTION

Q. PLEASE STATE YOUR NAME, EMPLOYER, AND TITLE.

A. My name is James McMahon. I am a Vice President at Charles River Associates (“CRA”) in the energy practice.

Q. PLEASE DESCRIBE CRA AND YOUR JOB FUNCTION.

A. CRA is a consulting firm that offers economic, financial, and strategic expertise to support our clients in business decisions, regulatory and litigation proceedings, and market and policy analysis. CRA’s energy practice advises electric utilities, power developers, investors, and other energy market participants in the areas of strategy, market analysis and forecasting, asset transactions and valuation, resource planning, and regulatory support and compliance. I specialize in utility investment planning and transaction support and have advised many utilities in the U.S. I currently oversee many of CRA’s utility projects and utility client relationships, working on a broad range of topics related to resource planning, market price forecasting, and electric rate analysis.

Q. HOW LONG HAVE YOU BEEN IN YOUR ROLE AND WHAT POSITIONS DID YOU HOLD PRIOR TO CRA?

A. I have been in my current role at CRA for approximately five years. Overall, I have more than twenty years of experience in energy consulting with CRA and other firms. A consistent theme in my client work has been evaluating complex utility investment decisions.

1 **Q. HAVE YOU TESTIFIED PREVIOUSLY BEFORE THE PUBLIC UTILITIES**
2 **COMMISSION OF THE STATE OF SOUTH DAKOTA (“COMMISSION”)?**

3 A. No, I have not.

4 **Q. HAVE YOU TESTIFIED IN OTHER JURISDICTIONS?**

5 A. Yes, I have submitted testimony before the following public utility commissions:
6 Arkansas, Missouri, Oklahoma, California, Kansas, and Wyoming. I also have submitted
7 testimony at FERC.

8 **Q. PLEASE DESCRIBE YOUR EDUCATION.**

9 A. I hold a J.D. and a M.B.A. from the College of William and Mary, and a B.A. in
10 Economics from Tufts University. A copy of my resume is attached to my testimony as
11 Exhibit JM-1.

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

13 A. I have been engaged by Black Hills Power ("Black Hills") to review Black Hills' avoided
14 cost calculations related to a proposed Qualifying Facility (“QF”) contract with the Fall
15 River Solar, LLC generating facility (“Fall River”). I have been asked to opine on
16 whether the methodology relied on by Black Hills to calculate avoided costs is consistent
17 with PURPA as it has been interpreted and implemented by South Dakota. I also have
18 been asked to opine on whether Black Hills' modeling produces a result that is reflective
19 of Black Hills' expected avoided costs. Finally, I have been asked to review the
20 testimony of Fall River's witness Mr. Mark Klein and respond to claims he makes
21 regarding Black Hills' calculation of avoided costs.

1 **Q. HOW ARE YOU QUALIFIED TO RENDER AN OPINION IN THIS MATTER?**

2 A. As I indicated earlier, I have more than twenty years of experience consulting with utility
3 clients and other electric market participants on complex investment decisions. I have
4 provided independent guidance and expertise to a range of utilities including Northern
5 Indiana Public Service Company, DTE Energy, Liberty Utilities, FirstEnergy, CPS
6 Energy, Southern Company, and Duke Energy. I have also provided my expertise to
7 generation developers including Macquarie Infrastructure, OMERS, PSP Investments,
8 Perella Weinberg, and Siemens. My work for these clients has included designing and
9 developing integrated resource plans, capital allocation, conducting valuation studies, and
10 conducting energy procurements. To support these client engagements my teams
11 frequently run market models similar to the models relied on by Black Hills to develop
12 avoided cost estimates.

13 **Q. PLEASE SUMMARIZE YOUR CONCLUSIONS REGARDING THE**
14 **COMPANY’S CURRENT APPLICATION.**

15 A. In my testimony I draw the following conclusions:

- 16 • Black Hills calculated avoided costs for Fall River consistent with PURPA and
17 the methodology endorsed by the South Dakota Public Utilities Commission
18 (“Commission”).
- 19 • Black Hills' avoided cost modeling produces a result that is reflective of its
20 expected avoided costs.
- 21 • The method that Witness Mark Klein employed to calculate the avoided costs for
22 Fall River QF is flawed.

1 **Q. WHAT MATERIALS AND INFORMATION HAVE YOU REVIEWED IN**
2 **FORMING YOUR OPINION?**

3 A. I have reviewed the following information to form my opinion: (1) PURPA and the
4 federal and state regulations and orders implementing the rule; (2) recent South Dakota
5 regulatory orders involving QF avoided costs; (3) outputs of Black Hills' modeling of Fall
6 River's avoided cost; (4) Witness Klein's testimony and Witness Vrba's testimony; and
7 (5) discovery produced by Fall River.

8 **Q. HOW IS YOUR TESTIMONY ORGANIZED?**

9 A. I have structured my testimony in five parts:

- 10 • First, I provide background on Fall River's complaint and the difference between
11 Fall River's and Black Hills' calculations of avoided costs;
- 12 • Second, I discuss the correct methodology for calculating avoided costs in South
13 Dakota based on PURPA and interpretation of PURPA by this Commission;
- 14 • Third, I describe Black Hills' calculation of avoided energy and capacity costs;
- 15 • Fourth, I describe Black Hills' modeling of avoided energy and capacity costs;
16 and
- 17 • Fifth, I rebut many of the arguments made by Mr. Klein and Mr. Vrba.

18 **II. BACKGROUND OF FALL RIVER'S COMPLAINT**

19 **Q. PLEASE PROVIDE YOUR UNDERSTANDING OF FALL RIVER SOLAR LLC**
20 **AND THE PROJECT THE COMPANY IS DEVELOPING.**

21 A. Fall River Solar LLC, a subsidiary of Energy of Utah LLC, is seeking to develop an 80
22 MW solar farm in Fall River County, near Oelrichs, South Dakota. The solar farm was

1 granted Qualifying Facility (“QF”) status in February 2018¹, as that term is defined by
2 PURPA.^{2,3}

3 **Q. WHAT IS THE NATURE OF FALL RIVER’S COMPLAINT THAT IS THE**
4 **SUBJECT OF YOUR TESTIMONY?**

5 A. Fall River has filed a complaint with the Commission that requests the Commission to
6 enter an order that, among other things, requires Black Hills to enter into a 20-year power
7 purchase agreement with Fall River at a levelized avoided cost of \$41.66 per MWh of
8 energy and capacity produced by Fall River.

9 **Q. DOES BLACK HILLS AGREE WITH FALL RIVER’S AVOIDED COST**
10 **CALCULATION?**

11 A. No. Black Hills' position is that Fall River’s avoided cost estimate is significantly
12 inflated. Black Hills has calculated an avoided cost of \$24.95 per MWh compared to Fall
13 River’s estimate of \$41.66 per MWh.⁴

14 **Q. WHAT ARE THE PRIMARY DIFFERENCES BETWEEN FALL RIVER’S AND**
15 **BLACK HILLS' CALCULATIONS OF AVOIDED COST?**

16 A. I observe significant methodological differences between Fall River’s and Black Hills'
17 avoided cost calculations. These differences apply to both the energy and capacity cost
18 calculations. For the energy cost calculation, the primary difference is that Fall River

¹ FERC Form 556 of Energy of Utah LLC [Fall River]. Docket No. QF18-630-000. (Filed on February 14, 2018)

² In the Matter of the Complaint of Energy of Utah, LLC and Fall River Solar, LLC against Black Hills Power, Inc. Complaint for Determination of Avoided Cost. Paragraph 9.

³ Title 18 CFR § 292.203 - General requirements for qualification.

⁴ Black Hills had previously calculated avoided costs in association with ongoing negotiations with Fall River. Documents exchanged between the Parties show that, on or about August 29, 2018, Black Hills provided modeling outputs and assumptions supportive of a \$21.77 avoided cost price which, at that point included a 20MW solar resource associated with SD Sun in the Black Hills resource portfolio. I have reviewed the August 2018 outputs and it appears the August 2018 modeling was accomplished in the same manner, as that provided in 2018 other than elimination of the SD Sun solar resource from the portfolio.

1 calculates an avoided energy cost in hours when Black Hills is long energy (supply
2 exceeds load) and unable to back down generation to strictly meet its load requirements.
3 This might occur in hours where substantial renewable intermittent energy is operating
4 and baseload plants are operating at their minimum levels. Black Hills' position is that in
5 these hours the avoided energy cost is zero, because Black Hills is not avoiding any costs
6 even if Fall River would be producing in these hours. This approach balances the goals
7 of PURPA in furthering a competitive market while holding customers indifferent to the
8 generation source.

9 For the capacity cost calculation, the primary difference is that Fall River uses the
10 cost of constructing, operating, and maintaining a new solar plant (net of energy margins)
11 as the avoided capacity cost. Black Hills, on the other hand, calculates avoided capacity
12 cost based on the seasonal firm market purchases it expects it would avoid by relying on
13 Fall River's capacity. Black Hills' position is that the cost of a new plant is not an
14 accurate reflection of the capacity price over the forecast period as the Company is able
15 to secure significantly cheaper capacity in the market and has a relatively small capacity
16 requirement, notwithstanding.

17 **III. METHODOLOGY FOR DETERMINING AVOIDED COSTS**

18 **Q. WHAT ARE AVOIDED COSTS AND WHY ARE THEY RELEVANT TO**
19 **CALCULATING PAYMENTS TO QUALIFYING FACILITIES?**

20 **A.** PURPA created a legal obligation for electric utilities to purchase energy and capacity
21 from QFs at just and reasonable and non-discriminatory rates.⁵ A rate that equals the

⁵ Title 18 CFR § 292.303. Electric utility obligations under this subpart.

1 electric utility's avoided cost was deemed just and reasonable.⁶ Avoided costs are
2 defined under the federal rules as "the incremental costs to an electric utility of electric
3 energy or capacity or both which, but for the purchase from the qualifying facility or
4 qualifying facilities, such utility would generate itself or purchase from another source."⁷

5 **Q. HAS SOUTH DAKOTA PUBLISHED RULES OR REGULATIONS RELATED**
6 **TO THE IMPLEMENTATION OF PURPA AND THE METHODOLOGY FOR**
7 **CALCULATING AVOIDED COSTS?**

8 A. Yes. Order F-3365,⁸ published in December 1982, provides some guidance. The Order
9 adopts a recommendation proposed by Staff to value avoided energy based on the
10 average of the expected hourly incremental avoided costs calculated over the hours in the
11 appropriate peak and off-peak hours.

12 **Q. DO RECENT COMMISSION ORDERS REGARDING THE CALCULATION OF**
13 **QF AVOIDED COSTS PROVIDE CLEAR GUIDANCE AS TO THE**
14 **COMMISSION'S INTERPRETATION OF PURPA?**

15 A. Yes. Most recently, in December 2017, the Commission resolved a dispute between
16 Consolidated Edison Development and Northwestern Corporation ("Northwestern")
17 regarding the methodology for calculating avoided costs, among other things.⁹ This
18 dispute related to three South Dakota wind projects that had been designated as QFs.
19 Likewise, in 2013, the Commission resolved a dispute related to a QF avoided cost

⁶ Title 18 CFR § 292.304. Rates for purchases.

⁷ Title 18 CFR § 292.101. Definitions.

⁸ *In the Matter of the Investigation of the Implementation of Certain Requirements of Title II of the Public Utilities Regulatory Policy Act of 1978 Regarding Cogeneration and Small Power Production*, Docket No. F-3365, Decision and Order (December 14, 1982).

⁹ *In the Matter of the Complaint by Consolidated Edison Development, Inc. against Northwestern Corporation dba Northwestern Energy for Establishing a Purchase Power Agreement*, Docket No. EL16-021 (December 20, 2017).

1 calculation between Oak Tree Energy LLC ("Oak Tree") and Northwestern. Oak Tree
2 was a wind generation project in Clark County, South Dakota.¹⁰ Taken together, both
3 cases provide clear guidance as to how South Dakota intends PURPA's avoided cost
4 calculation to be applied in cases involving vertically integrated utilities.

5 **Q. HAVE YOU APPLIED THIS GUIDANCE FROM THE COMMISSION IN**
6 **FORMING YOUR IMPRESSION OF THE CORRECTNESS OF BLACK HILLS'**
7 **AVOIDED COST METHODOLOGY?**

8 A. Yes, in my opinion Black Hills has calculated avoided costs consistent with the
9 methodology that has been endorsed by the South Dakota Commission.

10 **IV. BLACK HILLS' METHODOLOGY FOR DETERMINING AVOIDED COST**

11 **Q. DID BLACK HILLS DETERMINE AN AVOIDED COST ASSOCIATED WITH**
12 **FALL RIVER'S PROPOSED PRODUCTION?**

13 A. Yes, in an email dated March 8, 2019, Black Hills advised Fall River that it had
14 calculated a proposed avoided cost for Fall River of \$24.95 per MWh on a 20-year
15 levelized cost basis. This updated avoided cost accounted for removal of the South
16 Dakota Sun project from Black Hills' resource assumptions.¹¹

17 **Q. DID BLACK HILLS' AVOIDED COST CALCULATION INCLUDE BOTH**
18 **CAPACITY AND ENERGY?**

¹⁰ *In the Matter of the Complaint by Oak Tree Energy LLC against Northwestern Energy for Refusing to Enter into a Purchase Power Agreement*, Docket No. EL-006, (May 17, 2003).

¹¹ Black Hills had previously calculated avoided costs in association with ongoing negotiations with Fall River. Documents exchanged between the Parties show that, on or about August 29, 2018, Black Hills provided modeling outputs and assumptions supportive of a \$21.77 avoided cost price which, at that point included a 20MW solar resource associated with SD Sun in the Black Hills resource portfolio. I have reviewed the August 2018 outputs and it appears the August 2018 modeling was accomplished in the same manner, as that provided in 2018 other than elimination of the SD Sun solar resource from the portfolio.

1 A. Yes, Black Hills' avoided cost calculations include an energy component and a capacity
2 component.

3 **Q. IN PREPARING THIS TESTIMONY, HAVE YOU BEEN MADE AWARE THAT**
4 **BLACK HILLS INTENDS TO UPDATE THE AVOIDED COST CALCULATION**
5 **THAT HAS BEEN PROVIDED TO FALL RIVER?**

6 A. Yes. I understand that Black Hills will be updating its avoided cost calculation for Fall
7 River to reflect changes to the inflation factor and discount rate.

8 **IV-1. AVOIDED ENERGY COSTS**

9 **Q. PLEASE SUMMARIZE THE METHODOLOGY THAT BLACK HILLS USED**
10 **TO CALCULATE THE AVOIDED ENERGY COST.**

11 A. Black Hills calculated avoided energy costs based on what the utility can actually avoid
12 by purchasing Fall River's output. Black Hills identified two circumstances where this
13 could occur. First, where Black Hills is short energy in a given hour and Fall River is
14 producing energy in that same hour, Black Hills could avoid the purchase of energy in the
15 market by relying on Fall River's output. In these hours, Black Hills' modeling credited
16 Fall River the expected market price of power for avoided energy cost purposes. Black
17 Hills referred to this situation as "Short". Second, in hours where Black Hills' resources
18 are meeting its load requirements, but can be backed down to accommodate energy from
19 Fall River, Black Hills can avoid the cost of operating the highest cost units by relying on
20 Fall River's output. In these hours, Black Hills' modeling credited Fall River the variable
21 cost of the dispatchable resource with the sequentially highest variable cost. Black Hills
22 referred to these hours as "Long".

1 **Q. DO “SHORT” AND “LONG” COVER ALL HOURS WHERE FALL RIVER MAY**
2 **BE PRODUCING POWER?**

3 A. No. A third category of hours, referred to as “Long 2” by Black Hills, is defined as hours
4 when Black Hills is meeting its load requirements with its owned or contracted resources
5 at minimum generating levels. In these hours, Black Hills cannot back down its
6 resources.

7 **Q. WHY WOULD BLACK HILLS BE IN A SITUATION WHERE IT CANNOT**
8 **BACK DOWN RESOURCES?**

9 A. For at least two reasons: operational limitations and contractual terms. First, generation
10 resources have inter-temporal operating constraints such as minimum operating levels,
11 ramp rates, and start-up and shutdown times that prevent them from following the
12 optimal dispatch command. For example, a coal plant with 8 hours minimum run time
13 cannot be taken off line after its start-up is completed for 8 hours even if its variable cost
14 is greater than the system marginal price. Similarly, most generation resources have a
15 designed minimum operating level. For coal plants, that varies between 35% and 50% of
16 nominal capacity.¹² Second, Black Hills has certain contracts with "take or pay"
17 provisions, meaning the company cannot avoid cost by refusing the energy. Black Hills'
18 "take or pay" contracts are discussed in more detail in the testimony of Kyle White.

19 **Q. DID BLACK HILLS CALCULATE ANY AVOIDED ENERGY COSTS IN “LONG**
20 **2” HOURS?**

¹² See Bird, L. Milligan, M and Lew, D. (2013). Integrating Variable Renewable Energy: Challenges and Solutions. National Renewable Energy Laboratory Technical Report. NREL/TP-6A20-60451. Page 8. Available at: <https://www.nrel.gov/docs/fy13osti/60451.pdf>

1 A. No. In Long 2 hours, Black Hills calculated the avoided energy cost as zero because
2 Black Hills could not avoid any energy costs with production from Fall River.

3 **Q. WHY DOES BLACK HILLS NOT AVOID ANY ENERGY COSTS IN LONG 2**
4 **HOURS?**

5 A. If Black Hills is unable to adjust its own resource output to accommodate the output from
6 Fall River, which is modeled as zero cost in Black Hills' model, then Black Hills is not
7 avoiding any cost.

8 **Q. IS THE METHODOLOGY USED BY BLACK HILLS TO CALCULATE**
9 **AVOIDED ENERGY COSTS CONSISTENT WITH THE COMMISSION'S**
10 **GUIDANCE?**

11 A. Yes. Black Hills relied on the methodology for calculating avoided energy costs that was
12 expressly endorsed by the Commission in *Consolidated Edison Development v.*
13 *Northwestern Energy* ("*Consolidated Edison*"), which is the most recent dispute before
14 the Commission on avoided costs.

15 **Q. WHAT GUIDANCE DID THE *CONSOLIDATED EDISON* ORDER PROVIDE**
16 **REGARDING CALCULATING AVOIDED ENERGY COSTS WHEN THE**
17 **UTILITY IS IN A "SHORT" POSITION?**

18 A. In *Consolidated Edison*, the Commission found that "Northwestern can reduce its market
19 purchases by purchasing the energy from a QF, and therefore, its avoided costs are
20 market prices."¹³

¹³ *Consolidated Edison*, Docket No. EL16-021, at ¶32.

1 **Q. HOW DID BLACK HILLS CALCULATE AVOIDED ENERGY COSTS IN**
2 **“SHORT” SITUATIONS CONSISTENT WITH THE *CONSOLIDATED EDISON***
3 **ORDER?**

4 A. As described above, in “Short” hours where Fall River was expected to generate, Black
5 Hills credited Fall River with the market price of energy.

6 **Q. WHAT GUIDANCE DID THE *CONSOLIDATED EDISON* ORDER PROVIDE**
7 **REGARDING CALCULATING AVOIDED ENERGY COSTS WHEN THE**
8 **UTILITY IS IN LONG POSITION?**

9 A. In *Consolidated Edison*, the Commission found that “NorthWestern can reduce the output
10 of its resources by purchasing the energy from a QF, and therefore its avoided costs are
11 the variable costs of operating the highest cost generating resource for which
12 NorthWestern can reduce the output.”¹⁴

13 **Q. HOW DID BLACK HILLS CALCULATE AVOIDED ENERGY COSTS IN**
14 **“LONG” SITUATIONS CONSISTENT WITH THE *CONSOLIDATED EDISON***
15 **ORDER?**

16 A. As described above, in “Long” hours where Fall River was expected to generate, Black
17 Hills credited Fall River with the variable cost of the sequentially highest cost resource(s)
18 that was expected to be displaced by Fall River in that hour.

19 **Q. WHAT GUIDANCE DID THE *CONSOLIDATED EDISON* ORDER PROVIDE**
20 **REGARDING CALCULATING AVOIDED ENERGY COSTS WHEN THE**
21 **UTILITY IS IN LONG 2 POSITION?**

¹⁴ *Consolidated Edison*, Docket No: EL16-021 at ¶ 34.

1 A. In *Consolidated Edison*, the Commission found that, in the Long 2 situation, when a
2 utility cannot avoid any costs by purchasing more energy, its avoided costs are zero.¹⁵

3 **Q. HOW DID BLACK HILLS CALCULATE AVOIDED ENERGY COSTS IN**
4 **“LONG 2” SITUATIONS CONSISTENT WITH THE *CONSOLIDATED EDISON***
5 **ORDER?**

6 A. As described above, in “Long 2” hours where Fall River was expected to generate, Black
7 Hills calculated avoided costs as zero.

8 **IV-2. AVOIDED CAPACITY COSTS**

9 **Q. PLEASE SUMMARIZE THE METHODOLOGY THAT BLACK HILLS USED**
10 **TO CALCULATE THE AVOIDED CAPACITY COST.**

11 A. Black Hills calculated avoided capacity costs based on the capacity that Black Hills
12 expects to avoid if Fall River were available as a capacity resource to help Black Hills
13 meet its peak demand and reserve margin requirements. Black Hills determined that it
14 may be able to avoid certain seasonal capacity purchases with Fall River as a resource.

15 **Q. IS THE METHODOLOGY USED BY BLACK HILLS SIMILAR TO WHAT WAS**
16 **USED BY NORTHWESTERN IN *CONSOLIDATED EDISON*?**

17 A. Yes, it is similar in that Northwestern determined the capacity costs it could avoid if the
18 QF displaced an alternative resource. In the case of Black Hills, that alternative resource
19 is seasonal capacity purchases.

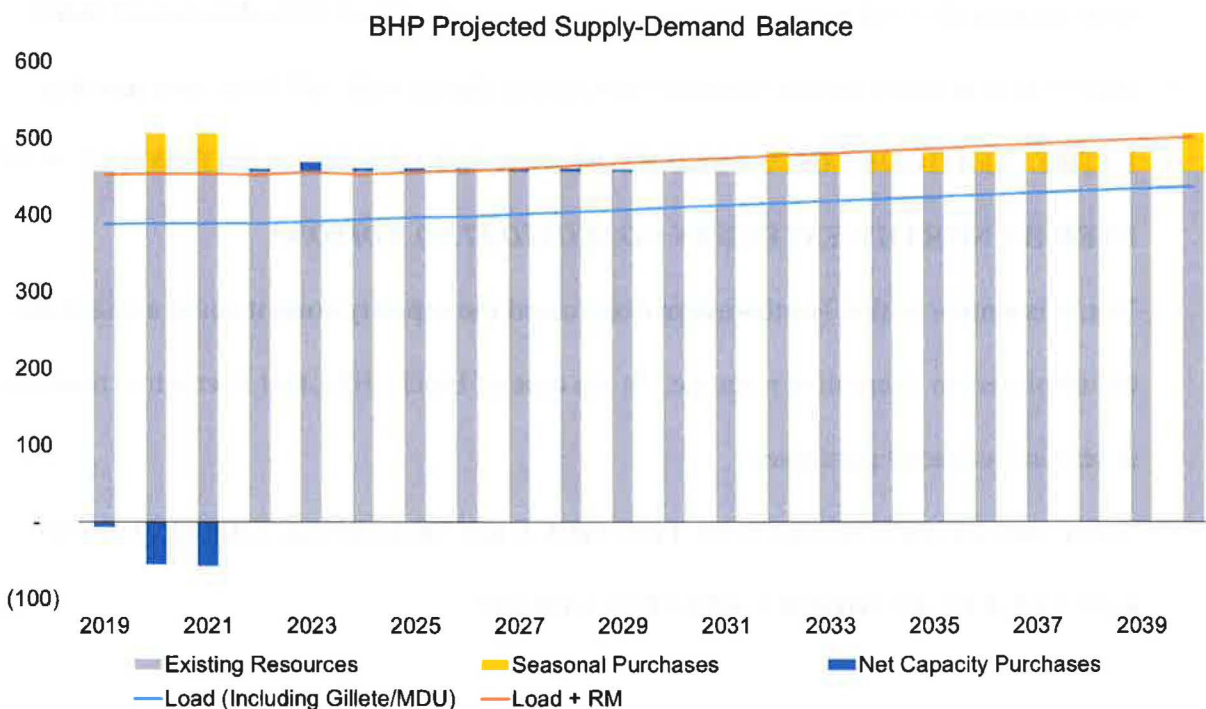
20 **Q. WHY DID BLACK HILLS USE THE PRICE OF SEASONAL CAPACITY TO**
21 **CALCULATE AVOIDED CAPACITY COSTS?**

¹⁵ *Consolidated Edison*, Docket No: EL16-021 at ¶ 36.

A. Black Hills currently has an intermittent capacity gap of 0 MW to 50 MW that it meets through seasonal purchases. This reflects Black Hills' expectation of only modest load growth of 0.6% p.a. over the 20-year forecast period. At this point, Black Hills expects to meet all anticipated capacity shortages over the 20 year forecast period through this same mechanism.

Q. DOES BLACK HILLS ANTICIPATE CONSTRUCTING ANY NEW CAPACITY TO MEET CAPACITY SHORTAGES OVER THE 20 YEAR CONTRACT PERIOD?

A. No. Black Hills expects less than a 50 MW gap over the 20-year forecast period, which it plans to meet through seasonal firm purchases during limited months in the forecast period, as it does currently. Figure 1 illustrates Black Hills' forecast annual load-resource balance.



1 **Q. HOW DID BLACK HILLS DETERMINE A PRICE FOR SEASONAL**
2 **CAPACITY?**

3 A. Black Hills estimates the cost of seasonal capacity based on the price for firm delivery of
4 an on-peak block of energy for months where it expects to be short capacity. Black Hills
5 forecasts the price of this block of energy based on the forecast price of a 6 x 16 on-peak
6 energy contract, plus a firm capacity premium of 20%.

7 **Q. WHY IS THE PALO VERDE HUB USED FOR PRICING THE COST OF**
8 **SEASONAL PURCHASES?**

9 A. Palo Verde is used as a pricing benchmark as it is a liquid trading hub in the western
10 wholesale market and has relatively more transmission access than the Mid-Columbia
11 trading hub in the Pacific Northwest.

12 **Q. IN YOUR OPINION, IS BLACK HILLS' APPROACH FOR DETERMINING**
13 **THE COST OF SEASONAL PURCHASES REASONABLE?**

14 A. Yes, I think Palo Verde is a reasonable pricing point for estimating the cost of seasonal
15 purchases given that Black Hills is not in an organized market and Palo Verde provides
16 an accessible and transparent market for procuring power.

17 **V. BLACK HILLS' MODELING OF AVOIDED COSTS**

18 **Q. PLEASE DESCRIBE THE MODELS THAT BLACK HILLS USED TO**
19 **CALCULATE AVOIDED COSTS CONSISTENT WITH THE**
20 **METHODOLOGIES DISCUSSED ABOVE.**

21 A. Black Hills used Planning and Risk, a production cost and portfolio model licensed from
22 ABB Inc., to calculate avoided capacity and energy costs consistent with the
23 methodologies discussed above.

1 **Q. WHAT IS MEANT BY A PRODUCTION COST AND A PORTFOLIO MODEL?**

2 A. A production cost model forecasts the hourly cost of producing energy from a utility's
3 owned or contracted resources. This forecast reflects that some resources have a fixed
4 output and some resources are dispatchable. A production cost model forecasts the
5 output of dispatchable resources based on how the marginal production cost of each such
6 resource compares to the market price of power in a given hour.

7 A portfolio model determines the mix of utility resources and market purchases,
8 needed for the utility to exactly meet its load obligation in each hour. In each hour when
9 the sum of energy from utility owned or contracted resources is short of the utility's
10 energy requirements, the portfolio model determines the market purchases that are
11 needed to balance the utility's system.

12 **Q. DID BLACK HILLS USE PLANNING AND RISK PRODUCTION COST AND**
13 **PORTFOLIO MODULES TO CALCULATE BOTH AVOIDED ENERGY AND**
14 **AVOIDED CAPACITY COSTS CONSISTENT WITH THE METHODOLOGY**
15 **DISCUSSED ABOVE?**

16 A. Yes.

17 **Q. PLEASE EXPLAIN HOW BLACK HILLS USED PLANNING AND RISK TO**
18 **CALCULATE AVOIDED ENERGY COSTS CONSISTENT WITH THE**
19 **METHODOLOGY DISCUSSED ABOVE.**

20 A. As I described above, Black Hills calculated avoided energy costs related to Fall River in
21 three situations: (1) in hours where Black Hills was forecast to be short energy; (2) in
22 hours where Black Hills was able to meet load with expected generation from its owned
23 or contracted resources but could back down production to accommodate energy

1 expected to be generated by Fall River; and (3) in hours where Black Hills was able to
2 meet load with expected generation from its owned or contracted resources running at
3 minimum levels, and could not back down generation to accommodate energy that would
4 be expected to be generated by Fall River.

5 Black Hills ran the production cost model for a 20 year forecast period. Black
6 Hills ran two scenarios, one where Fall River was part of Black Hills' resource mix and
7 one where Fall River was not. In situation (1), where Black Hills was short energy, the
8 model calculated the cost of the additional energy from Fall River at the market price of
9 power in those hours. This is the price at which Black Hills would have procured this
10 additional energy absent production from Fall River. Thus, the avoided cost of energy
11 was based on the market price of power. In situation (2), the model displaced the
12 sequentially highest cost Black Hills generation resource(s) with Fall River because a
13 Black Hills resource could be backed down, or avoided. Thus, the avoided cost of energy
14 was based on the marginal cost of the displaced resources. In situation (3), a Black Hills
15 resource could not be backed down to accommodate Fall River, thus the price of avoided
16 energy was zero in those hours.

17 **Q. CAN YOU DESCRIBE THE MARKET PRICE FORECAST USED IN THE**
18 **PRODUCTION COST MODELING?**

19 A. Black Hills subscribes to a semi-annual market price forecasting service from ABB.

20 **Q. IN YOUR EXPERIENCE, IS ABB'S FORECAST CONSIDERED A RELIABLE**
21 **SOURCE FOR MARKET PRICE AND NATURAL GAS PRICE FORECASTS?**

22 A. Yes. In my experience, many utilities and a range of other industry participants rely on
23 ABB's electricity and natural gas price forecasts. I have seen ABB's forecasts relied upon

1 in resource planning, certificate filings, and commercial due diligence involving power
2 generation transactions.

3 **Q. WHAT PORTION OF THE \$24.95 PER MWH AVOIDED COST IS**
4 **ATTRIBUTABLE TO THE AVOIDED ENERGY COMPONENT?**

5 A. Of the \$24.95 per MWh avoided costs, avoided energy is \$23.53 per MWh on a 20-year
6 levelized cost basis.¹⁶

7 **Q. HOW DID YOU ASCERTAIN WHAT PORTION OF THE \$24.95 AVOIDED**
8 **COST WAS ATTRIBUTABLE TO THE AVOIDED ENERGY COMPONENT?**

9 A. I reviewed the change in Black Hills' system costs between a modeling run where the
10 Fall River facility was included in the Black Hills supply portfolio and a modeling run
11 where it was excluded. These modeling runs are described more fully by Black Hills'
12 Witness Amanda Thames. I determined avoided energy costs as the difference between
13 the variable operations and maintenance, fuel, and start-up costs for Black Hills' thermal
14 units, as calculated in the two model runs.

15 **Q. PLEASE EXPLAIN HOW BLACK HILLS USED PLANNING AND RISK TO**
16 **CALCULATE AVOIDED CAPACITY COSTS CONSISTENT WITH THE**
17 **METHODOLOGY DISCUSSED ABOVE.**

18 A. As I described above, Black Hills calculated avoided capacity costs as the seasonal
19 purchases that the Fall River plant would be expected to displace. Black Hills used a
20 three-step approach to model these effects. First, Black Hills calculated the difference
21 between required capacity and Black Hills' owned or contracted resources in each month
22 of the forecast period. Black Hills ran this analysis for two cases: one where Fall River

¹⁶ Includes \$0.15 per MWh for avoided transmission cost.

1 was included in the Black Hills' supply portfolio and one where it was not. In the case
2 where Fall River was included in the supply portfolio, Fall River's nominal capacity was
3 reduced to 50.4 MW for capacity accreditation purposes (based on a 63% capacity credit
4 for solar). Second, where a shortage existed, Black Hills calculated the cost of procuring
5 the required capacity based on a Palo Verde index price, as described above. Third,
6 Black Hills incorporated the costs of acquiring seasonal capacity into the Planning and
7 Risk production cost model to capture a total avoided cost impact.

8 **Q. WHY DID BLACK HILLS USE A 63% ACCREDITATION FACTOR FOR**
9 **CALCULATING FALL RIVER'S CAPACITY?**

10 A. Accreditation Factor refers to the percentage of a resource's nameplate capacity that can
11 be counted toward meeting system peak demand. An intermittent resource, like solar,
12 will not reliably be available during all peak hours. Therefore, the accreditation factor
13 will be lower than 100%. According to the testimony of Amanda Thames, Black Hills
14 used a 63% accreditation factor for solar in its modeling, including for Fall River. Black
15 Hills utilized this accreditation factor because it recently had been used in resource plans
16 for an affiliated energy company.

17 **Q. IN YOUR OPINION, IS IT APPROPRIATE FOR BLACK HILLS TO USE A 63%**
18 **ACCREDITATION FACTOR?**

19 A. I have not conducted an independent evaluation of the appropriate accreditation factor for
20 Fall River. However, I was able to review capacity accreditation of solar resources in
21 other markets. Black Hills' accreditation of Fall River's capacity (of 63%) appears to be
22 on the high end of solar resources when comparing to resources in organized markets
23 where accreditation data was readily observable. For instance, I noted that the average

1 accreditation factor for solar resources in PJM was 47% in 2018.¹⁷ As another example,
2 the Midcontinent Independent System Operator ("MISO") uses a 50% accreditation
3 factor for new solar resources.

4 **Q. DID BLACK HILLS USE THE SAME MODEL THAT NORTHWESTERN USED**
5 **TO CALCULATE AVOIDED COST IN THE *CONSOLIDATED EDISON***
6 **DEVELOPMENT CASE?**

7 A. No, but the model Black Hills used is similar to the one used by Northwestern.
8 Northwestern used the PowerSimm software for its production cost and portfolio
9 modeling. This tool is licensed from Ascend Analytics. While PowerSimm has many
10 capabilities not relevant to avoided cost calculation, one of its key functionalities is
11 production cost and portfolio modeling, which it performs almost identically to Planning
12 and Risk.

13 **Q. WHAT PORTION OF THE \$24.95 PER MWH AVOIDED COST IS**
14 **ATTRIBUTABLE TO AVOIDED CAPACITY?**

15 A. Of the \$24.95 per MWh avoided costs, avoided capacity is \$1.42 per MWh, all on a 20-
16 year levelized cost basis.

17 **Q. HOW DID YOU ASCERTAIN WHAT PORTION OF THE \$24.95 PER MWH**
18 **AVOIDED COST WAS ATTRIBUTABLE TO THE AVOIDED CAPACITY**
19 **COMPONENT?**

20 A. I reviewed the change in Black Hills' system costs between a modeling run where the
21 Fall River facility was included in the Black Hills supply portfolio and a modeling run
22 where it was excluded. These modeling runs are described more fully by Black Hills'

¹⁷ PJM 2018 State of the Market Report.

1 Witness Amanda Thames. I determined avoided capacity costs as the difference in the
2 cost of seasonal capacity purchases between the two model runs.

3 **VI. OPINION ON BLACK HILLS' MODELING APPROACH AND**
4 **CALCULATIONS**

5 **Q. ARE YOU FAMILIAR WITH THE ABB MODEL THAT WAS UTILIZED BY**
6 **BLACK HILLS FOR PURPOSES OF THE FALL RIVER AVOIDED COST**
7 **CALCULATION?**

8 A. Yes. Although CRA uses a different modeling software for production cost modeling
9 and portfolio modeling, I understand the functionality of the ABB Planning and Risk
10 software well. I have led projects in the past where the production cost and portfolio
11 modeling was completed by ABB using its models. I've also reviewed the inputs and
12 outputs of the software with Black Hills' lead modeler, Amanda Thames.

13 **Q. CAN YOU PROVIDE EXAMPLES OF WHERE YOU HAVE RELIED ON ABB'S**
14 **MODELS IN OTHER PROJECTS?**

15 A. Yes. One example is a current engagement with The Empire District Electric Company.
16 I am an expert in a resource planning analysis that involves similar ABB models to those
17 used at Black Hills. I am responsible for reviewing all of the inputs and outputs of the
18 models, understanding the models' functionality, and providing an opinion on
19 reasonableness. In that work, I determined that the models were industry standard and
20 reasonable in addressing resource questions.

21 **Q. CAN YOU DESCRIBE YOUR REVIEW OF THE MODELING PERFORMED BY**
22 **BLACK HILLS?**

1 A. Yes. I have reviewed the key inputs and outputs of the modeling and met with Black
2 Hills' modeler Amanda Thames.

3 **Q. BASED ON YOUR REVIEW OF THE MODELING INPUTS AND OUTPUTS**
4 **AND BLACK HILLS' APPROACH TO MODELING, IS IT YOUR OPINION**
5 **THAT THE MODEL IS BEING USED CORRECTLY?**

6 A. Yes. The model appears to function as intended and is being used correctly.

7 **Q. HOW DID YOU FORM THIS OPINION?**

8 A. In a couple of ways. First, the outputs of the modeling were intuitive and consistent with
9 what I would have expected based on the inputs provided. Second, the structure of the
10 model and approach to populating inputs that I reviewed with Ms. Thames is similar to
11 models CRA licenses and, on that basis, appeared reasonable.

12 **Q. IN YOUR OPINION, DID BLACK HILLS CALCULATE THE AVOIDED COSTS**
13 **ASSOCIATED WITH FALL RIVER CORRECTLY?**

14 A. The calculation of the \$24.95 per MWh appears correct based on the modeling
15 completed. As I noted above, I understand Black Hills plans to supplement its price and
16 modeling to reflect a change in the inflation rate and discount rate.

17 **Q. HOW DID YOU FORM YOUR OPINION?**

18 A. I formed my opinion based on my understanding of PURPA and recent guidance
19 provided by the Commission as to the calculation of avoided costs. I also formed my
20 opinion after reviewing the analysis that went into calculating the avoided cost of
21 \$24.95 per MWh.

22 **Q. PLEASE DESCRIBE YOUR REVIEW OF BLACK HILLS' ANALYSIS**
23 **SUPPORTING THE ENERGY COMPONENT OF THE AVOIDED COST.**

1 A. I reviewed the detailed output spreadsheets from the ABB models that showed the hours
2 when avoided energy costs were being calculated by the model. I also reviewed the
3 pricing used to calculate avoided energy costs in the Short hours to make sure it was
4 consistent with the ABB market price forecast, which it was.

5 **Q. PLEASE DESCRIBE YOUR REVIEW OF BLACK HILLS' ANALYSIS**
6 **SUPPORTING THE CAPACITY COMPONENT.**

7 A. First, I reviewed Black Hills' load-resource balance, which indicates for each month of
8 the forecast period the net dependable capacity, the forecast load, and the reserve margin.
9 Second, I reviewed Black Hills' calculation of its capacity short or long position in each
10 month of the forecast period. Third, I reviewed Black Hills' calculation of the seasonal
11 purchases that would be required to fill Black Hills' intermittent short position in any
12 month for cases with and without Fall River. Fourth, I reviewed Black Hills' calculation
13 of the seasonal capacity purchases that would be avoided with Fall River. Finally, I
14 reviewed Black Hills' calculation of the value of those seasonal purchases based on
15 pricing at Palo Verde, as described earlier.

16 **Q. IN YOUR OPINION, DID BLACK HILLS ACCOUNT FOR CAPACITY**
17 **CORRECTLY?**

18 A. Yes.

19 **VII. WITNESS MARK KLEIN'S AVOIDED COST CALCULATION METHOD**

20 **Q. DOES MR. KLEIN AGREE WITH BLACK HILLS' CALCULATION OF**
21 **AVOIDED COST RELATED TO THE FALL RIVER QF CONTRACT?**

22 A. No. Mr. Klein disagrees with how Black Hills calculated the energy component of
23 avoided cost and the capacity component of avoided cost.

1 Q. WHAT IS MR. KLEIN'S CRITICISM OF BLACK HILLS' CALCULATION OF
2 AVOIDED CAPACITY COST?

3 A. Mr. Klein believes that Black Hills did not calculate an avoided cost of capacity: "Black
4 Hills did not include any allowance for the value of capacity in its calculations, despite
5 the requirement in federal law that an avoided cost calculation should include . . . the
6 incremental costs . . . of electric energy or capacity or both . . ." ¹⁸

7 Q. IS MR. KLEIN CORRECT THAT BLACK HILLS DID NOT CALCULATE AN
8 AVOIDED CAPACITY COST?

9 A. No. As I described in detail above, Black Hills' avoided cost of \$24.95 per MWh
10 includes both avoided energy costs and avoided capacity costs.

11 Q. WHAT DOES MR. KLEIN CONCLUDE IS THE CORRECT AVOIDED
12 CAPACITY COST FOR FALL RIVER?

13 A. Mr. Klein calculates an avoided capacity cost of \$19.81 per MWh.

14 Q. HOW DOES MR. KLEIN MAKE HIS AVOIDED CAPACITY COST
15 CALCULATION?

16 A. In several steps oriented around calculating the supposed capacity benefit of a proxy solar
17 plant. First, Mr. Klein projects the levelized cost of electricity ("LCOE") from the South
18 Dakota Sun I plant over a 20-year period as \$53.35 per MWh. Mr. Klein's LCOE
19 estimate represents his estimate of the total discounted cost to construct, operate, and
20 maintain the South Dakota Sun I plant, divided by the energy he expects it would

¹⁸ Direct Testimony and Exhibits of Mark Klein. *In the Matter of the Complaint of Energy of Utah, LLC and Fall River Solar, LLC against Black Hills Power, Inc.* Docket No. EL18-038. Page 11, Lines 22-23.

1 produce. In simple terms, LCOE represents the amount the plant would need to recover
2 per megawatt hour generated to exactly recover its all-in costs over its lifetime.

3 Next, Mr. Klein calculates the 20-year levelized avoided energy cost for the South
4 Dakota Sun I plant. Mr. Klein determines this value to be \$33.54 per MWh based on a
5 methodology that I describe more below.

6 Finally, Mr. Klein determines an avoided capacity cost of \$19.81 per MWh as the
7 difference between his LCOE estimate for South Dakota Sun I plant (\$53.35 per MWh)
8 and his estimate of the levelized avoided energy cost (\$33.54 per MWh).¹⁹

9 **Q. DO YOU SEE ANY PROBLEMS WITH MR. KLEIN'S APPROACH TO**
10 **CALCULATING AVOIDED CAPACITY COSTS?**

11 A. Yes, I see several problems with Mr. Klein's approach. First, Mr. Klein assumes that the
12 price of a new renewable resource should be used to price avoided capacity. As I stated
13 above, Black Hills does not have a need for a new plant and, moreover, expects to
14 procure any capacity shortages at a cost that is much lower than the unit cost (\$ per kW)
15 of a new resource. Black Hills expects that it can procure its monthly capacity shortages,
16 which range from 0 to 50 MW, through seasonal purchases. Seasonal purchases enable
17 Black Hills to procure capacity in the months when it is needed, rather than rely on a new
18 resource that provides capacity in all months, including months when it is not needed.
19 Based on Black Hills' avoided cost analysis, Black Hills can procure capacity at a cost of
20 \$1.42 per MWh. This compares to Mr. Klein's avoided capacity price calculation of
21 \$19.81 per MWh.

¹⁹ Direct Testimony and Exhibits of Mark Klein. *In the Matter of the Complaint of Energy of Utah, LLC and Fall River Solar, LLC against Black Hills Power, Inc.* Docket No. EL18-038. Page 11, Lines 22-23.

1 Second, even if the Commission were to conclude that the cost of a new power
2 plant was the right measure of avoided cost when Black Hills is able to procure
3 significantly lower cost capacity through seasonal purchases, this Commission has not
4 endorsed the proxy plant method that Mr. Klein suggests.

5 Finally, as I describe more fully below, I disagree with the methodology that Mr.
6 Klein uses to calculate the levelized avoided energy cost for South Dakota Sun I (Step 2,
7 above). In short, Mr. Klein includes in his avoided energy cost calculation hours where
8 Black Hills is in the "Long 2" position.

9 **Q. IS IT REASONABLE THAT ALL DEMAND GROWTH WOULD BE MET WITH**
10 **SEASONAL CAPACITY PURCHASES OVER THE NEXT 20 YEARS?**

11 A. Yes. Black Hills anticipates moderate load growth in demand for the next 20 years.
12 Black Hills' maximum capacity need never rises above 50MW, and many months is zero
13 or minimal. Moreover, the cost of the seasonal purchases necessary to meet anticipated
14 monthly shortages is expected to remain significantly below the equivalent cost from a
15 new capacity resource. Based on this expectation, I think it is reasonable that Black Hills
16 can continue to procure its capacity requirements through seasonal purchases, rather than
17 through a more costly resource addition.

18 **Q. WHAT IS MR. KLEIN'S CRITICISM OF BLACK HILLS' CALCULATION OF**
19 **AVOIDED ENERGY COST?**

20 A. Mr. Klein criticizes Black Hills for "not includ[ing] any payment to Fall River" in hours
21 when Black Hills is in what he refers to as a Long 2 position.²⁰

²⁰ Direct Testimony and Exhibits of Mark Klein. *In the Matter of the Complaint of Energy of Utah, LLC and Fall River Solar, LLC against Black Hills Power, Inc.* Docket No. EL18-038. Page 13, Lines 7-8.

1 **Q. WHAT DOES MR. KLEIN MEAN BY “LONG 2” POSITION?**

2 A. These are hours when Black Hills expects to generate more electricity than its load
3 requirements with Fall River included due to constraints on its ability to back down
4 generation from its owned or contracted resources for the aforementioned reasons.

5 **Q. WHY DOES MR. KLEIN BELIEVE THAT LONG 2 HOURS SHOULD BE**
6 **INCLUDED IN THE AVOIDED ENERGY COST CALCULATION?**

7 A. Mr. Klein believes that avoided energy costs should include hours when Black Hills has
8 no choice but to dump energy into the market. Mr. Klein apparently seeks to justify this
9 view, previously rejected by the Commission, by urging that “Black Hills has contractual
10 arrangements to sell all of the electricity it generates when it is in a long situation. Black
11 Hills realizes income from the sale of energy.”²¹

12 **Q. DOES BLACK HILLS IN FACT HAVE CONTRACTUAL ARRANGEMENTS IN**
13 **PLACE TO SELL ALL OF THE ELECTRICITY IT GENERATES WHEN IT IS**
14 **IN A LONG 2 SITUATION?**

15 A. No. Black Hills has relationships in place with other utilities to engage in bilateral trades
16 when one or the other utility is long or short, but not contractual arrangements, per se.
17 Black Hills is not a member of an organized market and must, therefore, rely on these
18 partners for buying or selling power as conditions on the system change.

19 **Q. IN YOUR OPINION, IS IT APPROPRIATE TO CALCULATE AVOIDED**
20 **ENERGY COSTS IN HOURS WHERE INCLUDING FALL RIVER IN THE**

²¹ Direct Testimony and Exhibits of Mark Klein. *In the Matter of the Complaint of Energy of Utah, LLC and Fall River Solar, LLC against Black Hills Power, Inc.* Docket No. EL18-038. Page 12, Lines 17-19.

**BLACK HILLS SUPPLY PORTFOLIO WOULD INCREASE OFF-SYSTEM
SALES?**

A. No. As I stated earlier in my testimony, Black Hills does not avoid costs in these hours. PURPA and recent Commission guidance make clear that energy costs must be avoided by the utility to be included in the utility's avoided cost calculation. PURPA defined avoided cost as "but for the purchase from the qualifying facility or qualifying facilities, such utility would generate itself or purchase from another source."²² Likewise, in *Consolidated Edison* the Commission found that in the Long 2 situation, when a utility cannot avoid any costs by purchasing more energy, its avoided costs are zero.²³

**Q. WHY WOULD IT BE BAD POLICY FOR THE COMMISSION TO INCLUDE
LONG 2 HOURS IN THE AVOIDED ENERGY CALCULATIONS?**

A. If Long 2 hours are included in the avoided energy calculation, Fall River is effectively being paid to deliver more power to the system than is needed to serve the utility's customers. Fall River would be paid a fixed price based on a forecast of the price at which the excess energy could be sold into the market. By guaranteeing the price to Fall River, Black Hills' customers would be at risk for any differences between the fixed price and actuals.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes, at this time.

**Q. DO YOU ANTICIPATE THAT YOU MIGHT NEED TO SUPPLEMENT
OR MODIFY YOUR TESTIMONY?**

²² 18 CFR §292.101(b)(b).

²³ *Consolidated Edison*, Docket No. EL16-021 at ¶36.

1 A. Given the current state of discovery and the reservations contained in the testimony of
2 Mr. Klein and Mr. Vrba, it is possible that I may need to provide supplemental testimony;
3 therefore I reserve the right to supplement, amend and/or modify this testimony.

**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**

[illegible]

James McMahon

My Commission Expires

4/12/2024

