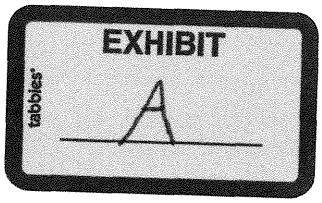

Avoided Cost Analysis for Fall River Solar

Introduction: Pacific Northwest Energy Consultants LLC (PNEC) has performed this avoided cost analysis for Fall River Solar. Fall River Solar is an 80 MW AC solar photovoltaic (PV) facility that will interconnect as a Network Resource approximately 22 miles from the Westhill 230 kV substation on the Westhill to Stegall 230 kV transmission line. The commercial operation date is December 31, 2020 (COD). The basis for this evaluation is the Black Hills Power (BHP) avoided cost study for Fall River provided on August 28, 2018 that uses the Spring 2018 Reference Case Assumptions. In this avoided cost study, BHP included in the resource stack a new planned 20 MW AC solar PV facility, SDSun Solar Phase 1.

In discussions between Fall River Solar and BHP, BHP disclosed that they we no longer pursuing two other solar PV projects totaling 32 MW. The planned commercial operation date for SDSun Solar Phase 1 (SD1) is late 2019 which will be challenging if PV panels have not been secured for the project.

Calculation of Lifecycle Cost for SD1:

To establish the avoided cost for Fall River Solar its necessary to calculate the 35-year lifecycle levelized cost of SD1 as this is the next resource to be added by BHP as an owned asset. PNEC uses recent cost data for the capital cost, development cost and operating cost related to three 20 MW solar PV facilities under construction in the Rocky Mountain area.

The cost elements are identified in Table 1

Table 1:

Cost Element		**Nominal $**
Capex	**$/Wdc**	
Interconnection		(715,000)
Collector Substation		(2,485,000)
Panels ($/Wdc)	$0.35	(8,400,000)
Tracker ($/Wdc)	$0.11	(2,640,000)
Inverters ($/Wdc)	$0.04	(840,000)
Balance of Plant	$0.40	(9,600,000)
Capex Subtotal		**(24,680,000)**
Development Cost		
Interconnection Study		(16,000)
Engineering		(25,000)
Legal		(25,000)
Permitting		(25,000)
Development Subtotal		**(91,000)**
Operating Costs (35 years)		

O&M		(3,425,280)
Insurance		(1,696,320)
Land Lease		(1,214,489)
Property Tax		(18,671,272)
Operating Cost Subtotal		**(25,007,360)**

To establish the levelized cost of SD1 over the entire 35-year life of the facility the following assumptions are shown in Table 2.

Table 2:

SD1 Solar Lifetime Cost Assumptions	
Size (MWdc)	24
Size (MWac)	20
Annual Generation (MWh)	43,441
Annual Degradation	0.50%
Project Life (Years)	35
Federal Tax Rate	21.00%
ITC	30.00%
Black Hills Power (WACC)	7.41%

The resulting levelized cost using the cost elements for Table 1 and the financial modeling assumptions from Table 2 the resulting levelized cost for SD1 over its entire 35-year lifetime is shown in Table 3 below.

Table 3:

Levelized SD1 Costs (2021) $/MWh	
Levelized Capex Costs	($48.29)
Levelized Development Costs	($0.21)
Levelized Operating Costs	($17.16)
ITC Benefit	$14.54
Depreciation and Taxes	($2.23)
Levelized SD1 Lifetime Cost	($53.35)

Calculation of the Levelized Energy Cost for SD1:

Using the BHP avoided cost study for Fall River provided on August 28, 2018 that uses the Spring 2018 Reference Case Assumptions, PNEC established the base BHP annual power cost for 2021 through 2040 by removing SDSun Solar Phase 1 (20 MW). After establishing the base BHP annual power cost, SD1 is added into the portfolio offsetting future purchases identified as BHP_Purchase_100 and the resulting reduction in future nominal annual power costs is identified in Table 4 below.

Table 4										
	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
BHP System Base No Solar ($000)	$21,249.93	$28,040.11	$31,860.55	$37,030.09	$37,684.82	$37,477.40	$38,511.73	$39,401.61	$37,465.39	$35,455.31
BHP System with SD1 (20MW) ($000)	$20,005.92	$26,785.77	$30,551.41	$35,701.46	$36,358.40	$36,071.86	$37,108.51	$37,910.05	$35,930.07	$33,884.68
Annual Avoided Cost of SD1 Solar Project ($000)	$1,244.01	$1,254.35	$1,309.14	$1,328.63	$1,326.42	$1,405.54	$1,403.22	$1,491.56	$1,535.32	$1,570.63
SD1 Production (GWh)	45.355	45.126	44.898	44.67	44.448	44.236	44.008	43.786	43.575	43.352
SD1 Avoided Cost ($/MWh)	$27.43	$27.80	$29.16	$29.74	$29.84	$31.77	$31.89	$34.06	$35.23	$36.23
	2031	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
BHP System Base No Solar ($000)	$36,015.03	$37,157.85	$37,562.82	$37,408.42	$38,257.32	$39,302.45	$39,452.44	$40,021.09	$40,667.91	$41,860.09
BHP System with SD1 (20MW) ($000)	$34,431.79	$35,552.99	$35,963.85	$35,770.78	$36,610.57	$37,648.89	$37,780.47	$38,307.55	$38,973.69	$40,133.30
Annual Avoided Cost of SD1 Solar Project ($000)	$1,583.24	$1,604.85	$1,598.96	$1,637.64	$1,646.74	$1,653.56	$1,671.97	$1,713.54	$1,694.22	$1,726.79
SD1 Production (GWh)	43.141	42.919	42.708	42.485	42.28	42.074	41.863	41.641	41.435	41.23
SD1 Avoided Cost ($/MWh)	$36.70	$37.39	$37.44	$38.55	$38.95	$39.30	$39.94	$41.15	$40.89	$41.88

Using the results from Table 4 and the weighted average cost of capital for BHP of 7.41% the levelized avoided cost of energy for SD1 is calculated in Table 5.

Table 5. Avoided Cost of SD1 (20 MW) Solar Project Summary - Fall 2018 Reference Case Forecasts

Avoided Energy Cost of SD1 (20 MW) Solar Project with Seasonal Firm Energy Purchases ($/MWh)		Annual Production (GWh)	Annual production reduction assumption	Annual Cost ($)	Levelized cost of energy	Levelized energy	Including the levelized avoided cost of Transmission
					$33.29	43,761	$33.54
2019							
2020							
2021	$ 27.43	45.36	1.000	$ 1,244,010			
2022	$ 27.80	45.13	0.995	$ 1,254,345			
2023	$ 29.16	44.90	0.995	$ 1,309,137			
2024	$ 29.74	44.67	0.995	$ 1,328,627			
2025	$ 29.84	44.45	0.995	$ 1,326,418			
2026	$ 31.77	44.24	0.995	$ 1,405,544			
2027	$ 31.89	44.01	0.995	$ 1,403,221			
2028	$ 34.06	43.79	0.995	$ 1,491,562			
2029	$ 35.23	43.58	0.995	$ 1,535,319			
2030	$ 36.23	43.35	0.995	$ 1,570,626			
2031	$ 36.70	43.14	0.995	$ 1,583,241			
2032	$ 37.39	42.92	0.995	$ 1,604,853			
2033	$ 37.44	42.71	0.995	$ 1,598,964			
2034	$ 38.55	42.49	0.995	$ 1,637,638			
2035	$ 38.95	42.28	0.995	$ 1,646,744			
2036	$ 39.30	42.07	0.995	$ 1,653,558			
2037	$ 39.94	41.86	0.995	$ 1,671,971			
2038	$ 41.15	41.64	0.995	$ 1,713,541			
2039	$ 40.89	41.44	0.995	$ 1,694,224			
2040	$ 41.88	41.23	0.995	$ 1,726,791			

Calculating the Cost of Capacity for SD1:

Previously the total levelized cost for SD1 over its entire 35-year lifecycle was established in Table 3 as $53.35 per MWh. Subtracting the levelized cost of energy of $33.54 per MWh for SD1 from the results in Table 5 establishes the levelized value of capacity as $19.81 per MWh.

Calculation of the Levelized Energy Cost for Fall River Solar:

Using the results from the calculation of the avoided cost of energy for SD1 and adding the annual generation from Fall River and further offsetting future purchases identified as BHP_Purchase_100 the resulting reduction in future nominal annual power costs is identified in Table 6 below.

Table 6										
	2021	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
BHP System New Base Case with SD1 ($000)	$20,005.92	$26,785.77	$30,551.41	$35,701.46	$36,358.40	$36,071.86	$37,108.51	$37,910.05	$35,930.07	$33,884.68
BHP System with Fall River (80MW) ($000)	$15,392.90	$22,988.64	$26,400.27	$31,083.91	$31,598.25	$31,378.15	$32,419.98	$32,502.67	$30,263.96	$27,926.68
Annual Avoided Cost of Fall River Solar Project ($000)	$4,613.02	$3,797.13	$4,151.14	$4,617.55	$4,760.16	$4,693.71	$4,688.53	$5,407.38	$5,666.10	$5,958.00
Fall River Production (GWh)	188.976	188.032	187.087	186.714	185.221	184.299	183.378	182.994	181.559	180.638
Fall River Avoided Cost ($/MWh)	$24.41	$20.19	$22.19	$24.73	$25.70	$25.47	$25.57	$29.55	$31.21	$32.98
	2031	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
BHP System New Base Case with SD1 ($000)	$34,431.79	$35,552.99	$35,963.85	$35,770.78	$36,610.57	$37,648.89	$37,780.47	$38,307.55	$38,973.69	$40,133.30
BHP System with Fall River (80MW) ($000)	$28,496.45	$29,338.64	$29,734.25	$29,470.08	$30,303.23	$31,239.10	$31,267.50	$31,890.00	$32,584.45	$33,782.92
Annual Avoided Cost of Fall River Solar Project ($000)	$5,935.34	$6,214.35	$6,229.60	$6,300.70	$6,307.34	$6,409.79	$6,512.97	$6,417.55	$6,389.24	$6,350.37
Fall River Production (GWh)	179.74	179.369	177.945	177.047	176.173	175.815	174.402	173.551	172.677	172.309
Fall River Avoided Cost ($/MWh)	$33.02	$34.65	$35.01	$35.59	$35.80	$36.46	$37.34	$36.98	$37.00	$36.85

Using the results from Table 6 and the weighted average cost of capital for BHP of 7.41% the levelized avoided cost of energy for Fall River is calculated in Table 7.

Table 7. Avoided Cost of Fall River 80 MW Solar Project Summary - Spring 2018 Reference Case Forecasts

Avoided Energy Cost of Fall River (80 MW) Solar Project with Seasonal Firm Energy Purchases ($/MWh)		Annual Production (GWh)	Annual production reduction assumption	Annual Cost ($)	Levelized cost of energy	Levelized energy	Including the levelized avoided cost of Transmission
					$28.70	182,466	$28.95
2019							
2020							
2021	$ 24.41	188.98	1.000	$ 4,613,022			
2022	$ 20.19	188.03	0.995	$ 3,797,126			
2023	$ 22.19	187.09	0.995	$ 4,151,136			
2024	$ 24.73	186.71	0.998	$ 4,617,555			
2025	$ 25.70	185.22	0.992	$ 4,760,158			
2026	$ 25.47	184.30	0.995	$ 4,693,710			
2027	$ 25.57	183.38	0.995	$ 4,688,532			
2028	$ 29.55	182.99	0.998	$ 5,407,382			
2029	$ 31.21	181.56	0.992	$ 5,666,105			
2030	$ 32.98	180.64	0.995	$ 5,958,003			
2031	$ 33.02	179.74	0.995	$ 5,935,337			
2032	$ 34.65	179.37	0.998	$ 6,214,349			
2033	$ 35.01	177.95	0.992	$ 6,229,597			
2034	$ 35.59	177.05	0.995	$ 6,300,702			
2035	$ 35.80	176.17	0.995	$ 6,307,338			
2036	$ 36.46	175.82	0.998	$ 6,409,788			
2037	$ 37.34	174.40	0.992	$ 6,512,971			
2038	$ 36.98	173.55	0.995	$ 6,417,552			
2039	$ 37.00	172.68	0.995	$ 6,389,236			
2040	$ 36.85	172.31	0.998	$ 6,350,375			

Calculation the Total Levelized Avoided Cost (Energy & Capacity) for Fall River Solar:

Table 7 establishes the avoided cost of energy for Fall River Solar at $28.95 per MWh and adding the levelized cost of capacity of $19.81 per MWh the all-in 20-year levelized avoided cost for Fall River Solar is $48.76 per MWh inclusive of energy and capacity.