2019 IRP Electric Supply-Side Resources - Energy Storage

Draft 7/24/18

2018 $	Units	Pumped Hydro Energy Storage		Battery Energy Storage System (BESS)			
		Closed Loop (8 Hour)	Closed Loop (8 Hour)	Li-Ion 2-hr (2 Cycles Daily)	Li-Ion 4-hr (2 Cycles Daily)	Flow 4-hr (2 Cycles Daily)	Flow 6-hr (2 Cycles Daily)
Nameplate Capacity	MW	500	300	25	25	25	25
Winter Capacity	MW						
Capacity Credit	%						
Operating Reserves	%	3%	3%	3%	3%	3%	3%
Capital Cost	$/KW	$2,612	$2,612	$1,550	$2,680	$1,732	$2,378
O&M Fixed	$/KW-yr	$14.55	$17.40	$20.54	$32.16	$30.80	$40.27
O&M Variable	$/MWh	$0.90	$1.50	$0.00	$0.00	$0.00	$0.00
Forced Outage Rate	%	1%	1%	<2%	<2%	<5%	<5%
Degredation	%/year	(a)	(a)	(d)	(d)	(d)	(d)
Operating Range (e)	%	147-500 MW (b)	112.5-300 MW (c)	2.0%	2.0%	2.0%	2.0%
R/T Efficiency	%	80%	80%	82%	87%	73%	73%
Discharge at Nominal Power	Hours	8	8	2	4	4	6
Location		PSE	PSE	PSE	PSE	PSE	PSE
Fixed Transmission	$/KW-yr	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Variable Transmission	$/MWh	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Flexbility Benefit	$/KW-yr						
First Year Available		2025	2025	2021	2021	2021	2021
Economic Life	Years	30+	30+	20	20	20	20
Greenfield Dev. & Const. Leadtime	years	5 - 8	5 - 8	1	1	1	1

Notes

PHES (assumed to represent a slice of a larger project).

a - PHES degradation close to zero

b - The operating range minimum is the average of the minimum at max (111 MW) and min head (183 MW).

c - The operating range minimum is the average of the minimum at max (86 MW) and min head (139 MW).

Li-ion BESS: Additional capacity prepurchased included in capital to ensure 20 yr operating life

d - Fixed O&M costs costs include augmentation by OEM ensuring MW and MWh rating for project life.

e - Battery can discharge upto the indicated percent of nameplate