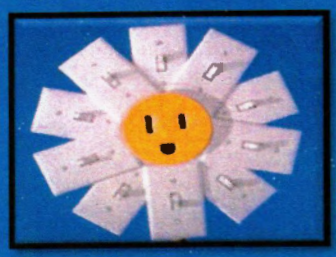

2015 Integrated Resource Plan Volume I

Let's turn the answers on.

HEARING SUBMITTAL TO
DIVISION OF WATER RIGHTS
Right No.: 89-74, 1285, 1513
Date: 20 DEC 2016
Submittee: ~~PROTESTANT~~
MATT PACENZA

1/3

March 31, 2015

PACIFICORP | Pacific Power
Rocky Mountain Power

Table 6.6 – Cumulative Maximum Renewable Selection Limits by Year for the Regional Haze Reference Case

Type	Renewable Resource	Capacity Factor	Total MW Available		
			2020	2021-2022	2028-2034
Wind	Oregon Wind (Arlington)	29%	0	400	400
	Washington Wind (Walla Walla)	29%	0	600	600
	Utah Wind (South)	31%	0	400	400
	Idaho Wind (Goshen)	31%	0	800	800
	Wyoming Wind (Aeolius)	43%	0	0	762
Solar	Oregon Solar (Lakeview)	29%	405	405	405
	Washington Solar (Yakima)	22%	200	200	200
	Utah Solar (South)	32%	800	800	800
Geothermal	Utah Geothermal (Milford)	90%	30	30	30
	Oregon Geothermal (Neal Hot Springs)	90%	30	30	30

Nuclear

The supply side resource table includes two nuclear technology options. One is the larger 2,236 MW system, which reflects the traditional sized plant based on current state-of-the-art advanced licensed plants; it is modeled on the Westinghouse AP1000 technology currently being employed in Southern Company's construction of Vogtle Units 3 & 4 in Georgia. This is the technology that Blue Castle Holdings has indicated is the design basis for its proposed Blue Castle nuclear facility currently in development near Green River, Utah. Compared to other fuels, the cost of nuclear fuel is relatively low cost and exhibits limited price volatility; thus changes in nuclear fuel prices have a negligible impact on the total cost of energy. The cost of nuclear fuel used in the supply side resource table is $7.73/MWh in 2014 dollars, including the spent fuel permanent disposal levy.

In 2014, the Company commissioned Sargent & Lundy (S&L) to prepare a report to summarize costs, performance and development efforts on emerging commercially viable small modular reactor (SMR) nuclear technologies. SMR's offer simplicity, convenience, attractive economics based on transportable modular construction processes, and, most importantly, an opportunity for the producers of electric generation to reengage the nuclear option with significantly less capital risk compared to traditional large-scale reactor designs. Three emerging SMR designs were assessed (NuScale, mPower and Holtec); all are Integral Pressurized Water Reactors (iPWRs) with passive safety design features. The SMR designs use varying degrees of first-of-a-kind (FOAK) design concepts that simplify the SMR plant systems, enhancing safety, and reducing capital and operations cost. However, these FOAK design concepts create risk that SMR plants may not perform to a rated capacity and reliability or could result in design, construction, or commissioning delays. The designs of all the assessed SMRs are evolving rapidly. The Company will continue to monitor the SMR market.

At this time, other than technology monitoring, the Company is not actively involved in development efforts of either the Blue Castle project or any specific SMR technologies. Currently nuclear power is not considered a viable resource option until the 2025-2030 timeframe. Significant considerations are capital cost uncertainty (both for EPCs as well as Owner's costs), schedule risk, the high cost of development and permitting over an extended

2/3

period, cost recovery uncertainty associated with unsuccessful development efforts, sociopolitical resistance and regulatory obstacles.

Energy Storage

As in previous IRPs, a number of energy storage technologies are considered; these include compressed air energy storage (CAES), pumped hydroelectric storage and advanced batteries. CAES is of significant interest because of the potential development of solution-mined storage sites associated with Magnum Energy's development activities adjacent to the Intermountain Power Project located in Delta Utah.

Energy storage continues to be of interest since the variable nature of some renewable generation alternatives could be enhanced if the energy produced during low demand or transmission constraint periods could be stored at low cost. Energy storage resources also have the ability to provide ancillary resources in the form of spinning reserves and sources of voltage control.

In 2014, PacifiCorp engaged HDR to update its 2011 Energy Storage Study[44]. Table 6.7 summarizes the costs and performance of available storage technologies from the updated HDR study. Table 6.7 does not include dry cell and Zinc-Bromide (ZnBr) battery options because these systems are similar to other options shown. Zinc-Bromide batteries are similar to the VRB batteries, while dry cells are similar to the Lithium-Ion (Li-Ion) batteries.

Table 6.7 – HDR Energy Storage Study Summary Cost and Capacity Results (2014$)

	Flywheel	Li-Ion	NaS	VRB	Pumped Storage	CAES
System Cost ($/kW and/or $/kWh)	$2,862 per kW	$800 - $1,200/kWh (High Energy)	$4,000/kW	$675/kWh	$1,700-$2,500/kW	$2,000-$2,300/kW
Rated System Size (MW)	20	1 - 32	1	1	600	300+
Rated Capacity (hours)	0.25	1 (High Energy)	7.2	1	8 to 10	8+
Roundtrip, AC to AC efficiency (%)	85	91	70 – 75	65 – 75	75 – 82	64

Three examples of pumped storage hydro projects are described in the HDR study. The three example projects detailed in the 2014 Energy Storage Screening Study are Swan Lake North in Oregon, JD Pool in Washington and Black Canyon in Wyoming. These proxy projects were selected based on technical and commercial development progress. A composite case is presented in the resource table representing both the size of this technology (over 600 MW)[45] and costs at the high end range to reflect the permitting, design and construction cost uncertainty. CAES is represented in the 2015 IRP at the size case described in the HDR study. A 300 net MW capacity case is shown in the resource table at the 4,640 foot elevation reflecting prospective CAES resources under development by Magnum Energy near Delta, Utah. Capital costs include the solution mining component of the technology.

[44] See Volume II, Appendix Q for the 2014 Energy Storage Study (except associated appendices) the full version is available on accompanying data disk and PacifiCorp's IRP web page at: http://www.pacificorp.com/es/irp.html.

[45] EDF, the developer of the Swan Lake pumped storage project, has recently indicated that they are currently exploring a project size of 300-400 MW instead of the originally contemplated 600 MW, reflecting the results of their internal valuation modeling work.

3/3