BEFORE THE PUBLIC SERVICE COMMISSION OF UTAH

PacifiCorp's 2023 Integrated Resource Plan	Docket No. 23-035-10

Questions Submitted by Fervo Energy Company
in Advance of Technical Workshop

INTRODUCTION AND BACKGROUND

Pursuant to the Scheduling Order and Notice of Technical Conference issued on June 27, 2023, Fervo Energy Company ("Fervo") provides the following questions and comments regarding the Integrated Resource Plan filed by PacifiCorp d/b/a Rocky Mountain Power ("PacifiCorp") on April 3, 2023, and amended on May 31, 2023 ("2023 IRP"), and the supporting materials filed on April 17, 2023 and June 20, 2023, in advance of the Technical Workshop scheduled for October 24, 2023.

PacifiCorp is a major potential buyer or developer of geothermal energy in a multi-state region with significant geothermal development potential. However, the 2023 IRP does not select new geothermal in any scenario and provides few further details on pathways for geothermal procurement. The overarching purpose of Fervo's questions is to help clarify these pathways. Several of the questions reflect recent findings on geothermal in other regional resource plans as well as research and recommendations by the U.S. Department of Energy ("DOE"), National Renewable Energy Laboratory ("NREL"), and other entities.

The 2023 IRP does indicate PacifiCorp's interest in the category of clean, firm power, in the form of advanced nuclear technology and unspecified firm resources. While geothermal provides the same capabilities as these resources, and at lower cost than is modeled for nuclear, it is excluded from the preferred portfolio and all sensitivity portfolios.

Fervo and the geothermal sector look forward to working with PacifiCorp and the Public Service Commission of Utah ("Commission") to clarify the expansion opportunities for geothermal in Utah and the rest of the PacifiCorp service territory. Geothermal can provide clean, firm and even operationally flexible power as well as local economic development opportunities.

The geothermal resource potential in Utah is massive, and because geothermal energy development requires the drilling and completion of a substantial number of wells, the construction workforce needed by the geothermal industry has a nearly identical skillset to that of the oil and gas industry. The incredible resource potential, the demand for clean power, the existence of a robust oil and gas supply chain, and the ability of the geothermal industry to employ oil and gas workers make geothermal a great match for Utah's All-of-the-Above energy strategy.

QUESTIONS

Question 1. What are the selection criteria applied to supply side resources that determine inclusion in the preferred and sensitivity portfolios? If the portfolios are chosen based on cost, why is geothermal not selected when its costs are lower than those of SMR?

Modeled costs of geothermal as depicted in the Supply Side Resources table are less than those of advanced nuclear technology (see Table 1 below), with higher capacity factors and lower EFOR. However, the Preferred Portfolio selects 1,500MW of SMR and no geothermal, nor is geothermal

selected in any of the portfolio variants.

Please clarify the selection criteria that contribute to this result.

Table 1. Comparison of geothermal and nuclear costs and operational assumptions.

Resource	Total Resource Cost ($/MW)	Capacity Factor	EFOR
Geothermal (Blundell expansion)	$45.33	90%	0%
Geothermal (Greenfield Binary)	$58.82	90%	0%
Nuclear (Small Modular Reactor)	$68.03	86%	5%

Question 2. The *2023 Renewables IRP report*[1] ("Renewables Report") prepared by WSP includes a review of geothermal costs and operational characteristics. How were the operational assumptions developed?

The Renewables Report, and subsequently the 2023 IRP, explores two options for geothermal electricity generation, a dual flash expansion of the Blundell Power Plant, and a greenfield binary plant. As stated in the report, "all data provided and reviewed from the New Zealand team fits with current industry standards"[2]. However, one of the three reports cited by the analysis, *Assessment of Current Costs of Geothermal Power Generation in New Zealand (2007 Basis)*[3] ("Assessment"), is nearly 15 years old, even older than PacifiCorp's own previous analysis of geothermal[4]. There have been significant developments in the geothermal industry, in both subsurface resource development as well as power plant construction, since either of these reports were published.

Firstly, the Renewables Report fails to note the extremely outdated nature of flash technology. Binary plants are more flexible, can utilize lower temperature resources, and are completely emission-free. In fact, aside from one triple-flash plant constructed in 2011, all geothermal plants constructed since 2000 have been binary plants[5].

Also problematic is the Renewable Report's extrapolation of analysis focused on geothermal resources in New Zealand and applying it to development in Utah. Much like comparing apples and oranges, they are two completely different geologic areas, with completely different geothermal resources. For example, because of its volcanic setting, geothermal resources in New Zealand are extremely hot, shallow, and permeable. On the other hand, the geothermal resource in Utah is less hot, deeper, and less permeable; this necessitates completely different techniques to drill and complete wells, in addition to generating power.

In fact, the Assessment warns of generalization of its results to other geologies, in this case, Australia: "Although we consider the method to be robust and suitable for Australian projects, there are very real differences between the two countries which make the specific results inapplicable"[6]. Utah's geology is much closer to Australia's – which also has cooler and deeper resources, requiring stimulation of wells

[1] WSP USA. *2023 Renewables IRP. PacifiCorp.* September 2022. PacifiCorp 2023 IRP, Appendix M. https://pscdocs.utah.gov/electric/23docs/2303510/3281822023IRPFnlVlmII5-31-2023.pdf
[2] Ibid.
[3] Quinlivan, Paul. *Assessment of Current Costs of Geothermal Power Generation in New Zealand (2007 Basis)*. Australian Geothermal Energy Conference 2009. https://www.geothermal-energy.org/pdf/IGAstandard/AGEC/2009/Quinlivan_2009.pdf
[4] Black & Veatch Corporation. *Power Generation, Geothermal Resource Study*. August 2010. https://pscdocs.utah.gov/electric/09docs/09203501/68052FinalRep8-4-2010.pdf
[5] Robbins, Jody C. et al. *2021 U.S. Geothermal Power Production and District Heating Market Report.* National Renewable Energy Laboratory. https://www.nrel.gov/docs/fy21osti/78291.pdf
[6] Quinlivan, Paul. *Assessment of Current Costs of Geothermal Power Generation in New Zealand (2007 Basis)*. Australian Geothermal Energy Conference 2009. https://www.geothermal-energy.org/pdf/IGAstandard/AGEC/2009/Quinlivan_2009.pdf

and pumping of production fluid.

Please provide clarification for the reasoning behind the operational assumptions used in the Renewables Report.

Question 3. Why is geothermal not included in the capacity expansion analysis? Can the process for the Plexos LT modeling be described further to explain whether geothermal was screened out prior to the modeling or included in the modeling but not selected by the tool?

Chapter 8 of the 2023 IRP discusses the Long-Term (LT) Capacity Expansion Model, and its ability to endogenously dispatch new capacity. According to that discussion, "two non-CO2-emitting thermal resources are considered: advanced nuclear projects and non-emitting peaking units"[7]. Why is geothermal included in this list of considered resources?

There are significant geothermal resources available for development, and the sum of the geothermal project sizes reviewed by PacifiCorp in the 2023 IRP (400 MW) is well below the regional resource potential for the state of Utah, let alone the entirety of PacifiCorp's service territory. A 2008 analysis by the U.S. Geological Survey estimated Utah's enhanced geothermal systems potential at 32.6 GWe[8], conservatively. An analysis published earlier this year by the NREL estimated Utah's geothermal resource capacity at between 18-108 GW[9].

Please explain the Plexos LT model capability with respect to choosing geothermal resources, and the reason geothermal was not considered for capacity expansion.

CONCLUDING COMMENTS

Fervo appreciates the opportunity to ask these questions and provide comments on PacifiCorp's 2023 IRP.

Dated: October 10, 2023

Respectfully submitted,
/s/
Laura Singer
Fervo Energy Company

[7] 2023 IRP. Volume I. Page 227.
[8] Williams, Colin et al. *Assessment of moderate- and high-temperature geothermal resources of the United States*. U.S. Geological Survey. September 2008. https://pubs.usgs.gov/fs/2008/3082/
[9] Augustine, Chad et al. *Enhanced Geothermal Shot Analysis for the Geothermal Technologies Office.* National Renewable Energy Laboratory. January 2023. https://www.nrel.gov/docs/fy23osti/84822.pdf