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To: Utah Public Service Commission

From: Division of Public Utilities
Philip Powlick, Director
Artie Powell, Manager, Energy Section
Joni Zenger, Technical Consultant

Date: October 4, 2010

Re: PacifiCorp's 2008 Integrated Resource Plan Update, Docket No. 09-2035-01, Geothermal Resource Study

RECOMMENDATION: The Public Service Commission's directive has been met. Based on the findings of the Geothermal Resource Study, the Company should proceed with the Blundell (a.k.a. Roosevelt Hot Springs geothermal resource area) expansion, which the report identifies as a feasible resource with the lowest cost. The Division of Public Utilities (Division) further recommends that the Commission direct the Company to complete a more in-depth geothermal potential study before the 2011 IRP Update is filed.

I. BACKGROUND

PacifiCorp (Company) filed its 2008 Integrated Resource Plan (IRP) on May 28, 2009. The Division, as well as interested stakeholders, filed public comments on June 22, 2009. The Public Service Commission (Commission) issued its Report and Order in this matter on April 1, 2010, acknowledging the Company's IRP, but directed the Company to file a geothermal resource study within 60 days of the date of its Order.[1] The Company met informally with the Division, the Office of Consumer Services (Office), and Commission staff to discuss the scope and content of the geothermal report, considering the cost to develop the study as well as the timeframe

[1] Report and Order, Docket No. 09-2035-01, April 1, 2009, p. 35.

required to prepare the report. The parties agreed that this study would be narrowed in scope and possibly expanded at a future time. On April 29, 2010, the Commission granted the Company's request to extend the filing date to August 10, 2010.

On July 19, 2010, the Company submitted to the IRP mailbox its draft report titled "Power Generation, Geothermal Resource Study." The Division filed preliminary comments on the draft report on July 28, 2010. The Company filed the final report with the Commission on August 10, 2010.

II. PURPOSE OF THE GEOTHERMAL POTENTIAL STUDY

The Commission ordered the Company to conduct the geothermal potential study based on parties' concerns that the Company understates the potential geothermal resources in its resource portfolio modeling in its 2008 IRP. The preferred portfolio that resulted from the IRP analysis included only 35 MW of geothermal generation from Blundell 3 in the year 2013 even though the resource options identified geothermal as among the least-cost options available. The Company contracted with Black & Veatch and GeothermEx (BVG) to review geothermal resource areas near its service territory and to evaluate the commercial viability of these projects. The Division notes that the Company did not have sufficient time to conduct a detailed review in order to meet the Commission's 60-day report deadline and, therefore, the BVG study is only a high-level review and screening of potential sites.

Many assumptions were made in the BVG report that limited the analysis, i.e., is the developer credible, is there adequate site control, is there a credible development plan, is the project viable from social and environmental constraints, etc.[2] In addition, the screening level cost estimates used in the BVG analysis are based on public information.[3] More detailed and proprietary information calculated on a consistent basis might yield different comparisons and more accurate findings.

III. DRAFT BVG REPORT

[2] Section 3, p. 3-3.
[3] Section 1, p. 1-4 and Section 7, p. 7-5.

As previously mentioned, the Division provided preliminary comments to the Company regarding the BVG draft report. Many of our preliminary comments were editing changes, corrections to tables, and language clarifications. The Company corrected those changes in its final report filed with the Commission on August 10, 2010.

The Division's preliminary comments also addressed several substantive issues. Some of those issues were addressed in the Company's final report. Of those substantive issues that were not addressed in the final report, the Division has particular concerns with the following items. Each item is introduced by the Division's "Suggested Change" followed by the Company's response or "Resolution."[4]

1. Suggested Change:

   The report should point out that Blundell is already permitted for existing facilities and (presumably since some new wells have actually been drilled) for expansion. It should also note that a 97 MW wind farm lies just a few miles from Blundell on private and BLM land, and it was permitted without any wildlife issue, in spite of Blundell's being listed in the report as being in or near both a WREZ wilderness and wildlife area and a "Citizen Proposed Wilderness" area. It is also fairly near and on land very similar to Thermo. Thermo's facilities - so far - seem not to have raised any environmental issues.
   Resolution: No clear resolution is in place in the document.

2. Suggested Change:

   The Company (or the BVG report) should explain the rationale for only evaluating projects in the confirmation stage. Why does the report not also examine projects for which a successful exploratory well has been completed?
   Resolution: No changes were made to the text.
   The report does examine all projects for which a "successful exploratory well (i.e. a Discovery Well) has been completed." The questioner may be asking why no projects at the Exploration Stage (pre-Discovery Well) are considered in detail. This is simply a function of the risk tolerance of PacifiCorp, as explained in the opening paragraph of Section 3.1. Limiting the focus to projects at the Confirmation and Development stages is done only to screen the list from the overall list of 80+ projects for the purposes of this

[4] Response to DPU Comments on PacifiCorp's Geothermal Resource Study, August 10, 2010, pp. 2-4.

study (as stated at the bottom of page 3-2) and is consistent with PacifiCorp's risk tolerance.

3. Suggested Change:

> BVG did not evaluate any sites for which confirmation wells have not been done, meaning BVG did not look at anything (with the exception of Blundell) that is not already being developed by someone else and that is pretty far along. The Company should explain why, in the BVG report, there is no analysis of places that PacifiCorp might develop on its own (other than Blundell).
>
> **Resolution: Confirmation wells have not been drilled at Crystal-Madsen (Renaissance), but the project was included for detailed consideration because it is in the Confirmation Stage, after completion of a Discovery Well.** However, it is true that BVG did not look at anything that is not already being developed by someone else (excepting Blundell). The reasoning for this is risk tolerance decisions by PacifiCorp regarding well exploration risks being shouldered by its shareholders. **No changes are made to the text regarding this suggested change.**

The Division is not satisfied with the Company's responses to our preliminary comments, in particular, the Company's responses regarding the risk tolerance decisions by PacifiCorp regarding well exploration risks being shouldered by its shareholders. The Division believes that the Company should explain further its risk tolerance policy to determine if risk avoidance is forcing the Company to miss out on low cost geothermal resources. In addition, the Division is not satisfied with responses where no resolutions were made and no changes were made to the text.

IV. OVERALL COMMENTS ON THE GEOTHERMAL RESOURCE STUDY

BVG examined over 80 geothermal resource areas near the PacifiCorp system. Of these 80 sites, BVG selected eight sites, which it considered to be commercially viable, for more in-depth analysis.[5] For these eight sites, the estimated levelized cost of energy ranges from $46/MWh at the Roosevelt site in Southwestern Utah to $100/MWh at Raft River, Idaho, and Crystal-Madsen,

[5] Commercial viability is defined as a level of maturity in the development of the project such that a prudent commercial investor feels that the project can reasonably be expected to be profitable (Section 3, p. 3-1.).

in Northern Utah.[6] A total potential capacity of 800 MW net was identified as commercially viable sites for PacifiCorp.[7] The BVG report determined that Roosevelt Hot Springs (i.e., Blundell) with a net capacity of 81 MW is, at $46/per MWh, one of the most potentially attractive geothermal sites for PacifiCorp. Cove Fort, Utah with an estimated potential of about 80 net MW in the range of $68/MWh to $75/MWh, is the second most attractive geothermal site in BVG's study. Unfortunately, the Cove Fort resource is currently being developed by Enel and, as the BVG report notes, the opportunity for PacifiCorp to obtain power from the potential 80 net MW at this site is now limited or unlikely.[8]

While the report's scope was narrowed to meet the Commission's deadline, and possibly to provide some information for the next IRP round, the Division believes the results are of questionable use in determining the overall potential of geothermal resources. The Division had anticipated that a report would evaluate a broader range of potential resources. For example, in our IRP comments, we encouraged the Company to evaluate greenfield projects in both PacifiCorp's east and west control areas. The Western Governor's Task Force estimated future development of commercial geothermal generation of 230 MW by the year 2015 and 620 MW by 2025 for the state of Utah alone.[9] The Division believes that the Company needs to proactively pursue geothermal resources in order to avoid missing future opportunities, such as Cove Fort, that are low cost geothermal resources.

The Division recommends that the Commission Order the Company to conduct an analysis of site specific issues that affect final development and costs and commission a second more in-depth geothermal resource potential study in the future. The study should evaluate in particular greenfield projects in both PacifiCorp's east and west control areas. The study should be completed by the time the Company files its 2011 IRP Update.

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[6] As used in the BVG study, levelized cost is calculated from the viewpoint of the developer, including the developer's direct costs, charges and incentives, as well as an expected rate of return on the equity. Actual costs of generation used in the model escalate over time. The levelized cost of energy is the constant cost (no escalation) that produces the same net present value as the actual modeled costs of generation over the life of the project. (The cost is not an all in cost of development, but is a break even analysis that represents sufficient revenues to meet an authorized return over the life of the project.)

[7] BVG assumes that a binary plant consumes 20 percent and a flash plant uses 10 percent of a plant's capacity. Net capacity will be either 80 or 90 percent of the plant's gross capacity.

[8] Section 8, p. 8-1.

[9] http://www.blm.gov/wo/st/en/prog/energy/geothermal/geothermal_nationwide/Documents/Final_PEIS.html,

Additionally, we expect the 2011 IRP to include a thorough description and analysis of how the levelized cost of electricity identified in the BVG report compares to the total resource cost modeled in the 2008 IRP. Finally, the Division reserves for the 2011 IRP process further comment on how the results of the BVG report should be modeled in the IRP.

The BVG report seems largely to confirm the previous IRP modeling results that showed expansion of the Blundell facility to be an attractive, low-cost resource option. The Division recommends that the Company move forward quickly with expanding the Blundell facilities. Indeed, one of the clear implications the Division takes away from this report is that Pacificorp should already have completed the expansion (given its low cost and that it is a Company-owned resource).

V. COMMENTS ON LEVELIZED COST OF ENERGY CALCULATION

To compare the various projects selected, BVG employ a simple breakeven analysis based on the net present value (NPV) of future cash flows including a return on investment, which BVG refer to as the NPV of Equity Return (NPV-ER).[10] The BVG model chooses the year one cost of generation—the price per megawatt hour—that produces a NPV-ER of zero or, in other words, a sufficient cash flow over the life of the project to cover expenses plus a return on investment. The annual or nominal prices used in the model are escalated from the year one price using annual escalation rates that vary from year-to-year over the range of 1.6% to 2.0%. The levelized cost of energy (LCOE), a constant amount whose present value over the life of the project is the same as the present value of the stream of nominal prices,[11] is the main output of the BVG model and is the metric used to compare the various projects reported by BVG.

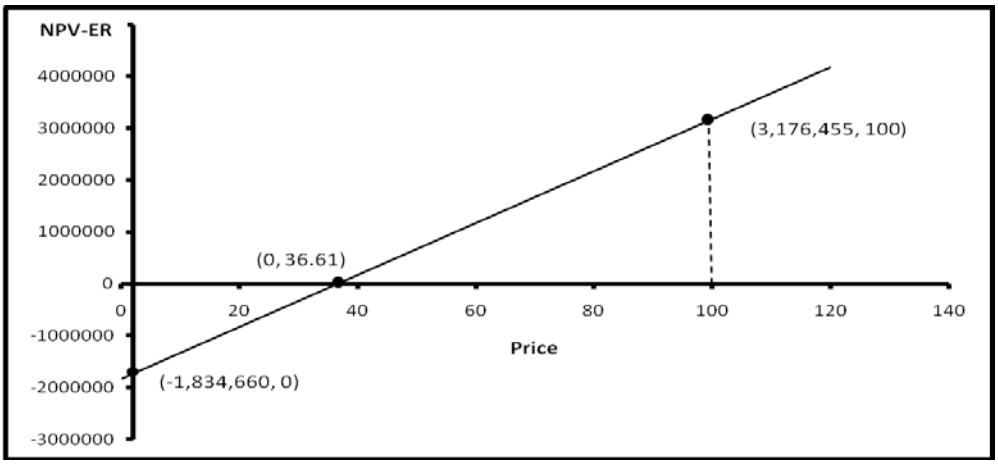
To derive the year one price, the BVG model assumes a linear relationship between the price per megawatt hour and the NPV-ER. Setting the first year price for the Roosevelt project, for

[10] Section 7.0 Analysis of Project Economics, 7-1 through 7-2.

[11] If the stream of nominal prices is represented by $P_1, P_2, \ldots, P_n$, then the present value of the cost of energy is $NPV_p = \sum_{i=1}^{n} \frac{P_i}{(1+r)^i}$, where "r" is the interest or discount rate. The levelized price, L, is then $L = NPV_p / \sum_{i=1}^{n} (1+r)^{-i}$

example, at $100/MWh yields a NPV-ER equal to approximately $3.2 million.[12] If the first year price is set at $0/MWh, the NPV-ER is approximately -$1.8 million. The breakeven price is then found as the solution to the line connecting these two points. In this case, the first year breakeven price is $36.61/MWh. This relationship is depicted in Figure 1 below**.**

Figure 1: Black & Veatch Analytical Model (Roosevelt, Low Scenario)



This linearity assumption, which is not identified in BVG's geothermal report, appears to place peculiar restrictions on the output the model. For example, the total annual megawatt hours do not affect the final LCOE. This is because percent changing the capacity of the project changes both the revenues and the expenses by the same percentage and, therefore, the LCOE is unchanged. Similarly, increasing the O&M costs in the Roosevelt model from $21 per MWH to $26.25 per MWh, approximately 25%, increases the LCOE from $45.60 per MWh to $52.11 per MWh, approximately 14% or approximately half of the increase in the O&M cost. Other percentage changes in the O&M cost yield similar changes in the LCOE.

The Division observations are not necessarily meant as a criticism of the model but are offered as observations from an analysis of the model. The Division recognizes that each model is setup specifically for a project with a "known" cost structure and was not meant as a general model of the relationship between capacity, revenues, and costs for geothermal projects. As BVG explain,

[12] In response to the Division's data request, DPU 12.1, PacifiCorp provide a copy of Black & Veatch's model for the Roosevelt HS, or Blundell, project. The results referred to herein are for the low cost scenario.

"The simplifying assumptions allowed the model to serve its analytical purpose and still be streamlined enough to quickly evaluate multiple projects. Because of the simplifications, the model was not intended to simulate the exact financial performance of any one project. Use of the model in this way would be inappropriate."[13] The Division concurs with this warning and adds that use of the models output as an approximation of the financial performance of any potential geothermal project evaluated in the study as a comparison to other types of supply or demand side resources is equally inappropriate. As BVG state, "These screening level costs estimates are based on available public information. More detailed estimates based on proprietary information and calculated on a consistent basis might yield different comparisons."[14] Given the limitations of the model and its results, the Division recommends that further study be conducted. At the least, we expect the 2011 IRP to include a description of how the levelized cost of electricity identified in the BVG report compares to the total resource cost modeled in the current IRP and caution against basing resource choices on the BVG limited study alone.

VI. CONCLUSION AND RECOMMENDATIONS

The Division commends the Company's efforts to conduct the geothermal potential study. We find that the Company has met the Commission's directive in its April 1, 2010 Order in Docket No. 09-035-23. We recommend that, in the future, the Company include in its continued pursuit of geothermal resources an analysis of site specific issues that affect final development and costs. In addition, we recommend the following:

- The Company should proceed with the Blundell (a.k.a. Roosevelt Hot Springs geothermal resource area) expansion, which the BVG report identifies as a low cost, feasible resource.

- The Company must include within the 2011 IRP a thorough description and analysis of how the levelized cost of electricity identified in the BVG report compares to the total resource cost modeled in the current IRP.

[13] Reference P. 7-2.
[14] See final report, Table 7-1, Note (d).

- The Commission should order the Company to commission a second, more in-depth geothermal resource that includes proprietary cost estimates rather than publicly available estimates in order to yield more accurate results.
- The study should evaluate greenfield projects in both PacifiCorp's east and west control areas. The study should be completed by the time the Company files its 2011 IRP Update. This will allow sufficient time to include the above-mentioned items.
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cc: Dave Taylor, PacifiCorp
Pete Warnken, PacifiCorp
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