

THE ECONOMICS AND VIABILITY OF INTEGRATED GASIFICATION COMBINED CYCLE (IGCC) IN THE PACIFICORP SYSTEM

MidAmerican Energy Holdings Company (“MEHC”), as part of their acquisition of PacifiCorp, committed to consider the utilization of advanced coal-fuel technology such as super-critical or integrated gasification combined cycle (“IGCC”) technology when adding coal-fueled generation. MEHC and PacifiCorp committed to study the economics and viability of IGCC resources. The summary results of this study effort were presented at two technical conferences. The first conference was held on April 3, 2006 and was entitled "Request for Proposal Technical Conference: Utah Docket 05-035-47" (“April 3 Presentation”) and the second conference entitled “Request for Proposal Technical Conference: Oregon Meeting (Following Utah Docket 05-035-47” was held on April 10, 2006 (“April 10 Presentation”).

Over the past two years, PacifiCorp has performed IGCC studies to evaluate gasification technologies at its Hunter and Jim Bridger sites with a variety of coals. The purpose of these studies was to determine the site specific impacts, such as altitude and coal quality, on the performance and cost of various IGCC technologies. The primary and most recent study is the WorleyParsons study, which was completed in July 2006, entitled "PacifiCorp IGCC Feasibility Evaluation Shell and E-Gas Technologies - Hunter and Jim Bridger Stations." Due to the confidential content of this report it has not been provided; however, the report will be made available to interested third parties who qualify under confidentiality arrangements.

The results of the 2006 WorleyParsons study were used to develop estimates of the total cost of energy for each of the IGCC technologies at the various locations and coal types. The cost of energy estimates for these IGCC options were then compared to the cost of energy for advanced pulverized-coal fired options using supercritical boiler-turbine technology at the same sites and coals. Specifically the 2006 WorleyParsons study was to determine the performance of ConocoPhillips’ “E-Gas” and Shell’s gasifier technologies at both the Hunter and Jim Bridger Plant locations. In addition, the 2006 WorleyParsons study expanded on an earlier study which did not include Shell’s gasifier technology and it included an evaluation at the Jim Bridger plant with its higher elevation and the use of lower rank coals. The 2006 WorleyParsons study also included a determination of the impact of General Electric’s then recent announcement on its improved output of its 7FB gas turbine. The General Electric 7FB gas turbine was assumed to be the building block for the IGCC reference plant used in the study.

Inasmuch as the results of an earlier study had indicated that ConocoPhillips’ “E-Gas” technology was marginally better than General Electric’s gasifier technology, it was decided to limit the comparison in the 2006 WorleyParsons study between the ConocoPhillips’ “E-Gas” gasifier technology with Shell’s gasifier technology in order to limit the overall costs of the study. However, it should not be inferred from this process

that General Electric as a potential technology supplier has been excluded; for future development work involving individual feasibility studies with the technology suppliers, General Electric would be asked to participate.

For the 2006 WorleyParsons study, bituminous Utah coal, Southwestern Wyoming, and Powder River Basin coals were evaluated at the Hunter located IGCC plant using the two different gasifier technologies. The performance impacts of Powder River Basin and south western Wyoming coal were evaluated on the two different gasifier technologies for the Jim Bridger site.

The major design basis guidelines used in the WorleyParsons study were as follows:

- The plant would be based on a “Reference IGCC Plant” consisting of a “2x1” configuration consisting of two General Electric 7FB gas turbines and one steam turbine. A spare gasifier would be installed to achieve 90% capacity factor on coal. Natural gas would be available for startup and backup.
- The plant would utilize wet cooling with a mechanical draft cooling tower.
- The plant would be equipped with selective catalytic reduction to more closely match the emissions of a natural gas-fired combined cycle plant.
- The plant would be designed and constructed to be “carbon capture ready” so that CO₂ capture equipment could be installed in the future. The gasifier and supporting equipment would be sized to match the fuel requirements of the gas turbines without CO₂ capture.

In determining the cost of energy for the various IGCC options it was assumed that all of the gasification equipment would be depreciated using a ten-year Modified Accelerated Cost Recovery System approach. The revenue requirements for the plant were based on an assumed 40 year life using the company’s weighted average cost of capital and site specific ad valorem taxes. In determining the total capital cost, a number of other owner’s costs were added; these include switchyard costs, sales taxes, escalation during construction, water, project management costs, and allowance for funds during construction. These costs and processes were applied to the evaluation of supercritical pulverized coal resources as well.

The estimated overall cost of energy for each of the IGCC options includes operating and maintenance costs. In addition to the capital costs from the 2006 WorleyParsons study, operating and maintenance costs were also provided, which were modified. Overall, the adjustments made by PacifiCorp reduced the estimated O&M costs for an IGCC plant at an existing brownfield PacifiCorp site compared to the 2006 WorleyParsons study estimates by approximately 15%.

Using the process outlined above, the capital and operating and maintenance cost estimates from the 2006 Worley-Parsons (WP) study, combined with the company’s fuel

cost estimates, were used to develop the cost of energy for each of the IGCC technology/location/coal scenarios. The levelized costs of electricity for these IGCC options are shown on Slide 13 of the April 3 Presentation and the April 10 Presentation.

From the array of IGCC technology and coal options, the scenario at each location that was determined to have the lowest cost of energy was selected for comparison to supercritical pulverized coal technology options. For the Jim Bridger site this was determined to be the ConocoPhillips' "E-Gas" technology utilizing southwestern Wyoming coal. At the Hunter site, this was determined to be ConocoPhillips' "E-Gas" technology utilizing bituminous Utah coal. These lowest cost IGCC options were compared to pulverized coal supercritical boiler-turbine technology units at the same sites using the same fuels. This comparison is shown on Slide 14 of the April 3 Presentation and the April 10 Presentation.

In addition to cost information that PacifiCorp was to provide, there was a commitment to provide an overall timeline for an IGCC project. As part of the April 3 Presentation and the April 10 Presentation an IGCC Development Schedule was presented (Slide 16). A number of assumptions were made in development of this strawman schedule. The primary assumption is that the permitting work would be started upon completion of the feasibility studies and a technology supplier had been selected. It is assumed that permitting would likely be one of the critical path activities and that a notice to proceed would not be issued until the final permit, and any other major permits, had been issued. Permitting duration would be impacted by site factors and the degree the project receives federal funding. The other primary assumption in preparing the development schedule is that a resource solicitation process would not be required. The overall duration of the detailed engineering, procurement, construction, and commissioning cycle was assumed to be 48 months.

Copies of the presentations referenced in this document are provided as Attachments A and B to this summary report and can also be accessed electronically at the following link: <http://www.pacificorp.com/Article/Article62879.html>