Proceedings of the 2018 Geothermal Resources Council Annual Meeting
Reno, NV

Geothermal Development in the Philippines

Kevin R. Beavers
AP Renewables Inc.
2018 Geothermal Resources Council
Annual Meeting

***Abstract*— Blessed with abundant geothermal resources, the Philippines is the world's third largest producer of geothermal power. Competition from subsidized variable renewable energy, low cost fossil sources, and lack of options to reduce the economic risk of geothermal project development has led to a stagnation of growth in the Philippine geothermal sector. The strategy of AP Renewables to sustain and grow its geothermal generation capability has been to focus on innovation, optimization, and efficiency of its geothermal facilities.**

***Keywords*— geothermal, market, incentives, capacity, renewables, energy, programs, optimization, efficiency**

I. About Philippines

Geothermal development of power generating facilities in the Philippines began in January 1979 with the inauguration of the 110 MW Tiwi Geothermal Plant, the first in a series of three such facilities to be constructed there. By 1983, 330 megawatts of capacity had been installed at Tiwi and a number of other large installations were being developed around the country in seven primary geothermal producing regions in Luzon, Negros, Leyte, and Mindanao. These installations quickly became among the largest in the world, such as the 588 MW Unified Leyte Geothermal projects developed by California Energy and Energy Development Company and the 458 MW Makiling-Banahaw (Mak-Ban) Geothermal projects developed by the National Power Corporation.

Today, the pace of geothermal development has slowed following the passage of the Electric Power Industry Reform Act (EPIRA). This law mandated the Philippine Energy Regulatory Commission to promote competition, encourage market development, and ensure consumer choice in this restructured electricity market. The competitive retail electricity market established as part of this rulemaking functions as a level playing field for all electric generators to execute their energy sales. While development has slowed, geothermal development continues with new capacity being added, such as the 20 MW Maibarara Geothermal project that achieved commercial operation in 2014, with a 12 MW expansion project coming on line in 2018..

II. About AP Renewables

In July 2008, Aboitiz Power, through wholly owned subsidiary AP Renewables Inc., (APRI) won the bid for and was awarded the Tiwi and Mak-Ban geothermal facilities. Tiwi and Mak-Ban consist of several steam field and power station assets located in the provinces of Laguna, Batangas and Albay in Luzon island. Steam field operations are managed by Philippine Geothermal Production Company (PGPC) and APRI operates the power production facilities.

A large-scale capital improvement and rehabilitation project was initiated by APRI, since the facilities were in a severe state of disrepair or non-functional at the time of acquisition. APRI committed to completely rehabilitate these units within four years from May 2009 and each of the generating units had to achieve their design gross capacity, determined by measuring their maximum attainable output for a continuous 72-hour test. AP Renewables Inc. successfully completed the rehabilitation of the Tiwi and Mak-Ban geothermal facilities in 2013, resulting in improved availability and reliability factors.

Aboitiz Power also inaugurated the Cleanergy Center on August 28, 2013. The Cleanergy Center is an educational facility located at the Administration Compound at Mak-Ban Geothermal Power Plant. The Center is focused on energy education through the use of audio visual presentations, interactive displays, and conducts tours of the working geothermal power plant.

More recently, APRI successfully completed the rehabilitation of an existing Organic Rankine Cycle (ORC or Binary) generation facility at Mak-Ban in 2016, bringing another 6 MW of capacity back into operation. In August 2018, a new contract was executed by APRI and PGPC for the drilling of new production wells at Tiwi and Mak-Ban. The agreement to drill additional production wells is aimed at providing a framework to ensure the sustainable long-term operation of the facilities.

III. The Philippine Energy Market Environment

The Philippines enjoys a well-functioning and robust wholesale energy spot market that allows generators to competitively bid their energy into the market. Generators are then selected based on merit to fulfill their bids. Geothermal energy comprises 18% of the Philippine energy market and competes effectively with other sources of generation in the spot market.

The country's total economic output, measured in terms of real GDP, rose faster at 6.9 percent in 2016 than in the previous year's 6.1 percent. Philippines energy demand is expected to expand approximately 4.3 percent annually, while the total primary energy supply is projected to grow at a rate of 4.4 percent. The energy mix will continue to be dominated by coal and oil, with geothermal energy sources

making up a mere 0.4 percent of the renewable energy growth forecast. A total of 213 MW of new geothermal power capacity is projected to be added over the next 25 years.

Many of the challenges for geothermal development are similar to the challenges for other generation technologies, such as permitting, social acceptance, and the regulatory environment. However, the lack of meaningful risk mitigation tools and low ability to secure tariff pricing meant to spur renewables development have caused geothermal development to lag behind other technologies. The 2008 Renewable Energy Act (RE Act) included a feed-in-tariff given to solar, wind, and other renewable energy companies with "emerging technology" for the Philippines, but did not include geothermal energy producers.

IV. Development Opportunities for Geothermal

In 2016, the National Geothermal Association of the Philippines (NGAP) called for coverage under the feed-in tariff program for geothermal technologies currently not commercially viable under existing market and pricing structures.

Under the RE Act, policies to be implemented in the near-term offer the potential for mitigating the high development costs of geothermal power. The Renewable Portfolio Standards (RPS) places an obligation on power industry participants such as generators, distribution utilities, or suppliers serving on-grid areas to source or produce a specified fraction of their electricity from eligible RE resources. The proposed Green Energy Option is a mechanism to provide end-users the option to choose RE resources as their source of energy.

In light of regulatory uncertainty and few mechanisms to mitigate geothermal development risk, it's expected that new geothermal projects will be significantly smaller in capacity than predecessor developments. Installed capacities will likely be sized in the five to twenty megawatt range, although several geothermal service areas in the Philippines boast potential development opportunities higher than this. The emergence of new technologies and higher utilization of potential end use applications will continue to offer developers a means to keep geothermal competitive with fossil and other renewable sources.

V. AP Renewables Focus

With the challenges described above, the focus of AP Renewables is to pursue a strategy of efficiency and optimization of our existing facilities in parallel with evaluation of our development, merger, and acquisition opportunities.

Evaluation of projects to increase capacity have followed several paths, including brownfield development, capital additions, and modifications of existing components. Some of these projects are described below:

- APRI is evaluating further potential for new waste heat bottoming cycle capacity additions at the existing facilities. The utilization of Organic Rankine Cycle equipment to maximize the waste heat from these single flash facilities is significant. It is estimated that up to 20 to 25 megawatts of additional generating capacity can be attained from current injection brine volumes at Tiwi and Mak-Ban.

- The nature of the Tiwi and Mak-Ban reservoirs has led to a large number of existing wells that flow intermittently and may cease flow for extended periods before recovering. Evaluation of emerging technologies and modular systems for wellhead generation is ongoing to reliably utilize these so called "pressure-sensitive wells" that could provide better utilization of the resource by reduction of backpressure from the original surface equipment and allowing the wells to flow unrestricted at a lower pressure.

- Evaluation of turbine steam path modifications with re-engineered components continues to be one of the best strategies for efficiency improvement projects. The modification of the steam path at Tiwi Unit 2 yielded a steam utilization improvement of four megawatts from a partial re-engineering the steam path based on today's steam conditions, which have substantially deviated from design conditions due to steam decline.

- Full conversion of gas removal systems to hybrid designs to maximize efficiency through thermal to electric conversion. The remaining units at Mak-Ban are undergoing conversion to a steam ejector-vacuum pump configuration to replace the originally designed two stage steam ejector system. The conversion projects are conservatively expected to yield a total improvement in net output of eight megawatts..

VI. Summary

Geothermal development in the Philippines will continue to be a challenge until the full implementation of the nation's RE Law is set in place. The current inventory of power generation projects under construction are expected to meet the country's increasing energy demand for the next five to seven years, which will maintain pressure on economic margins for developers. Successful new projects will need to utilize multiple strategies for profitability, including utilization of development grants, renewable energy incentives, and design engineering that maximizes efficiency.

Alternatively, capacity improvements can be effectively executed within existing operational projects by seeking and implementing innovative and strategic projects, such as those described herein.