



Geothermal Steam Turbine Retrofit for Performance Improvement and Life Extension

Project Highlights

- + Collaboration between EthosEnergy and Aboitiz Power ensured the most cost effective results by minimizing costs and using as many of the existing components that were fit for service.
- + A method of redesign and modifications assured that test results exceeded performance guarantees.

Key Challenges

- + Operator faced with a decreased amount of flow from the geothermal resource
- + The turbine which was designed for 60MW was producing less than 30 MW
- + The operator was also faced with a steam path which was deteriorated
- + Customer keen to minimize cost by using as much of the components that were fit for service as possible
- + Unexpected discoveries such as discrepancies in the design of various units caused complications in both the steam path as well as stationary components

Key Results

The test results exceeded the performance guarantees. The end result was a mix of new components for stages 1, 2 & 3 and modifications to stages 4 & 5 to reach a balance between cost and performance gains. After completion AP Renewables saw an increase in both steam rate and efficiency. The unit Steam Rate improved by 10%, while the efficiency improved by 14%.

The new steam path was completely analyzed for the new conditions and material selected to provide improved reliability. This asset of AP Renewables now has an extended life due to the well thought out program and execution.

Project Overview

Due to the continued steam decline of the geothermal reservoir, the single operating turbine at Tiwi Geothermal Plant (TGP) operated at approximately half capacity and resulted in inefficient steam consumption.

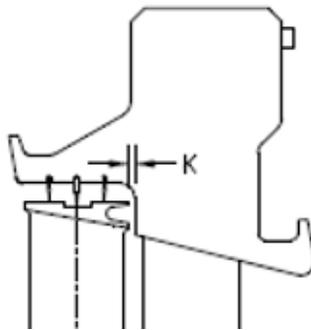


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The EthosEnergy Solution

EthosEnergy performed a thermodynamic and mechanical analysis of the existing unit and assessed what improvements could be made. From this analysis the turbine diaphragms and blades for three of the six stages were redesigned by reducing the blade height. Since new blades and diaphragms were required, EthosEnergy changed the design to an integral covered configuration with replaceable tip spill strips in the diaphragm. This change eliminated one of the biggest issues on geothermal steam turbine blades which is tenon erosion. The integral cover design eliminates the tenon and allows for improved sealing.



The analysis indicated that six stages were still the best design but the nozzle mouth heights had to be reduced on stages 4 & 5.

Even though the steam specific volume went up, the flow required to make the target output of 32.2 MW was lower than the original design volume flow. Nozzle and blade flow passing areas were also changed to account for the change in total volume flow and to distribute the loading optimally across each stage.



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