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Power and fuel supply options study for the Toliara Project in Madagascar

In 2018, Zutari was appointed as technical advisor for a power and fuel supply options study for the mineral sands focused Toliara Project in Madagascar for the Australian Securities Exchange (ASX) listed mining company, Base Resources. After a prefeasibility study and options analysis, Zutari recommended a hybrid power plant consisting of a solar photovoltaic (PV) system, reciprocating engines, and battery energy storage, to be procured through an independent power producer (IPP).

The second phase of the project involved the sourcing of an IPP to finance, design, procure, construct, own and operate the hybrid power plant to be located at the mine. This included the development of the request for proposal (RFP), the power purchase agreement (PPA) in conjunction with the client"s legal team, the representative load profile, and the technical requirements.

Seven shortlisted bidders were invited to submit full commercial, funding, and technical tenders for the supply of energy from a hybrid power plant under a 20-year PPA.

Zutari facilitated the tendering process, which attracted bids from a list of international IPPs. Both Base Resources and the IPPs commended the level of technical detail provided in the tender documents, which assisted the IPPs to prepare detailed and firm priced bids. Zutari assisted Base Resources by evaluating the tenders and providing a recommendation on a shortlist of preferred tenderers, who submitted best and final offers in May 2020. Zutari will continue to support Base Resources throughout negotiations with the preferred IPP.

While hybrid power projects have been developed for existing mines, this is - to Zutari"s knowledge – the largest off-grid hybrid power plant ever to be developed in parallel with a greenfield mine development. This posed several unique challenges, including how the operational performance guarantees of the power plant should be structured; how to incentivise the IPP to continuously optimise performance such as fuel consumption and spinning reserve, while still providing reliable, quality power to the mine; and not having load profile data due to it being a new development, which is critical in designing an off-grid hybrid power plant.

To overcome these challenges, Zutari developed a unique performance guarantee mechanism, which removes the risk of variable solar resource from the IPP while incentivising the IPP to continuously optimise the combined efficiency of the power plant. The mechanism penalises the IPP for poor performance but allows both the mine and the IPP to share in the success of performance improvements.

The Zutari team also worked closely with Base Resources to simulate a detailed and accurate load profile that can be used as a basis for the design of the hybrid power plant. To create this load profile, our team had to develop an in-depth understanding of the proposed operation of the mine, including planned and emergency start-up and shutdown sequences, characteristics of planned and unplanned outages, and worst-case load fluctuations. The team also used load profile data from Base Resources" operational mineral sands mine in Kenya to calibrate the simulated load profile.

The solar and battery storage portion of the hybrid power plant is expected to reduce the power plant"s greenhouse gas emissions by at least 30%. With the incentive for future performance improvements, further greenhouse gas reductions are expected.

Base Resources and sub-contractors will employ 1 629 people during the construction of the Toliara Project. An additional 2 148 indirect and induced jobs will also be created, leading to an annual average of 3 777 created. During the operational phase, 980 people will be directly employed.

"The way the performance guarantees, solar PR and heat rate of thermal generation all integrated into a measurable, guaranteed-value for the client, was an innovative result and a first of its kind in Africa. The efficiency of the tender process led to world-class hybrid power companies delivering solutions at very competitive prices for the client," says Loda Dedekind, Zutari Technical Director.