Project briefing

SOLAR AND STORAGE AT SCALE IN WESTERN AUSTRALIA

In the heart of Western Australia, the DeGrussa Copper-Gold Mine lies 150 kilometres away from the nearest town and well beyond any hope of a grid connection to power its intensive industrial activity. The mine's reliance on vast amounts of diesel, shipped in from afar, represented a golden opportunity for clean technologies to come in and prove their off-grid advantages. Sandfire Resources, a mid-tier Australian mining company that operates the mine, called on developers to co-locate not only a solar power plant, but also a utility-scale energy storage system alongside its existing diesel power station. Showcasing the latest technological advances, the newly completed project in the Peak Hill Mineral Field has been hailed as one of the largest renewable energy systems installed at a mine anywhere in the world and certainly the largest in Australia.

The AU$40 million (US$30 million) DeGrussa Solar Power Project is owned by France-based renewable energy firm Neoen, while German solar specialist juwi Group was responsible for development, EPC and O&M.

Originally, KPS, a subsidiary of Pacific Energy, operated the 19MW diesel-fired power station as the only energy provider on the site – one of the Asia-Pacific region's premier high-grade copper mines discovered in 2009. Not only was Pacific Energy paid a capacity charge, but the mine required triple-trailer truck-loads of diesel brought in three times a week – an extremely costly endeavour. By installing a 10.6MW solar PV plant and a 6MW battery storage system, diesel consumption can be reduced throughout the day and to some extent after the sunlight begins to dwindle.

The project is set to provide significant carbon and cost reductions by cutting diesel use by 20% and minimising transport to and from the site, says Andrew Drager, managing director of juwi Renewable Energy. It will save about five million litres of diesel per annum while lowering the cost of diesel procurement. Although fuel pricing depends on the current market, Drager estimated savings of roughly AU$4 million. The inclusion of storage also provides extra benefits including the provision of ancillary services, frequency support, spinning reserves and improved power quality.

All these additions won't negate the original diesel station, which continues to provide base-load power to the DeGrussa mine so that the energy requirements of the mining process can still be met quickly and through the night. But it is estimated that the the new co-located systems will still save 12,000 tonnes of CO_2 each year.

While such a hybrid project is not unique to Australia, since low-cost renewable energy is competitive with traditional fossil fuels in many off-grid and mining applications globally, the sheer scale of the project turned plenty of heads on the date of commissioning.

Project in numbers

- 10.6MW solar
- 6MW battery storage
- 19MW diesel power station
- 34,080 solar PV panels,
- 20 hectares
- 4,700 supporting posts, with NEXTracker module tracking system
- Over 70km of electric cable
- Reduction in diesel consumption by ~5,000,000 litres per year
- CO_2 emissions reduced by over 12,000 tonnes

Environment and location

Environmental considerations are one of the first obstacles to most infrastructure projects, but as Meekatharra, the closest town with a population of just 800 people, is a huge distance away, there were very few complaints, says Drager. Indeed the closest major city of Perth also lies 900 kilometres to the south.

The trickiest consideration was locating the PV plant to avoid clashes with a landing strip on the mine. Developers also had to consider the high soiling losses from the PV panels due to the high levels of dust coming from the mining process.

"When it comes to the environmental side, a lot of these mines have permits for a certain amount of land," explains Drager. "So we were able to get on the mining lease and install the PV plant on the mining lease itself, which was good, but it means you also

By Tom Kenning

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have to comply with special mining requirements and the special mining applications, which is very onerous to say the least."

However, there were more benefits of the mine location, because Sandfire already had plenty of information about the topography and irradiance of the land, along with detailed site images. As a result there was no need for major scrutiny of the site. Furthermore, the land was already very flat, which pertained to simple installation of the PV structures.

Layout

National surveying and infrastructure construction company OTOC built the PV plant, which comprised 34,080 individual solar panels. While the ideal location would have been in close proximity to the diesel plant in order to limit the need for cable lines, says Drager, it had to be moved roughly 1.5 kilometres away due to flora and fauna on site as well as flood zones. The solar array now covers an area of 20 hectares.

The solar panels were attached to a single-axis tracking systems from tracker firm NEXTracker mounted on 4,700 steel posts to increase the yield advantage by more than 20% on a site that has very high irradiance. The developers used a standardised block as their PV implementation model; however, they had to use above-ground cable trays.

"This was better for us because of such hard ground," says Drager. "All the poles had to be pre-drilled. It's effectively soft concrete; the whole ground."

Storage system

Installing a battery was an effective method of optimising the use and quality of the solar power during fluctuations in the weather. Battery maker Samsung provided the lithium-ion battery storage solution.

"The battery is 1.8MWh and it is a 2C solution, which means it can do 3.6MW continuous or it can do 4C for a period of time, so that is 7.4MW effectively," says Drager. "However it is limited by the battery inverters, which are limited to 6MW." Swiss electronics giant ABB supplied the inverters.

The panels are connected via an extensive network of low-voltage, high-voltage and communication cables to the battery storage facility as well as the existing diesel-fired power station.

Challenges

The remoteness of the site was clearly the main challenge, as it involved flying in and out both personnel and equipment. "Hundreds of kilometres from the next decent-sized town – it's not like you could

rely on stuff to stride in," says Drager.

There was also a range of mining-specific requirements that are not normally faced by a grid-connected PV project. The line manager of the mine had to be 100% certain that the project installer actions were safe and needed to approve every stage of action. Standard PV developers usually just answer to a utility, whose daily task involves dealing with energy, whereas the mine managers obviously had other priorities.

Thirdly, integrating utility-scale PV with utility-scale diesel posed a major challenge as the risks were far greater and it required multiple considerations compared to smaller-scale integrations. "You can't just plug it in and hope for the best," says Drager. "There's a lot more thought going into the design and commissioning."

Integration

With all three energy technologies at play, a control system is needed to balance the diesel, solar and battery systems to ensure sufficient reserve capacity is always available in the event of clouds blocking the sun. If a cloud comes over the PV panels, a part of the energy demand has to be supported by the reserve diesel capacity to make up for the shortfall in solar power. However, it takes some time to start the generators and bring them online. "When a really dark cloud comes over very quickly, the battery helps smooth it out", says Drager. "It also allows more time for a diesel engine to come online."

During the interim period, the battery is able to meet the balance of demand until the new generators are up and running. Once the cloud passes, the power station reverts back to solar power and turns off the diesel generators, which are no longer needed.

As the afternoon approaches and the amount of sunlight reduces, the diesel generators then provide a steadily increasing proportion of the mine's power needs.

During the evening when the solar no longer provides power, the battery has the ability to continue providing auxiliary services such as frequency control, power factor correction, as well as a spinning reserve, thereby increasing the overall reliability of the power station.

Finance

Project owner Neoen was responsible for providing equity for the project and securing AU$15 million in debt finance from Australia's Clean Energy Finance Corporation (CEFC), the state-run firm responsible for promoting renewable energy investment in the country. CEFC recently reported a doubling of investments in renewable energy to AU$379 million in the financial year 2015/16, up from AU$189 million in 2014/15 despite consistent attempts from the federal government to hinder its renewables support.

The Australian Renewable Energy Agency (ARENA) also provided AU$20.9 million in recoupable grant funding.

O&M

Juwi is also in charge of operations and maintenance (O&M) on both the solar plant and storage system

"Definitely a lot more consideration and time is spent managing the storage," says Drager. "You need to keep the battery temperatures constant so there are more requirements to control the environment. From an O&M perspective, it's not super difficult, but the battery is just another consideration."

Meanwhile, the cleaning of the PV plant is carried out manually.

Future

Looking ahead juwi is already eyeing up similar projects at other diesel-reliant locations.

"We've signed an alliance agreement with Pacific Energy for Australia and they own 230MW of diesel power stations in Australia on about 20 brownfield sites," adds Drager. "We are looking at those opportunities to work together on greenfield opportunities. I think we will see a few more."

Hybrid projects do pose a challenge and this particular project had only a six-year PPA term, says Drager, so the project required government funding to underwrite the back end of the PPA. As a result the whole development involved nine different law firms and four technical advisers.

"There were a lot of different entities involved and the pure hybrid complexity was not just technical but more commercial. I think that was really why we have not seen more [similar projects]. Trying to get the numbers to work on a short PPA term is always challenging with off-taker risk that is normally a bit higher than with a utility," says Drager.

Solar energy plants are being utilised near mines worldwide, from many parts of Africa to copper mines in Chile, but the Degrussa project shows not only that energy storage can be used to optimise the functionality of these renewables systems but also that scale should not hold developers back. ■