CRONIMET MINING-POWER SOLUTIONS COMPLETES WORLD’S FIRST ONE-MEGAWATT DIESEL-PV HYBRID IN SOUTH AFRICA

By Elizabeth Judd, Energy and Mines
Photovoltaic power plants are especially compelling solutions for mines and industrial companies with captive -- or off-grid -- energy sources. Typically, mines in locales so rural that they can’t tap into an established power grid import diesel to run their enterprises. Over time, though, the mounting expense and distribution headaches associated with diesel have made these businesses hungry for new ideas.

Munich-based Cronimet Mining-Power Solutions plans, builds, finances, and operates captive renewable energy power solutions, explains Director Rollie Armstrong. He argues that photovoltaic (PV) is an ideal decentralized, hybrid solution for many mines in remote areas that also possess abundant solar resources.

Armstrong will be joining other mining and renewable energy experts at the Renewables and Mining Summit, Johannesburg. The summit will feature the most recent case studies from global mine’s that have incorporated renewables into their energy mix and the challenges and benefits of choosing and implementing these systems.

**THE COST BENEFIT OF CHOOSING PV**

In November 2012, Cronimet Mining-Power Solutions, formerly SOLEA Capital GmbH and the parent company of South African-based SOLEA Renewables, completed the world’s first one-megawatt (MW) photovoltaic diesel hybrid electric plant.

The PV plant supplies 60% of the 1.6 megawatts of power required for Cronimet’s South African chromium ore operations in Limpopo Province, located in a remote fringe grid region three hours north of Johannesburg. Although there are many arguments in favor of such a program, the most compelling is cost. By synchronizing a photovoltaic plant to an existing captive diesel mini-grid, mines can reduce diesel consumption dramatically during the day, Armstrong says.

In geographies with high solar resources, the cost to pay an external provider or an independent power producer (IPP) for photovoltaic electricity is roughly half the cost of diesel over the 20-year operating life of a typical plant. And for those companies that purchase the infrastructure and own the photovoltaic (PV) plant outright, the initial investment can be recouped in one-to-five years, as the variable costs to operate the PV plant are as low as $0.02/kWh (or two cents per kilowatt hour).

“Once they see there’s a power system that allows them to buy electricity at half the price to currently produce electricity, it becomes a pretty easy sales argument,” says Armstrong. He adds, “Rather than investing their cash reserves into new exploration and development projects, miners are feverishly seeking efficiencies within existing operations. The high cost of energy is a ubiquitous and material operating expense that until recently has been reluctantly accepted rather than actively exploring greater operating efficiencies.”
Power is considered “captive” when the energy doesn’t come from a utility company but from an independent source. Most often, explains Armstrong, mines bring in diesel generator sets (gensets) that run everything from office buildings to the infrastructure of the mine itself. The problem, he explains, is that the diesel fuel usually has to be shipped hundreds of kilometers in large trucks to reach the mine site. Diesel prices have been climbing 10-15% a year, and when there’s a glitch in the supply chain -- anything from a road closure to harsh weather -- the mine’s ability to operate is jeopardized.

PV isn’t the only hybrid option. Some mines choose wind, hydro or biogas generators coupled with diesel. However, solar has particular appeal in sub-Saharan Africa, South Africa, Australia, Indonesia, Chile, Southeast Asia, and other places where the sun shines brightly and steadily for much of the year. “PV wouldn’t be perfect in Maine or Washington State, where it rains more than it’s sunny,” laughs Armstrong. “It has to be applicable to its environment. But mining is widespread in arid places that are very rural and off the grid but that have high solar resources.”

With a photovoltaic plant, the sun’s irradiation hits an array of solar panels (Cronimet opted for a Jinko silicon-based panel for this South African chromium mine project). The energy is then converted into electricity. Each panel is 240 watts and has an area of roughly 1.6 square meters. Cronimet installed 4,158 PV panels on a hectare of vacant and previously unused land at the mining operations. The company procured and installed 63 decentralized three-phase inverters from German supplier SMA, each with a nominal power of 17 kilovolts (kV), that convert the DC electricity produced by the PV panels into AC electricity. The AC electricity is then stepped up with transformers to supply the load at the mine with its required voltage.

Cronimet required the mine’s two existing 800 kilovolt-ampere (kVA) diesel gensets to supply the mini-grid with stable and consistent voltage and frequency parameters. It then used the mini-grid parameters generated by the master supply to which the 1 MW PV plant was synchronized, using conventional grid-tied inverters.
Consequently, the PV plant can’t accommodate all of a mine’s power infrastructure needs, but it can significantly reduce the variable diesel consumption during the day. One scenario might be to have a ten-megawatt mini-grid with ten one-megawatt diesel gensets running all day and night. PV could then penetrate the 10,000 kVA diesel power system by up to 60%, synchronizing a 6MW PV plant to the mini-grid. Assuming the mine is operating in an area with high solar resources, the PV plant would replace between 3 million and 3.4 million liters of diesel fuel per year for 20 or more years.

PV technology is tested, and mine owners have come to understand and appreciate its reliability. “Power shortages, interruptions and outages are more costly to the mining operations than powering plants and equipment with diesel. The energy source needs to be reliable, consistent, and on demand,” says Armstrong. “Nowadays, we don’t have to do a lot of convincing that a photovoltaic plant provides twenty-to-thirty years of reliable energy. We’re beyond that.” He continues: “Today, with over 35 gigawatts of PV installed in Germany alone, the market understands that this is a reliable technology.”

At larger mines, Armstrong says that the head of engineering or of energy usually is the one who decides to embrace PV, while the managing director will ultimately sign off on the capital expense or the power purchase agreement. At Cronimet, for instance, Moritz Hill, director of Cronimet Mining Energy AG, gave the green light to his board, after the quality of power and the operating efficiencies were confirmed.
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PV plants hold out the promise of dramatic cost-savings within a relatively short timeframe. However, the conversation around precisely how much can be saved depends on which scenario a mine adopts, as well as physical and meteorological constraints at the site.

Some mines may opt to pay a third-party IPP to supply energy on a take-or-pay basis. The mine signs a power purchase agreement (PPA) with the IPP, which, in effect, transfers the balance sheet investment to a P&L operating expenditure. The price of the PPA will generally reflect the IPP’s levelized cost of electricity (LCOE), or the cost required to recoup the return on investment during a 15- to-25 year period. The longer the life of mine, the longer the PPA term, the lower the PPA price of electricity, says Armstrong. The PPA price— which includes all installed capital costs, the IPP’s own cost of capital and the PV plant operating expenses— still provides the mining company with a 20%-to-50% discount to the direct LCOE to operate the diesel mini-grid.

Cost-savings can be even more alluring for those mines that purchase the entire PV plant and generate energy on their own balance sheet, or within an affiliated corporate structure. In this scenario, a mine would pay a company like Cronimet Mining-Power Solutions to deliver the turnkey and commissioned power solution under an engineering, procurement and construction (EPC) agreement. This onetime fixed cost is capitalized and depreciated on the balance sheet and can offset income taxes on core-business activities. There are often renewable energy programs from international development funding institutions that will further reduce the cost of capital.

The PV plant is then monitored and managed by Cronimet under an operating and maintenance (O&M) contract. The variable costs to maintain a PV plant are virtually zero and the total operating costs range from between $0.02- $0.04 per kilowatt hour. This provides the miner with a natural energy hedge that will offset daytime diesel fuel prices for 20-to-30 years.

For mines that buy the entire system, electricity costs tend to be 90-98% less than using diesel. Armstrong explains that if the LCOE to run the diesel mini-grid is $0.50 per kilowatt hour, which includes capital costs for the gensets and the variable cost of a liter of diesel, and annual solar resources at the site are above 1800 kilowatt hours at peak power, then the breakeven on the capital installation costs of the PV plant can be as short as three- to four-years.
In the case of Cronimet’s South African chromium ore mine, Cronimet’s parent company in Switzerland ran the numbers and realized it made more economic sense to own the PV plant directly. Consequently, Cronimet owns and operates the PV plant infrastructure through a holding company that entered into a PPA with Cronimet’s chrome mining operations in South Africa. This is a model and a financing option that Cronimet Mining-Power Solutions offers to other mining operations anywhere in the world.

Unlike many forms of renewable energy, a PV plant can be up and running in just three months after construction has commenced. Miners love the speed of implementation, says Armstrong, noting, “They don’t want to wait for a two-year feasibility study and then wait another two years to build and commission a solution.”

Armstrong emphasizes that operating and maintaining a PV plant tends to be straightforward: “It doesn’t take a lot of manpower and that’s why the costs are so low.” Because it’s a hybrid solution, the diesel generators are always there and can ramp up to 100% of power in a matter of seconds if a large weather front were to create cloud coverage that dropped the PV plant output by 80% in a short period.

And although a worker needs to clean the panels and keep the grass mowed to prevent fires, an electrical engineer at Cronimet monitors the PV plant’s output with a remote Internet connection from Johannesburg and Germany.

Armstrong says that installing the initial PV plant for Cronimet was eye-opening. Whenever something is built in a remote area where no public power grid exists, the possibility of problems looms large. However, he emphasizes, “all went as planned; we installed on time and at budget and the cost estimates for the system are proving realistic as the mining company is already saving money each day.” He concludes: “Our lesson learned is that our forecasts and expectations have come true.

For more information about the Renewables and Mining Summit, Johannesburg, June 23-24, visit www.energyandmines.com/africa.