BUILDING A WIND FARM IN ARCTIC CONDITIONS: RIO TINTO'S DIAVIK MINE

Finding a way to power the Diavik Diamond Mine in Canada's northwest territories, an area where the thermometer can plunge to -50 degrees Celsius, is a large and costly challenge for Rio Tinto. Until 2012, this remote Arctic site relied entirely on diesel for all its energy needs, using approximately 70 million liters of diesel a year. Today, the mine has four 2.3 megawatt wind turbines that supply an average of 10% of the mine's total energy needs.

The harsh climate on the Lac de Gras island where the Diavik wind diesel hybrid facility is based places several constraints on how energy is supplied. Liezl Van Wyk, Manager of Business Improvement for the Diavik Diamond Mine, points out that there are no regular roads, shipping routes or transmission lines to the diamond mine, nor is there "a gas station around the corner where we can go buy our diesel." Supplies are trucked to the site during six-to-eight weeks in winter when an ice road is constructed from Yellowknife.

Before settling on wind, Van Wyk was open to other energy options. She soon ruled out geothermal (the diamond mine isn't deep enough), nuclear power (there is no regulatory framework for this in the Northwest Territories), and solar (the scale is small and breaking even financially difficult).

On the other hand, wind held plenty of appeal. A wind farm was scalable, says Van Wyk, explaining that the amount of energy generated depends upon the number of turbines added. What's more, the wind resource on the island was fairly attractive, and even though wind power is expensive, it is more economical than the cost of diesel in the arctic.

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Making the Case

In 2007, a meteorological tower was installed near the Diavik mine as part of a wind resource feasibility study. Three years later, Van Wyk began studying weather data and exploring the construction possibilities near the mine. "We launched a survey campaign on site to find the best wind locations on the island," she says, and then did geotechnical drilling to determine the strength of the rock on which the company planned to build the foundations.

She further explored wind turbine options in 2010 by attending the Canadian Wind Energy Association conference in Montreal, where she canvassed various suppliers and identified five interested companies. After creating a rating system for the tender offers, she chose Enercon, a German company that scored highest on a combination of technical design, price, and customer support, and could fit the turbine blades with a de-icing technology. In November 2011, Enercon shipped the four wind turbines from its factory in Germany to Canada before the turbines were trucked to the Northwest Territories.

Another challenge was reaching out to various stakeholders, including government entities that grant permits and the local aboriginal groups. Perhaps the most critical early-stage PR opportunity came when Van Wyk planned a ceremony and donated the meteorological tower used for the Diavik wind resource assessment to a Yellowknife business consortium so they could explore building their own wind farms in the Yellowknife area.

"You don't come out of nowhere and make this big announcement: We're building the first wind farm in the Northwest Territories," she says. "You start the discussion and engagement early, and donating the weather tower was a very good tool I had at my disposal to get discussions going regarding wind farms in the north."

Once Van Wyk had settled upon a financial model and solid business plan, the project was presented to various senior Rio Tinto executives to get capital approval for the $33 million project. She acknowledges that it was "a big ask," but the project met all the economic feasibility criteria. Final approval was granted by Rio Tinto's CEO (then Tom Albanese), who was already aware of the wind farm project because of the early stage stakeholder engagement work. He quickly gave the project his blessing.

Forethought was one key to success, says Van Wyk. She recommends frontloading as much work as possible, doing everything from weather research to financial modeling to risk assessment as early as possible. "For months I worked seven days a week to think through all the issues," she says. "Act as quickly as possible because things will pop up that you didn't anticipate even with very careful planning."

For several months in 2010 and well into 2011, Van Wyk constituted the entire wind farm team, a situation she now regards with gratitude. "If you need to move really fast, keep the team small and very aggressive," she advises. "I kept the project controls close to me and so most of the bureaucracy was out of the project and decisions were moved on rapidly."

In-House Innovation

Instead of hiring numerous consultants and contractors, Van Wyk worked closely with Diavik's resources and designed most of the wind turbine installation in house. Not only did this keep costs low, but it also fostered a strong team spirit. "Our own people had a chance to step up to the challenge," she says, "and this created buzz and a positive vibe. With specialist design work, we selected key contract partners that had a solid track record with us and would contribute to the project success, as this project had a higher than average risk profile."

Out of this work came several innovations. Rio Tinto designed and used its own communications protocol and design, instead of merely bolting on the suppliers' SCADA solution. She also found ways to keep the construction footprint as small as possible out of respect for the environmentally-sensitive tundra surrounding the mine site. For instance, the engineers designed the crane pads so that they could do double duty as a lay-down area for the turbine components. "We had the advantage of our own crews and mining equipment to build roads, blast foundations, mix and pour concrete, and tie into our overhead power lines," she says.

Finally, she says, the company had to find ways to protect the 100-meter-high wind turbines against lightning. Lightning was a particularly daunting challenge because the island is located on high-resistance rock that hampers lightning fault current from flowing to ground. In the end, the Diavik team took the novel approach of grounding the structures in the surrounding lake -- an idea that has proven quite successful. Again, Van Wyk had the initial inspiration but it required good electrical design done by one of the contractors to deliver on the idea.

Even with plenty of planning, some lessons could not be anticipated. The winter of 2011 to 2012, when commissioning was underway, was one of the coldest on record at the mine and so the lubricants in some of the components froze. Van Wyk was glad that a dedicated team was available to address problems during the construction and commissioning phase because the technicians could troubleshoot and replace the lubricants with a more suitable product.

"People will expect the plant to run smoothly, but it's seldom going to run smoothly from the start," she says. "If you don't have a dedicated team to resolve start-up issues, people will lose motivation and start pointing fingers."

Since February 2012, the wind turbines have achieved wind-diesel penetration of up to 45%, with an average of 8%. "We are aiming to generate 10% of our 20-25 MW mine electrical load with renewables. If we have a lot of wind, we can shutdown some of the diesel generators," she says. In addition, Diavik is planning to reduce its diesel use by approximately four million liters and its CO2 emissions by 12,000 tons.

To Van Wyk's delight, the turbines have been well received by the various stakeholders so far. "Now that we have a working example to learn from, we're hoping that this will make the case for further development and expansion of wind renewables in the north and in other remote communities."

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