

A Nicaraguan geothermal plant aims to
But first its team

prevent another energy crisis.
must accommodate a major mid-project change.

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BY PETER FRETTE // PHOTOS BY RICHARD LEONARDI

GAINING Steam

Nicaragua suffered an energy crisis in 2006, with countrywide blackouts lasting from four to 12 hours a day.

The cause? The country was too dependent upon imported fuel oil, which at the time was the source of most of its electricity. Oil prices had escalated from less than US\$40 to over US\$100 per barrel, which, when paired with a strict energy rationalization policy, left hundreds of thousands of citizens without power.

Determined to find a long-term sustainable solution, the Nicaraguan government embarked on an aggressive plan to dramatically increase the percentage of electricity coming from indigenous, renewable sources. Geothermal surfaced as a main component, prompting Ram Power Corp. and its subsidiary, Polaris Energy Nicaragua S.A., to launch the San Jacinto-Tizate geothermal drilling and power generation project near the city of León.

DRILLING DOWN TO DETAILS

The two phases of the megaproject aim to increase production from the initial 10-megawatt capacity ultimately up to 85 megawatts.

Building a plant of this nature starts with the steam field, which includes drilling wells and installing stations responsible for separating steam from hot water. The steam is then piped to the power plant, while the hot water is reinjected back underground through an injection well.

Then project teams must construct a 13-kilometer (8.1-mile) transmission line to connect the plant to the national grid. Simplifying this process is the long-term power purchase agreement Ram Power has in place with a subsidiary of Gas Natural Fenosa, a Spanish utility.

The final component is the power plant itself, which includes a turbine, a generator, a condenser and cooling towers—all built using materials designed to accommodate for the highly corrosive nature of geothermal steam.



The switching station

FACING THE HEAT

Throughout its life cycle, the project has been beset with cost overages. The original approved budget for phase one was US\$151 million—but the project closed at US\$184 million, roughly 20 percent over its estimate.

“The construction portion took longer to build than was initially estimated, which resulted in additional overhead costs as well as interest expense,” says Jose Antonio “Tono” Rodriguez, chief operating officer for Latin America at Ram Power in León.

Contributing to those delays was the need to change the prime contractor midstream after the project took on some major scope creep.

“When the original contractor signed on, the project was conceived as a very different project,” he explains. “It was initially going to be three units of 24 megawatts using different technologies.”

However, in October 2009, Polaris instituted a design change, incorporating two 36-megawatt steam turbines with the goal of increasing production and reliability.

“When the project changed to two 36-megawatt systems, construction methodologies changed as well,” Mr. Rodriguez says. “And, unfortunately, the contractor could not accommodate us.”

By shifting gears to larger, higher-efficiency geothermal turbines, the construction sequence altered. The

plan now had to accommodate a bigger building and foundations, as well as a significantly higher degree of automation.

To deal with the issue, Ram decided to bring the construction management and supervisory role within its project management office. While the change resulted in an adjustment period, the company was able to keep the majority of its onsite subcontractors active yet with new direction.

The well-defined relationship between the project team and senior management was instrumental in allowing this transition to succeed, according to Thomas May, project manager at Polaris. “Management includes separate but shared responsibilities,” he says.

With phase two well underway, Ram Power has had to come to grips with the fact that its project plan doesn’t match up to reality.

“For instance, we have several wells that were low producers, so we have to go back in and stimulate another to try to recover production,” Mr. Rodriguez says. “We had to adjust the model while we were moving full force ahead with plant construction.”

HOT COMMODITY

The project also faced some major financial hurdles. The downside for this type of investment is that the develop-

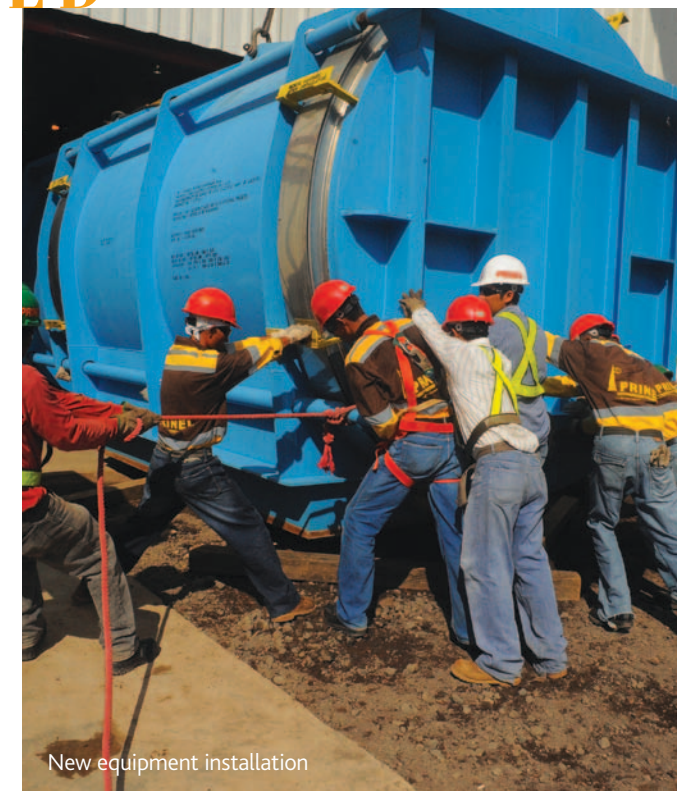
LESSONS LEARNED

As the project team proceeds with phase two of the San Jacinto-Tizate geothermal project, it has compiled a list of key takeaways:

Field assessments: Not having an accurate picture of the playing field makes for a costly investment. As a result, Ram Power has measures in place to better utilize consultants capable of reviewing the data and seeking out different opinions of what the geological reality is underground.

Financial freedom: Projects are only a success when the organization is able to push forward without concerns about available funds. As such, Ram Power is increasingly diligent at working with the investment community to ensure the availability of funding.

Contractor qualifications: In dealing with the tribulations of changing general contractors midway through the project, Ram Power learned firsthand the importance of selecting contractors based in part on their supervisory abilities.



New equipment installation

GENERATING POWER

December 2009: Construction begins.

September 2010: First well successfully flows.

February 2011: Delays and cost overages.

March 2011: Second well successfully flows.

April 2011: Third well successfully flows.

August 2011: Phase two approved.

January 2012: Plant synchronized to the national power grid.

ment company, Ram Power, front-loads all the risk, explains Steven Scott, director of investor relations and corporate secretary at the organization in Reno, Nevada, USA.

"Banks are not willing to come in on a geothermal project until the project confirms approximately 60 percent of the available resource," he says.

Wells typically cost between US\$7 million and US\$12 million each—and to date, the San Jacinto-Tizate site has 17.

The organization was able to remain active in part because its stakeholders decided in 2009 to create a diversified geothermal platform by consolidating various companies under an experienced management team, according to Mr. Scott.

Geothermal is "the renewable energy of choice," in part because it has no greenhouse gas emissions and allows for the selling of renewable energy credits on the open market, he explains. "But it is costly and labor-intensive, with a small pool of talent available."

Cost overruns strain relationships, Mr. Scott adds, "but through regular communication and explanation of the risks in advance, our stakeholders have been very understanding and accepting."

Over the past two years, Ram Power raised about US\$245 million for the initiative. "Using the Inter-American Development Bank and The World Bank's International Finance Corp. as the backbone for these large-scale loan structures was instrumental," Mr. Scott says. "At one point, we used nine globally located banks to fund the credit facilities. Because success in drilling came in late, we had to secure bridge financing and additional equity while we were building."

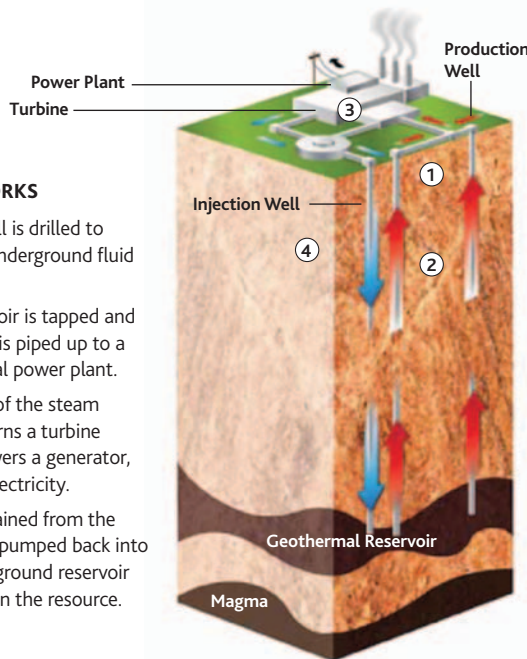
Keeping the project's forward momentum was critical, explains Dino Barajas, the project's lead counsel and partner at the law firm Akin Gump Strauss Hauer & Feld LLP in Los Angeles, California, USA. "There was a lot of complexity both in financing and keeping the project moving," he says. "Nicaragua had never seen a project of this scope or financial commitment. Even though we had to meet the various restrictions of each of the lenders and answer questions at each step of the way, we knew we could not afford to lose time—especially in an environment of economic uncertainty."

The project team relied upon those in a certain role to provide that forward-looking vision: "Field project managers must have the ability to see clearly from any point in the project forward to the finished project, and anticipate potential challenges," Mr. May

HARVESTING GEOTHERMAL ENERGY

HOW IT WORKS

1. A deep well is drilled to reach an underground fluid reservoir.
2. The reservoir is tapped and hot water is piped up to a geothermal power plant.
3. The force of the steam created turns a turbine which powers a generator, creating electricity.
4. Water retained from the process is pumped back into the underground reservoir to maintain the resource.



52%

The amount of energy generation in Nicaragua dependent upon imported fuel oil for electricity generation, **down from 74.5% in 2006.**

The San Jacinto-Tizate geothermal project contributed to **1/2** of that drop

says. "When unplanned events or reversals do occur, we must initiate recovery plans to maintain schedule discipline."

Electrical equipment and engineering interface issues led to delays on the project's first milestone, the switchyard and generator step-up transformer, which receives the electrical energy and connects it to the national grid.

The team brought the manufacturer's representatives and design engineers onsite during a holiday period—and at considerable cost to overcome potential delays in the critical milestone.

"Without proactive management support and flexibility on cost versus schedule risk, the overall schedule, including commercial operation, could have seen cascading delays," Mr. May says.

FULL STEAM AHEAD

The first phase of the megaproject closed in January, ringing in at US\$184 million, "essentially on schedule and within budget," Mr. May says. It was enough of a success, he adds, that the project has entered phase two—a "mirror image" of phase one.

"We will be operating the new 36-megawatt addition and the old 10-megawatt plant in conjunction with one another for about a year," Mr. Rodriguez says. "We will then bring online another 36 megawatts and retire the 10-megawatt plant."

The next phase is expected to cost about US\$213 million. "Although on a large scale, this plant is a fairly normal construction," Mr. Rodriguez says. "Of course, we have embraced a higher degree of automation equipment than you would see in older geothermal plants, including state-of-the-art Fuji Electric equipment."

Already, the project has met one of its biggest objectives: The Nicaraguan electricity matrix has diversified—in part because of the San Jacinto-Tizate geothermal plant, Mr. Rodriguez says.

"As of January, the dependence on imported fuel oil for electricity generation has dropped to 52 percent," he says. "Our current contribution accounts for half of the 20-percent reduction."

When the next 36-megawatt plant comes online, slated for this December, Ram Power expects to generate one-fifth of the country's electricity needs. **PM**

The recovery lagoon

