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Raft River Redux

U.S. Geothermal Inc. Built Idaho’s First Geothermal Power Operations and Plans Another Milestone in Oregon
by Ted J. Clutter

A landmark achievement sparked to life in the high sagebrush desert of Idaho’s southeastern corner in 2007, when U.S. Geothermal Inc. (Boise) generated the first commercial geothermal power in the state. The company bought the property from Vulcan Power Co. (Bend, Oregon) in 2002, with a vision of renewable energy production in a region rich with geothermal resources. But U.S. Geothermal’s start-up wasn’t the first time the Earth’s heat produced electricity at this remote site.

“The U.S. Department of Energy (DOE) drilled wells there in the 1970s to test binary cycle power technology and experiment with geothermal heat for agriculture and aquaculture,” said Idaho National Laboratory Renewable Power Engineer Greg Mines. “We proved the reservoir and successfully operated a 5-megawatt (MW) power plant for several months in 1980-82, but scrapped it when project funding ended.”

An independent study estimating reservoir power potential up to 110 MW confirmed U.S. Geothermal’s enthusiasm for building a power plant at Raft River. With backing by Canadian investors and a cost-sharing agreement with DOE to rework the site’s old geothermal wells, the company set out to make that dream a reality.

Raft River Unit 1 Development

“Private capital and public stock offerings provided $5 million for initial development at Raft River,” said U.S. Geothermal Chief Executive Officer Daniel Kunz. “In early 2005, we signed a 20-year, 10-MW Power Purchase Agreement (PPA) with Idaho Power Co. for output from the Raft River $52-million Phase One, Unit 1 development.”

With PPA in hand, the company’s subsidiary, Raft River Energy I, LLC, signed a $20.3 million contract in December 2005 with Ormat Nevada, Inc. (Reno) to engineer and build a 13-MW (net) binary cycle power plant at Raft River. U.S. Geothermal also planned a Phase Two development (Units 2 and 3) that would boost net capacity to 39 MW.

Through their wholly-owned Raft River Holdings LLC, Goldman Sachs put up $34 million toward construction in return for federal Production Tax Credits and a share of Raft River Energy I, LLC for

U.S. Geothermal Inc. generated the first commercial geothermal electricity in Idaho with its 13-megawatt (net) binary power plant at Raft River. The facility was designed and built by Ormat Nevada, Inc. PHOTOS BY TED J. CLUTTER.
the life of the project. Renewable Energy Credits worth an average $500,000 per year (for 10 years) are sold to Holy Cross Energy in Colorado. Additional U.S. Geothermal Inc. stock offerings and private financing since 2006 have raised some $75 million for working capital, acquisitions, exploration and development at Raft River and new projects in Oregon, Nevada and Guatemala.

The Raft River project started with seven old DOE production and injection wells, plus over 5,000 acres of property, leases and geothermal development rights. After U.S. Geothermal secured project financing, it issued a Notice to Proceed to Ormat in the spring of 2006. Ormat designed Raft River Unit 1 with its latest binary cycle technology, including a cooling tower for more efficient condensation of the power plant’s isopentane working fluid during the hot summer months.

In August 2006, U.S. Geothermal drilled a new injection well, deepened two injection wells, and bored legs in two production wells to boost fluid production for the Unit 1 power plant. “Drilling confirmed a large geothermal resource, with temperatures of 275° F to 300° F at 4,500 to 6,000 feet,” said U.S. Geothermal Chief Operating Officer Doug Glaspey.

U.S. Geothermal managed the remainder of project development. With land purchases and new U.S. Bureau of Land Management (BLM) leases, the company increased its holdings—including water rights and resource access—to nearly 7,000 acres. Raft River Rural Electric Cooperative (RRREC) agreed to reconstruct a 3.4-mile, 34.5-kilovolt power line from the project, and to install distribution lines to wellheads in the geothermal field.

During 2007, Raft River Unit 1 construction proceeded apace, with buildings, cooling towers

Map showing location of Raft River project in Idaho.
Future Development at Raft River

Since startup the Raft River Unit 1 power plant has performed well, but not to full capacity. “We are operating at 98.8-percent availability, and the project is making money,” said Glaspey. “But we’re still short of fluids. The existing wells just haven’t given up as much fluid as predicted. So instead of 13 MW, we’re scheduled for about 9.7-MW average in 2010.”

U.S. Geothermal’s immediate goal is to boost Unit 1 to full capacity, and find enough fluid for Phase Two development. “We have a recovery plan to repair a leaking casing lap joint in our hottest production well that has reduced its temperature from 299° F to 246° F,” said Glaspey. “The plan also includes drilling a new injection well, and new production legs from existing wells.”

Assisting the effort is a numerical model of the Raft River geothermal reservoir. “The model helps us with power generation forecasts, and as a diagnostic and predictive tool,” said Glaspey. More important may be a research project started in February 2010 with DOE to demonstrate Enhanced Geothermal System technology.

DOE will cost share $6 million of the $9-million project, with U.S. Geothermal providing an injection well, reservoir data and

and major power production components secured to their foundations by September. Drillers completed their work on producion and injection wells, and RRREC finished its transmission line. Hot geothermal fluid started flowing to the power plant by October.

“Technical issues delayed project completion, pushing startup from October to the end of the year,” said Glaspey. The wells and power plant were successfully tested during that time, and Ormat finished its work at Raft River Unit 1 by year’s end. On January 3, 2008, Idaho’s first commercial geothermal power plant was officially online.

A new Idaho Power PPA accepts full, 13-MW output from Raft River Unit 1, and an annual portion of power (June-November) from U.S. Geothermal’s proposed Unit 3 power plant. “We’re negotiating with another utility in the region for remaining output (December-May) from Unit 3,” said Kunz. The Eugene (Oregon) Water and Electric Board has a 25-year PPA for variable output up to 16 MW from the company’s proposed Unit 2 power plant.

U.S. Geothermal VP Exploration Bill Teplow is developing a model of the Neal Hot Springs geothermal reservoir to help him target drilling sites for production wells.
Raft River personnel. Project partners include the University of Utah Energy & Geoscience Institute, APEX Petroleum Engineering, and HiPoint Reservoir Imaging LLC. The team will study reservoir permeability at ~6,000 feet by measuring the impact of thermal fracturing with fluid injections at three different temperatures.

“We hope the work will improve our chances of drilling commercially viable production and injection wells at the site,” Glaspey said. “That means better use of capital, and the ability to extract geothermal fluid from the reservoir that is critical for Phase Two development.”

As the company pursues its recovery plan at Raft River, it will concentrate on new development projects. “We have high regard for Raft River, and still expect to build Units 2 and 3, but we’ve set the Phase Two project aside while we work with shallower resources at Neal Hot Springs (Oregon) and San Emidio (Nevada),” said Kunz. “These projects have lower drilling costs, and promise better cash flow and profitability in a shorter timeframe.”

Commercial Power for Oregon

Acquired by U.S. Geothermal in September 2006, the Neal Hot Springs project lies on private land covering 9.6 square miles near Vale, Oregon, about 90 miles west of Boise, Idaho. Chevron Minerals drilled the first discovery well at the site in 1979, confirming a commercial-grade geothermal resource. The company intends to build a 22-MW binary cycle facility on the site—Oregon’s first commercial geothermal power plant with a utility PPA.

U.S. Geothermal’s first production well at Neal Hot Springs in May 2008 found a temperature of 287°F at 2,305 feet. Geothermometer analysis indicated temperatures of 322°F to 350°F at greater depth. A second production well completed in October 2009 intercepted a large aperture fracture and temperature of 286°F at 2,896 feet. “We have 15 MW capacity in our first two production wells, which cost about $2 million each,” said U.S. Geothermal Exploration VP Bill Teplow.

The company initiated a temperature gradient (TG) drilling program in 2009 to learn the limits of the geothermal reservoir. The 4.5-inch wells were drilled 500 to 1000 feet, with some deepened to 2,000 feet. Geologic and flow data from the TG program and production wells are key components of a numerical model that will help Teplow target additional wells and demonstrate the potential size and output of the resource. He planned a third production well for completion by early summer 2010.

In late-2009, Idaho Power signed a 25-year PPA for up to 25 MW from the project, and will build a $3.2 million, 10.3-mile transmission line and substation from the facility by early 2011. “Our PPA with Idaho Power will make this project go,” said Kunz. Preliminary engineering is underway for a power plant at Neal Hot Springs, and transmission studies are complete.

DOE selected the Neal Hot Springs project in May 2009 for a possible low-interest project loan that could provide up to 75 percent of estimated maximum $134-million total capital cost. “The program applies to innovative technology, so we proposed a 22-MW air-cooled, modular binary cycle power plant,” said Teplow.
plant from Turbine Air Systems that uses R134A refrigerant rather than the usual isopentane or isobutene as its working fluid,” said Kunz.

To qualify for an Investment Tax Credit cash grant totaling 30 percent of total project cost, U.S. Geothermal intends to start construction before the end of 2010, “We are very bullish on Neal Hot Springs, and hope to be in commercial operation by the first quarter of 2012,” said Kunz. “We have two productive wells out there, with good production temperatures. We have a PPA in place, and with the DOE loan we will have very low-cost debt, which is very positive for the project.”

Repower and Expansion in Nevada

At a cost of $16.6 million in April 2008, U.S. Geothermal bought its second geothermal power operation and proven geothermal reservoir at San Emidio, 100 miles north of Reno, Nevada. Purchased from Empire Geothermal LLC and Mike Stewart, the property includes a 1987 vintage 3.6-MW (net) binary power plant, 22,944 acres of private and BLM geothermal leases, and 5,414 acres of nearby BLM leases at Granite Creek, NV.

In late-2009, the company purchased additional groundwater rights and a mothballed agricultural dehydration facility with office, shop, operation and storage buildings adjacent to the project well field.

With two producing geothermal wells, the San Emidio power plant provides 2.5- to 3-MW of electricity to NV Energy subsidiary Sierra Pacific Power Co. under a PPA in force until 2017. U.S. Geothermal has already invested nearly $600,000 in the existing operation, increasing output by a third and improving cash flow. “We’ve maintained the well field, improved cooling systems, retooled equipment, and improved maintenance standards,” said Glaspey.

The company plans a two-phase, $157-million repower and expansion project at San Emidio, with a new power plant and wells raising project output to 35 MW. “First is our repower, with the old power plant replaced by a new, more efficient 8- to 9-MW facility fueled with existing geothermal fluid flow (4,000 gpm at 285° F),” said Glaspey. “We haven’t chosen an equipment provider yet, but plan to start construction this year (2010) with startup before the end of 2011.”

Second phase expansion requires new production wells for increased power output of 26 MW, and an upgraded transmission line. The project is slated to be online by the end of 2012, but depends upon successful well drilling for additional geothermal resources. “Expansion will take drilling, and we expect that our geophysical exploration effort will tell us where to drill next,” said Glaspey.

In late-October 2009, U.S. Geothermal was awarded $3.77 million in Recovery Act funding for innovative exploration and cost-shared drilling at San Emidio. “The work will help us reduce the number of production wells we need to increase our resource base for the expansion project,” said Teplow.

“Existing production wells at San Emidio intersect a large aperture fracture, which is what we are looking for. We’re using detailed structural analysis and mapping with PSInSAR™, a satellite-based technique that measures extremely small difference in ground surface elevations.
Combining that with sophisticated seismic refraction profiles and processing methodology, we hope to actually image large fractures with enough precision that we can drill into them with two production wells.”

U.S. Geothermal still needs a PPA for its repower and expansion projects. “Our current contract with Sierra Pacific runs through 2017, and they will get the first 2.5 to 3 MW,” said Kunz. “Negotiations for a buyer of the repower balance are underway, and we expect to have a PPA in place by fall of 2010.”

Nevada Geothermal Exploration
In May 2008, U.S. Geothermal signed a joint venture agreement with Gerlach Green Energy LLC to explore the Gerlach geothermal system in northern Nevada. U.S. Geothermal is manager of development activities for the new company, Gerlach Geothermal LLC. U.S. Geothermal will invest $2 million in the project, including a BLM lease. GGE contributed one BLM lease and one 200-acre private geothermal lease. Total project acreage covers 3,615 acres, including Great Boiling Springs.

Bordering the town of Gerlach about 14 miles north of San Emidio, the geothermal system is well known, with an extensive database from exploration drilling. “It’s a great exploration target in an area of known geothermal activity, and the resource is shallow,” said Glaspey. “A discovery well found 265°F at 600 feet. We’ve permitted a site for a temperature gradient well by early summer 2010. If we can find 300°F, we’ll follow up with a production well. We’re excited about moving forward with the project.”

Hot Prospect South of the Border
In April 2010, the government of Guatemala awarded U.S. Geothermal Guatemala S.A. a 24,710-acre geothermal energy rights concession 14 miles southwest of Guatemala City. The concession is in the center of the Agua and Pacaya twin volcano complex. A key asset is the El Ceibillo geothermal project, with nine existing geothermal wells drilled in the 1990s to depths of 560 to 2000 feet.

“Six wells have temperatures of 365°F to 400°F, with thermal gradients, fluid flows and geology suggesting a deeper, higher permeability reservoir of 410°F to 446°F,” said Glaspey. “Two of the wells produce steam for local industry. El Ceibillo is in an industrial zone with major electrical transmission and distribution lines nearby.”

U.S. Geothermal has completed preliminary reservoir, transmission and environmental studies, and plans to quantify power capacity by deepening the best well with hopes to penetrate a commercially viable steam reservoir. The company will also explore and test at least four additional prospects that boast fumaroles, thermal springs and gas vents.

“The concession is very encouraging. We intend to build, own, and operate a geothermal power plant with a subsidiary in the country,” said Kunz. The company will seek development funding through international finance institutions. “Power price is typically over $100 per MW, so the market is very robust,” said Glaspey. “Our power demand point is very close, and the Guatemalan government is favorably inclined toward geothermal development. It will be very exciting to drill that first hole.”

References

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