AltaRock Energy / Davenport Newberry

Newberry EGS Demonstration Project

Frequently Asked Questions & Answers

Why is an EGS demonstration being conducted at Newberry National Volcanic Monument?

It is not being conducted at the Newberry National Volcanic Monument (NNVM). Davenport Newberry, in partnership with AltaRock Energy, will demonstrate Enhanced Geothermal System (EGS) technology outside of the NNVM. It is part of the U.S. Department of Energy's (DOE) Geothermal Technologies Program[1]. The DOE is committed to developing innovative technologies for clean, domestic power generation. Geothermal energy, a virtually untapped resource from the heat of the earth, is more important than ever before because it has a small environmental footprint, the ability to produce energy consistently around the clock, and emits little or no greenhouse gases.

A DOE-sponsored study, The Future of Geothermal Energy[2], by a panel of independent experts led by the Massachusetts Institute of Technology (MIT), examined the potential of geothermal energy to meet the future energy needs of the United States. The panel concluded that geothermal energy could provide 100,000 MWe or more in 50 years by using advanced EGS technology. EGS are fractured, hot-rock reservoirs that have been engineered to extract heat by the circulation of water between injection and production wells.

The DOE Geothermal Technologies Program, as part of the American Recovery and Reinvestment Act (ARRA), is providing $338.3 million in funding for 151 awards that will support projects in 38 states. Davenport Newberry and AltaRock Energy proposed the Newberry EGS Demonstration to the DOE due to the unparalleled potential of the site, and were awarded $21.45 million to develop the project. This is the largest grant awarded by

[1] http://www1.eere.energy.gov/geothermal/enhanced_systems.html

[2] http://www1.eere.energy.gov/geothermal/pdfs/future_geo_energy.pdf

the Geothermal Technologies Program and, thus, reflects DOE's confidence and support for the project. The AltaRock-Davenport partnership is also investing $22.36 million in the project, which will benefit from the research efforts of faculty and students at the University of Oregon, University of Utah, Lawrence Berkeley National Laboratory, Texas A&M, Temple University, and scientists from the U.S. Geological Survey.

What is the purpose of this project?

The goal of EGS, according to the U.S. Department of Energy, is to produce electricity by extracting energy from the earth's heat; this is done by creating a subsurface system of fractures, and circulating water through these fractures using deep well bores. Creating an EGS reservoir requires improving the natural permeability of rock. Water pumped into deep injection wells is heated by contact with the rock and returns to the surface through production wells to create a continuous heating loop.

The Newberry EGS Demonstration will develop an EGS reservoir in the high-temperature, low-permeability resource present on the northwest flank of the Newberry Volcano. The project team will demonstrate stimulation techniques to induce and sustain fluid flow and heat extraction from one injection well and two production wells, culminating in the conceptual design of a commercial-scale wellfield and power plant.

What are the major environmental concerns that people have about the Newberry EGS demonstration project?

At the outset, we would like to point out that we are subjecting all project activities to strict regulatory agency approval and oversight; each of our activities is subject to the National Environmental Policy Act, a 1969 law that set up procedural requirements for all Federal government agencies to prepare Environmental Assessments and Environmental Impact Statements to ensure adequate analysis of the possible impacts and necessary mitigation of any risks to the environment.

In addition, the project team has studied the science, refined the technology, and listened attentively to the community; we've also tried to use and deploy thoughtful planning and control systems.

Here are several of the issues we are addressing:

Water Consumption and Threats to Water Quality. The demonstration will use groundwater, pumped from shallow water wells located at the project site, to create the EGS reservoir, extract the geothermal energy, and drill two production wells. Adequate groundwater supplies are available at the site to support the demonstration.

Mitigation measures will be implemented to minimize the possible impact of project activities on surface and ground water resources in the area. All drilling wastes will be contained in the existing, lined drilling sump and disposed of promptly and properly, and any potential runoff from the drill pad will also be directed to the sump. Drilling fluids will be formulated from non-toxic components. All non-geothermal groundwater will be cased off and cemented.

Earthquakes. Stimulating fractures using EGS technology does create small seismic events, termed 'microseismicity'. However, the objective of the technology is to create events below the human detectable level. And, in fact, creating large fractures that might result in seismic events large enough to be felt by the nearest residents, about 6.5 miles away, is undesirable from an engineering standpoint; by slowly increasing the stimulation pressure and pumping volume while monitoring microseismicity, we can limit the size of the fractures and events that we produce. Regulators will be monitoring our activity as well, and we will be able to halt or suspend pumping at the first indication of a problem. Seismic data recorded at the site will be streamed real-time to Lawrence Berkeley National Laboratory, where it will be processed and displayed on a public web site.

Impacts to the Newberry National Volcanic Monument. The Monument is a precious national treasure, and Davenport and AltaRock share in the desire to protect the area. This will continue to be of paramount importance to us in our activities. As a result of local grassroots efforts, the central caldera region of Newberry Volcano was proposed for National Monument status in 1989 by a Monument Committee formed with representatives from a wide range of interested groups, including the community, environmental groups, government, and geothermal industry. In 1990, Federal legislation designated the central caldera and a narrower

band of land running north to Lava Butte as the Newberry National Volcanic Monument. The legislation included provisions for a geothermal lease swap, whereby existing Federal geothermal leases within the new National Monument were exchanged for leases *outside* of the boundary. This action excluded geothermal exploration and development within the newly created Monument, but provided that it may occur on leases outside the Monument. This agreement was the cornerstone of the consensus reached by the Monument Committee and was pivotal to establishment of the Newberry National Volcanic Monument. The creation of the Monument was not intended to eliminate geothermal development in the region, but to ensure it is done in the most appropriate and safe location.

Visual Impact. It's important to note that all project installations are temporary. The project is located in an area that has already been involved in geothermal exploration, including well drilling, since the 1980s. The area has also been used for logging, with a number of timber sales, thinning, and other timber management projects in the recent past, all of which have shaped the appearance of the landscape. Most operations will occur on existing well pads or below ground, resulting in little new surface disturbance. Where surface disturbance may occur, sites with the least amount of vegetation will be utilized, such as skid trails and landings from past logging operations. No permanent structures will be constructed for the demonstration project. The drilling rig mast will be approximately 140 feet in height and may be visible from Paulina Peak (approximately 4 miles from well pad S-29). This will be temporary in nature, as the drilling rig will not be permanently on site. A steam plume, resulting from drilling and flow testing of the wells, will be visible from nearby viewing points, particularly during cooler seasons. This will also be temporary in nature, as flow testing is anticipated to occur for no more than a total of approximately 80 days over a period of three years. Placement of equipment, such as that associated with the microseismic array (MSA), will be small in size. Careful siting and the limited small scale of the activities will allow the operations to be as inconspicuous as possible and subordinate to the landscape. Distance, topography, heights of surrounding trees, and existing landscape variation will also contribute to screening the project and making the operations not readily seen from roads or viewpoints, either inside or outside of the Monument.

Wildlife – Flora and Fauna. A recent Biological Evaluation in the project area determined that no Endangered, Threatened, Proposed, or Candidate species or Species of Concern occur within the project area. Drilling activities do, however, have the potential to disrupt nesting and remove nesting, foraging, fledging habitat at the well pads and proposed MSA borehole locations. But any disturbance to a known nesting pair within ¼ mile of a work location will be mitigated by halting operations during the breeding season (e.g., March 1- Aug 31 for goshawk). There is also suitable habitat, or potentially suitable habitat, in or near the proposed project area for Cooper's hawk, northern goshawk, sharp-shinned hawk, red-tailed hawk, northern flicker, hairy woodpecker, and flammulated owl. The same disturbance controls will be followed for all nesting birds.

How will you mitigate the possibility of an earthquake from project activities?

Prior to EGS activities, we will:

- Install a microseismic array (MSA) around the existing injection well to monitor EGS growth
- Install a strong motion sensor (SMS) in the nearest local community to monitor the effect, if any, on the local community
- Study the existing seismic regime and background seismicity to develop appropriate safeguards for the project
- Define appropriate buffers and exclusions zones in order to protect water resources (groundwater and surface)
- Define appropriate buffers and exclusion zones in order to prevent interaction with faults capable of damaging earthquakes

During and after EGS reservoir-creation activities (hydroshearing, circulation testing and production), AltaRock will:

- Use the MSA to constantly monitor the growth of the EGS zone to prevent growth into buffer and exclusion zones
- Provide timely updates to regulators and the public about the locations of induced microseismic events and the development of the EGS reservoir with respect to the project goals and limitations

- Slow or stop injection, in the safest manner possible, if microseismic events reach any buffer zone or if measured ground accelerations at the SMS reach shaking levels capable of damage.

In addition, AltaRock will implement the *Protocol for Induced Seismicity Associated with Geothermal Systems*, which includes the following steps:

Establishing a microseismic monitoring network. An MSA will be designed by a team of highly qualified seismologists and will be installed as part of Phase I operations. A permit has already been secured for installation of this network. The network will surround the target well. Initially, seismometers will only be installed at permitted surface locations and in existing well bores. Data will be downloaded manually and periodically from each site to provide input into the assessment of natural seismic hazards. As part of Phase II, and prior to stimulation, the MSA will be modified to include telemetry and real-time data monitoring, and may be modified with the drilling and installation of seismometers in additional bore holes.

Assessment of potential for natural and induced seismic hazards. Assessment of natural seismic hazards and induced seismicity potential will be conducted by an independent consultant approved by the Bureau of Land Management and U.S. Department of Energy, with results presented in a report to be completed at the culmination of Phase I, prior to any stimulation activities. Natural seismic hazard potential will be assessed by reviewing the seismic history available from permanent local and regional seismometer installations, from at least two seismic profiles conducted in and around Newberry Volcano (USGS and University of Oregon), and from data collected from monitoring of seismometers installed in Phase I.

Doesn't the geothermal technology you are using have a poor track record in terms of environmental safety?

No. Several hot dry rock and EGS projects have been conducted over the past 30 years, advancing the technology in degrees. There has, however, been one aberrant project over the last three decades. An attempt to

create an EGS reservoir in the bedrock beneath Basel, Switzerland, caused an earthquake that registered 3.4 on the Richter Scale. This was a very small disturbance. Nobody was injured and there was only minor structural damage. Much of the controversy and damage was due to the location in the midst of a densely populated area with older (and, in some instances, centuries' old) large buildings. Compounding the reaction was the fact that people were not prepared for the possibility of such events. We're not being defensive, and we're not trying to be 'Monday morning quarterbacks', but the project in Basel drilled and injected into an active earthquake fault in a densely populated area. Like virtually all the other proponents and practitioners of EGS, AltaRock does not target known faults and, in fact, avoids them; it also takes great pains to notify and educate the community about all its activities up front.

What is Alta Rock's recent history with this technology?

AltaRock has not yet tested this EGS technology. We were working in northern California at The Geysers, but EGS technology wasn't tested before the project was halted. The project ended before reservoir stimulation was attempted due to drilling difficulties unrelated to EGS or seismicity. A review by seismic experts concluded that the planned EGS activities at the Geysers project could be conducted safely. AltaRock and Davenport have assembled a highly qualified team of scientists and engineers, with extensive experiences in geothermal systems, and with our prudent approach we are confident that we can safely achieve the goals of the Newberry EGS Demonstration Project.

How will the Newberry community benefit from this geothermal project?

EGS has the potential to transform non-productive geothermal wells and resources into long-term renewable energy sources capable of supplying clean, renewable power to across the country. In addition, geothermal developments in rural areas are often the greatest source of tax revenue to the host county. Finally, in many cases, geothermal projects have provided relatively high paying jobs. Geothermal resource development requires a wide range of local service industries for support.

What role is the government playing in the Newberry project?

The U.S. Bureau of Land Management, the U.S. Forest Service, the U.S. Department of Energy, and a host of other Oregon state agencies, as well as local and county leaders, will review all our plans and issue applicable permits only when satisfied that the project complies with strict standards. These public-sector entities will also continue to monitor all aspects of the project as it progresses. We see this project as a true public-private collaboration. We welcome input from government officials and community members, and we seek an ongoing 360-degree conversation with all parties.

Why aren't you doing this in less populated areas like the middle of the desert?

Unlike the Basel project, the Newberry project is a safe distance from the nearest residents, and the area is not densely populated. In fact, the project is about 6.5 miles from the nearest private residence.

Does your company and your technology have critics? Does anyone support what you're doing?

Geothermal energy is proven and has tremendous potential, but it is still not fully understood. It has been generating electricity for nearly 50 years in America, and more than 100 years around the world. EGS is an extension of this original technology, and it can further increase the reach of geothermal power generation. A 2007 study led by the Massachusetts Institute of Technology estimated that with suitable investments and improvements to existing technology, EGS could supply up to 10 percent of America's electricity needs within 50 years at prices competitive with fossil-fuel fired generation, but with very low greenhouse gas emissions. Many supporters recognize that geothermal energy is one of the few baseload renewable power sources available. There is great support for geothermal technology from the U.S. government, both in Congress and in the Administration, and we have been fortunate enough to receive a recent $21.45 million American Reinvestment and Recovery Act grant through the U.S. Department of Energy to conduct this demonstration. The AltaRock-Davenport partnership is also investing $22.36 million in the project, which will benefit from the research efforts of faculty and students at the

University of Oregon, University of Utah, Lawrence Berkeley National Laboratory, Texas A&M, Temple University, and scientists from the U.S. Geological Survey.

For further details and additional background about the project, please go to www.newberrygeothermal.com/press/WhitePaper.pdf