Department of Energy
Golden Field Office
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FINDING OF NO SIGNIFICANT IMPACT

Newberry Volcano Enhanced Geothermal System (EGS) Demonstration Project DOI-BLM-OR-P000-2011-0003-EA; DOE/EA-1897

AGENCY: U.S. Department of Energy (DOE)

ACTION: Finding of No Significant Impact (FONSI)

SUMMARY: This FONSI was prepared in accordance with the *National Environmental Policy Act of 1969* (NEPA), the Council on Environmental Quality (CEQ) regulations for implementing NEPA, as amended, (40 CFR Parts 1500 to 1508), and DOE NEPA Regulations (10 CFR Part 1021). This FONSI supports DOE's decision to provide cost-shared funding[1] to the AltaRock Energy, Inc. (AltaRock) proposed project for developing and testing a geothermal reservoir created by using Enhanced Geothermal System (EGS) technologies and describes the process by which DOE determined that funding the proposed project would not have a significant impact on the human environment.

The U.S. Department of Interior, Bureau of Land Management (BLM), Prineville District Office was the lead federal agency and the U.S. Department of Agriculture Forest Service (USFS) and DOE were cooperating agencies on the Environmental Assessment for the *Newberry Volcano Enhanced Geothermal System (EGS) Demonstration Project (DOI-BLM-OR-P000-2011-0003-EA; DOE/EA-1897)* (EA), which evaluates the potential environmental impacts associated with DOE's proposed action and two alternatives including a no action alternative. DOE requested cooperating agency status (40 CFR 1501.6 and 1508.5) to participate in the preparation of an Environmental Assessment for the project on October 13, 2010. BLM formally accepted DOE as a cooperating agency by correspondence dated December 27, 2010 which updated a previous Memorandum of Understanding (MOU) that was executed on February 23, 2010. All provisions of the original MOU were retained but included an additional provision for DOE to provide technical expertise/support in the areas of EGS, induced seismicity, and drilling of geothermal wells. The EA was prepared in accordance with NEPA, as amended, the CEQ regulations for implementing NEPA (40 CFR Parts 1500 to 1508), the Federal Land Policy and Management Act (FLPMA) of 1976, and BLM's NEPA Handbook (H-1790-1; 2008).

[1] Prior to the issuance of this FONSI, DOE authorized AltaRock Energy, Inc. (AltaRock) to use a percentage of their federal funding for preliminary activities, which include preparation of the *Newberry Volcano Enhanced Geothermal System (EGS) Demonstration Project (DOI-BLM-OR-P000-2011-0003-EA; DOE/EA-1897)* (EA) and scientific data gathering. These activities are associated with the proposed project and do not significantly impact the environment nor represent an irreversible or irretrievable commitment by the Department of Energy in advance of the conclusion of the EA for the proposed project.

DOE hereby adopts the above referenced Final EA titled, *Newberry Volcano Enhanced Geothermal System (EGS) Demonstration Project (DOI-BLM-OR-P000-2011-0003-EA; DOE/EA-1897)* and incorporates it by reference into this FONSI.

PROJECT DESCRIPTION: As part of the American Recovery and Reinvestment Act of 2009, DOE issued funding opportunity announcement DE-PE36-09GO99019 Enhanced Geothermal Systems Demonstrations. Through this funding opportunity announcement, DOE sought to fund projects in a variety of geologic formations that could quantitatively demonstrate and validate stimulation techniques. These techniques should successfully sustain sufficient fluid flow and heat extraction rates for 5-7 years that would produce up to 50 MWe per year per project site/geothermal reservoir. AltaRock's proposed EGS project has the potential to advance EGS technology by developing and testing an EGS reservoir. DOE's proposed action is to provide $21.45 million[2] in financial assistance to AltaRock for the proposed EGS project. By providing financial assistance to support this project, DOE would further its mission to increase national energy options, reduce vulnerability to energy disruption and increase the flexibility of the market to meet U.S. energy needs.

The proposed project is located approximately 22 miles south of Bend, Oregon, on federal lands within the Bend-Fort Rock Ranger District of the Deschutes National Forest. Geothermal leases are held by Davenport Newberry Holdings LLC (Davenport). The proposed project and the associated federal leases are on the western flank of Newberry Volcano, outside the Newberry National Volcanic Monument, in areas identified as appropriate for future geothermal use in the legislation that established the Monument (that is, the Newberry National Volcanic Monument Act, Public Law 101-522).

The proposed project would develop and test an EGS reservoir deep underground, using an existing 10,060-foot geothermal well (NWG 55-29 or Well 55-29) drilled by Davenport in 2008. The existing well is on well pad S-29. Data from Well 55-29 documents that this site has a great deal of heat in the deep underground rock formations (> 600 ° F) but it does not have sufficient natural water for a standard hydrothermal geothermal system. Sites such as this may be suitable for EGS, where water can be added to naturally occurring hot rock in order to create a viable geothermal system.

Creation of the EGS involves engineering a "reservoir" in suitable hot rocks where water can circulate through and heat up, much like the heat exchange process of a radiator. The reservoir is created by using a process of well stimulation termed "hydroshearing." Hydroshearing is the process of using cold water to create a network of minute cracks in the rocks deep underground, where natural fractures and cracks already occur. During this process, water would be injected at pressures ranging between 1,160 and 2,600 psig at the bottom of Well 55-29, at depths of approximately 6,500 to 10,000 feet. Existing shallow groundwater wells would provide the water for the project. The reservoir creation would be monitored by up to 20 microseismic array (MSA) stations (10 surface and 10 borehole). All of these stations are on national forest system lands.

[2] As noted earlier, DOE previously authorized AltaRock to expend a portion of these funds for preliminary activities.

The project goal is to create a network of pore spaces from the injected high pressure water in a finite area of the hot rock formation that would then serve as a heat exchanger and become the EGS reservoir. After the reservoir has been created, two additional deep geothermal production wells would be directionally drilled from the same well pad into the "other end" of the EGS reservoir. Cold water would be pumped from the surface down the existing well into the reservoir, where it would become heated as it circulates through the network of pores and cracks of the hot rocks and then be brought back up to the surface as hot water, via the two production wells. This project would provide the ability to create, test, and demonstrate the EGS reservoir technology and its potential application to produce electricity in areas with underground heat but no natural water.

The analysis of this EGS project did not include the production of electricity and no facilities capable of generating electric power are being proposed. Further analysis under NEPA would be required prior to any future decision to develop an electric production facility at Newberry.

PUBLIC INVOLVEMENT IN THE EA PROCESS: On October 21, 2010 BLM mailed a Scoping Notice to 462 individuals, organizations, and agencies. Mailing lists from Prineville BLM, Deschutes National Forest, and Davenport were combined to obtain the widest coverage of people who are known to be interested in, or who may be interested in EGS technology and the proposed EGS project.

Three public meetings were held to provide information about the proposed EGS project to inform and engage the broadest possible central Oregon audience. On July 15, 2010 a meeting was held in La Pine, Oregon and was attended by 21 people, and more than a dozen people attended a similar meeting in Sunriver, Oregon on August 12, 2010. A public meeting was also held in Bend, Oregon on September 21, 2010 and was attended by approximately 26 people. AltaRock and Davenport (project proponents) conducted presentations, answered questions and engaged the audience in discussion at all three public meetings. The BLM with the USFS, DOE, and the project proponents led a field tour during the public scoping period on November 10, 2010, with 25 members of the public participating.

Various central Oregon media representatives were present at all three public meetings. In the local media, there were at least 23 articles and notices published about EGS, geothermal exploration at Newberry, and the proposed EGS project, many of which were picked up by Internet news websites and blogs. At least 6 of these were printed and 1 television news story was aired during the scoping period between October 21, 2010 and November 22, 2010.

BLM received nine comment letters from the public in response to the Scoping Notice and considered these as well as comments made during the public meetings. All comments received during the scoping period were considered, and substantive and relevant comments and concerns are addressed in the Final EA. The letters and the scoping analysis report are on file and publicly available at the Prineville BLM office.

BLM prepared the Draft EA and made it available for public comment for 30 days beginning December 23, 2011. The Draft EA was available on BLM's website and BLM issued a news release. DOE provided a link on the DOE Golden Field Office Public Reading Room website to

the Draft EA located on BLM's website. BLM received a total of eleven public comment letters and one tribal comment letter during the 30-day notice and comment period.

Many comment letters had similar questions or concerns that can be grouped into the following five areas: the hydroshearing process in the proposed project is equivalent to hydrofracking; toxic chemicals in the diverters and tracers would impact groundwater; the effects of induced seismicity to the surrounding area; because EGS is a new technology the effects of the project and the resulting induced seismicity are unknown; and water usage. A request by the Cultural and Heritage Department of the Klamath Tribe for completion of a Traditional Cultural Property (TCP) is being addressed through ongoing tribal consultation between BLM and the tribe. On-going consultation will include an opportunity for an on-site assessment of the proposed MSA station sites by members of the Klamath Tribe before construction takes place to ensure that there will be no adverse impacts to any potential sites of cultural significance. BLM compiled all comments and addressed comments in the BLM Decision Record (DR) dated April 5, 2012. All comments submitted during the public comment period were considered prior to finalizing the EA.

DOE's involvement during development of the EA is consistent with its implementing regulations at 10 CFR Part 1021. DOE conducts a rigorous environmental analysis through the NEPA process for all proposed funding actions to evaluate the potential environmental impact associated with the project and public comments are sought at various points in the process. As a cooperating agency with BLM and USFS, DOE was involved in the development and review of the EA. The Draft EA was available to the public and to federal, state and local agencies for review and comment prior to a final decision on the Proposed Action.

KEY ISSUES: Concerns and topic areas raised by the public, as well as those raised by the specialists from the cooperating agencies, were used to develop key issues that were analyzed and addressed in the EA. Key issues encompass those resources potentially impacted by the project, and include wildlife, scenic resources, groundwater, and the effects of induced seismicity.

Wildlife Key Issue

Preparing and clearing the vegetation for three of the borehole MSA stations has the potential to remove habitat at these locations for some species. The 0.6 acre area where vegetation will be removed is not considered suitable habitat for any Threatened, Endangered, Proposed and Candidate Species, Region 6 sensitive species (EA page 93-97 and Biological Evaluation). These locations do not provide nesting habitat for raptors, but may provide some form of habitat for certain Management Indicator Species (MIS) such as hiding cover for deer or cover for American marten or bird species. The total area of temporary habitat removal at each MSA station site will have a minimal impact on overall habitat for MIS species. The project proponents will rehabilitate these MSA station sites to USFS specifications once they are no longer needed.

Drilling activities, testing and stimulation activities, and an increase in human disturbance also has the potential to disturb raptor nesting sites up to ½ mile away during the breeding season or temporarily displace some wildlife species for up to two years. The magnitude and intensity of

the induced seismic events are anticipated to cause minimal temporary disturbance or displacement to nesting birds or large mammal species. Nest abandonment/failure or bird mortality is considered unlikely (EA page 93).

Measures outlined in the *Induced Seismicity Mitigation Plan for the Newberry EGS Demonstration*[3] (Appendix A of the EA) are designed to mitigate induced seismic events and their associated effects to wildlife. The mitigation plan requires a wildlife biologist to review the operation if nesting raptors are located within ½ mile of any of the activity sites and make a determination if drilling will need to be timed to not occur during the breeding season (EA page 96).

Scenic Resources Key Issue

Removal of vegetation for the MSA stations has the potential to result in up to 3 separate areas of approximately 9,375 square feet (0.2 acre) each, with a total of 28,125 feet or 0.6 acres of not meeting the Forest Plan standards for visual quality as seen from selected viewpoints. Depending on weather, the venting of steam during the short and long term circulation tests may also create a steam plume visible at times from certain selected viewpoints. The plumes would be least visible on warm, windy or cloudy days and most visible on cold, clear days. The circulation tests are estimated to take approximately two months to complete and the steam plumes could be visible over this time. Since these impacts are of short duration and intensity, the impacts to a forest visitor will be similar to that experienced from a small prescribed fire, which is common within and around the surrounding landscape and typically occurs during the same time period (EA page 112).

The drill rig and circulation testing facilities may be visible at times from some key viewer locations during the anticipated 2-year duration of the Project. The drill rig on the existing well pad (Well 55-29) will likely be visible from higher viewpoints in the area including Paulina Peak, the viewpoint with the greatest number of visitors annually. Very little, if any, of the project facilities and activities will be seen by average visitors at any of the six key visual observation point (VOPs) primarily due to the very small scale of the project (less than 0.6 acre of new ground disturbance) and its relationship to the surrounding landscapes that have Moderate to High Visual Absorption Capability. Some activity could be noticed from Paulina Peak and McKay Butte under certain circumstances, such as when a well or circulation test facility is venting on a clear day. The project is in compliance with Forest Plan direction and Scenic Management Objectives for both General Forest and Scenic Views management areas. Once the project activities are completed, disturbed areas are not likely to be noticeable to average visitors at any of the six key VOPs. The steam plume will no longer exist, and the project proponents will plant trees where necessary to feather edges of the created openings at the three new borehole sites, further reducing any line, texture, or color contrast.

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[3] The DOE requires that EGS demonstration projects throughout the U.S. meet or exceed the International Energy Agency (IEA) *Protocol for Induced Seismicity Associated with Geothermal Systems*. The protocol includes the preparation of an induced seismicity mitigation plan. The *Induced Seismicity Mitigation Plan for the Newberry EGS Demonstration* (ISMP) and all mitigations derived from this plan were included as part of the project design features during the EA.

Groundwater Key Issue

Withdrawal of groundwater from water wells for the development and testing of a belowground EGS reservoir has the potential to reduce the quantity of water available for other uses within the Deschutes drainage basin. The direct effects on the groundwater resource are the anticipated temporary drawdowns near the existing water supply wells. Previous pumping tests on the water supply well at the stimulation well pad have provided some preliminary information on aquifer properties and the direct effects that could occur during the project. The most recent pumping test at the stimulation well had no measurable effect upon the water level in the nearest observation well (the water well at S-16, 1.8 miles away). Aquifer testing indicates a relatively steep cone of depression around the water supply well and a small (less than 2,500 feet) radius of influence (amount of water level drawdown as one moves away from the well) (Appendix B of the EA p. 7). While the test was of shorter duration than the length of time the well will be pumped during stimulation, the hydrologist report concludes that the water well appears to be supportive of prolonged pumping durations and that the aquifer appears to be adequate to supply sufficient water for the project (Appendix B of the EA p. 8-9).

Given that the closest water well is one mile away (a water well owned by Davenport that will be used to monitor groundwater levels), no direct impacts to groundwater quantity in the immediate area are anticipated (EA page 119).

Although the development and testing of a belowground EGS reservoir has the potential to negatively impact groundwater quality within an aquifer, the EA analysis shows that the risk of development of a hydraulic connection between the proposed EGS reservoir and the shallow (project site) aquifer is extremely low (EA page 121-122). The planned EGS reservoir will be created at depths of approximately 6,500 to 10,000 feet below ground. The network of fractures will extend approximately 1,500 feet radially. If these fractures extended upward from the top of the EGS reservoir zone, it would be several thousand feet below the bottom of the local and regional aquifers. Given the very low permeability of the receptor rock throughout the length of the vertical borehole below the regional aquifer, there is minimal risk that fluids would be able to migrate vertically during the testing period.

Both the existing well and the two production wells to be drilled will be cased and cemented per BLM and the Oregon Department of Geology and Mineral Industries (DOGAMI) regulations to prevent any chemicals from entering the groundwater. The existing well is relatively young and had a positive casing integrity test conducted in 2008. The caliper survey in 2008, temperature surveys in 2008 and 2010, and the maximum pressure profile achieved during the inject-to-cool operation in 2010, indicate the casing has retained its integrity. This will both protect groundwater resources and prevent degradation of the geothermal production fluid within the well bore (EA page 126).

The diverters and tracers have been found by independent experts to not be harmful to groundwater in the concentrations that they will be used. BLM, DOE, and independent experts have reviewed the Material Safety Data Sheets (MSDS) for all chemicals proposed to be utilized. At the concentrations at which they will be used, the diverter and tracer materials will not pose a toxicity risk to the environment, wildlife or people. All of the diverters and tracers are non-toxic at the planned production concentrations and their breakdown products also do not pose any

toxicity concerns. The tracers to be used are commonly used in groundwater studies.[4] Therefore, materials injected as part of the EGS demonstration will not have an effect on groundwater quality in the regional aquifer.

Induced Seismicity Key Issue

The development of a below-ground EGS reservoir by hydroshearing has the potential to produce induced seismicity and increased seismic risk that could affect historic structures, resorts, and other recreation sites within the Newberry National Volcanic Monument (NNVM). Induced seismicity also could increase avalanche risk, could increase risk to above and below ground geologic features and could result in weak shaking in nearby population centers of La Pine, Sunriver, and Bend.

Ground shaking is predicted to be localized just around the stimulation well (Appendix A of the EA). The ground shaking is expected to be predominantly high frequency in content and short in duration, making it unlikely to be damaging to the structures within the NNVM (EA page 134). The combined conclusions of two different independent engineering analyses indicate that:

- The probable upper-bound maximum magnitude of an induced seismic event at Newberry is M 3.5-4.0.
- The probability of a seismic event with magnitude between M 3.0 – 4.0 is less than 1 percent.
- There is no difference in seismic hazard between natural seismicity and the hazard introduced by EGS induced seismicity.
- Mitigating measures outlined in Appendix A and Section 4.4 of the EA call for decreased flow at detection of events M 2.7 to 3.4 and then stop injection and flow the well to the surface to relieve pressure at detection of events equal to or higher than M 3.4.
- If an M 3.5 seismic event did occur, the potential for damage at the nearest structures within the NNVM will be low.

DETERMINATION: The project design features that have been committed to by the project proponents and identified in the BLM DR will be incorporated and enforceable through DOE's funding award documents. These project design features include but not limited to: drilling timed to not occur during the breeding season for specific bird species, control of noxious weeds/invasive species through vehicle washing and annual monitoring, and actions to reduce the potential adverse impacts of induced seismicity. Additionally, the project proponents will comply with all special lease stipulations attached to leases OR40497, OR45505, OR65371, OR12399, OR12437, OR65470, OR45506, OR47300, and OR53085 held by Davenport, which apply to the Proposed Action. The project proponents also will be required to comply with BLM's other Conditions of Approval, which also have been adopted by DOE to ensure environmental compliance. The project proponents will coordinate with the Forest Service during tree removal and marking the boundaries of the new pads. Finally, the Klamath Tribes Director of Culture and Heritage Department and Site Protection Specialist will make a site visit to the project area to determine if any culturally significant areas are present and if so, to assess

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[4] *Diverter Materials and Expected Degradation Products to be used at the Newberry EGS Demonstration* by Allen Apblett, Ph.D. and *Review of Tracer Use in the Newberry Volcano EGS Demonstration Project* by Stephen Wheatcraft, Ph.D.

any potential impacts to those culturally significant areas prior to any ground disturbance being initiated.

BLM will be responsible for monitoring approved operations to ensure compliance with Conditions of Approval for the Operations Plan, Geothermal Drilling Permits (GDPs), Geothermal Sundry Notices (GSNs), and associated leases. DOE will share the responsibility of monitoring the implementation and effectiveness of the mitigation measures derived from the ISMP. The GSN for stimulation will be issued when the BLM has received written acknowledgement from DOE that the MSA is installed, technically adequate and compliant with the ISMP.

Based on the information presented in the Final EA, DOE has determined that providing funding to support the proposed project as described above does not constitute a major federal action that significantly affects the quality of the human environment, individually or cumulatively with other actions in the general area. No environmental impacts meet the definition of significance in context or intensity as defined in 40 CFR 1508.27. Therefore, the preparation of an environmental impact statement is not required, and DOE is issuing this FONSI.

Copies of the Final EA and FONSI are available at http://www.eere.energy.gov/golden/Reading_Room.aspx or at http://energy.gov/nepa/nepa-documents or from:

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