Request for Information DE-FOA-0001869: Identifying Opportunities to Address Barriers for Lowering the Cost and Risk of Geothermal Drilling

DATE: 12/12/2017
SUBJECT: Request for Information (RFI)
RESPONSES DUE: 01/22/2018

Description

The Geothermal Technologies Office (GTO), within the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE), invites input from the public regarding challenges and opportunities associated with drilling geothermal wells. With the overall goal of better understanding barriers to lower the costs and risks of geothermal drilling for the purpose of electricity production, we are seeking input in three areas: defining the major challenges, research and development opportunities, and process improvement opportunities. The information requested is intended to ascertain where there are opportunities to reduce the costs of drilling, facilitating increased geothermal energy production in the United States.

Background

Geothermal energy has the potential to provide a significant amount of renewable electric power for the United States[1]. Because drilling costs can account for 50% or more of the total capital cost for a geothermal power project[2], reducing those costs becomes one of the most important factors to realizing this potential. A preliminary report from the GeoVision study[3] categorizes two approaches to reduce drilling costs: 1) reduce the time it takes to drill a well, and 2) reduce the material costs to drill a well.

[1] Williams, Colin F, et al. Assessment of Moderate- and High-Temperature Geothermal Resources of the United States. USGS Fact Sheet 2008–3082, 2008, https://pubs.usgs.gov/fs/2008/3082/pdf/fs2008-3082.pdf
[2] Tester, Jefferson W, et al., The Future of Geothermal Energy, Impact of Enhanced Geothermal Systems (EGS) on the United States in the 21st Century. November 2006, https://energy.mit.edu/wp-content/uploads/2006/11/MITEI-The-Future-of-Geothermal-Energy.pdf
[3] Lowry, Thomas S, et al., Reservoir Maintenance and Development Task Report for the DOE Geothermal Technologies Office GeoVision Study. Sandia Report SAND2017-9977, Sept. 2017, http://prod.sandia.gov/techlib/access-control.cgi/2017/179977.pdf

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Other recent publications[4] [5] [6] describe major limitations, define best practices, and suggest additional ways to reduce costs for various geothermal drilling operations including exploration drilling and full size production/injection well drilling. To continue to explore this topic and ensure up-to-date information is available, the GTO convened a drilling roundtable discussion at its Peer Review Meeting in Denver, Colorado on November 14, 2017. This RFI is to follow up on the results from that discussion which are summarized below.

Drilling Roundtable Summary:

All attendees of the 2017 GTO Peer Review were invited to participate in a geothermal drilling roundtable discussion. GTO requested comments on the most impactful technologies or methodologies in the general categories of decreasing material costs and increasing drilling speed which are the two primary cost drivers for geothermal drilling. Some recommendations were outside of these categories and were grouped as general solutions.

In the category of decreasing materials costs, several themes emerged, including:

- Improving drill bit and assembly performance – Suggestions covered overall drill bit performance and efficiency (bit life, trip times, etc.), and better analytics to predict when to change/pull bits.
- Developing novel well materials – Suggestions covered materials capable of withstanding harsh conditions, such as new alloys, composites, or coatings.
- Improving operational efficiency – Suggestions included reducing the drill rig footprint, or reducing overall equipment requirements through novel or customized equipment designs tailored for geothermal-specific applications.
- Drilling in harsh conditions – Suggestions covered strengthening drilling capabilities in high-temperatures and crystalline rock for maintaining verticality, and methods for drilling highly-deviated or horizontal wells.
- Advancing drilling and completion materials – Suggestions included improving drilling and cleaning fluids to address lost circulation, wellbore isolation materials (cement, etc.), and improved well casing material alternatives to steel.

In the category of increasing drilling speed, other themes were identified, including:

- Utilizing Analytics – Suggestions included developing the capability to identify trouble situations such: as lost circulation and corrosion, as well as methods to better predict

[4] Finger, John and Blankenship, Doug, Handbook of Best Practices for Geothermal Drilling, Sandia Report SAND2011-6478, February 2012, http://prod.sandia.gov/techlib/access-control.cgi/2011/116478.pdf

[5] Vollmar, D, et al., Geothermal Drilling Best Practices: The Geothermal translation of conventional drilling recommendations - main potential challenges. IGA Academy Report 0104-2013, 2013,

[6] Thorhallsson, Sverrir and Gunnsteinsson, Stefan S, Slim Wells for Geothermal Exploration. Short Course on Geothermal Development and Geothermal Wells, March 11-17, 2012, Santa Tecla, El Salvador, http://www.os.is/gogn/unu-gtp-sc/UNU-GTP-SC-14-28.pdf

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subsurface pressure, accurately determine bit lifetime, and methods to predict drilling conditions ahead of the bit. Further suggestions included using advancements in machine learning to improve rig data analysis and to implement rig automation.

- General drilling techniques advancement – Suggestions covered a wide range of potential improvements for novel drilling approaches including the possibility of energy drilling, casing while drilling, techniques for drilling with no fluid returns, waterless drilling, and improvements in high temperature drilling (that is to say temperatures in excess of 300 °C).
- Adopting analogous industry training and best practices – Suggestions included incorporating sound project planning practices from oil and gas such as: managing drill speed vs. quality of information, how to complete a well in rubbled, unconsolidated, or washout zones, and other parameters. Additionally, adopting new oil and gas rig technology, standardization techniques for oil and gas drilling, and the National Energy Technology Laboratory's 'extreme drilling' approach.
- Federally-sponsored drilling – Suggestions included knowledge sharing through a federally-sponsored program for field testing tools and drilling techniques with public results as a method to establish and improve the knowledge base for geothermal drilling.
- Improving well completion – Suggestions included methods for better and cheaper wellbore isolation such as novel coatings, propellants to fracture rock, thermal gradient cementing casing in place with thermites.

During the roundtable discussion, some suggestions did not fall into either category and were grouped as general solutions. These included focusing on early stage drilling utilizing micro bores and slimholes, seeking breakthroughs vs incremental improvements, and improving exploration methodology/techniques (for example, other validation methods). Other ideas included exploring liquid propellants in conjunction with traditional methods to fracture and drill rock more quickly, developing materials to perform in challenging clay (for example, smectite) conditions, and having dedicated federally-sponsored geothermal drill rigs.

Purpose

The purpose of this RFI is to solicit feedback from industry, academia, research laboratories, government agencies, and other stakeholders on issues related to lowering the costs and risks associated with drilling wells for geothermal development for electricity production. EERE is specifically interested in information on defining major challenges in geothermal drilling and identifying opportunities in research and development and process improvement. This is solely a request for information and not a Funding Opportunity Announcement (FOA). EERE is not accepting applications.

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Disclaimer and Important Notes

This RFI is not a Funding Opportunity Announcement (FOA); therefore, EERE is not accepting applications at this time. EERE may issue a FOA in the future based on or related to the content and responses to this RFI; however, EERE may also elect not to issue a FOA. There is no guarantee that a FOA will be issued as a result of this RFI. Responding to this RFI does not provide any advantage or disadvantage to potential applicants if EERE chooses to issue a FOA regarding the subject matter. Final details, including the anticipated award size, quantity, and timing of EERE funded awards, will be subject to Congressional appropriations and direction.

Any information obtained as a result of this RFI is intended to be used by the Government on a non-attribution basis for planning and strategy development; this RFI does not constitute a formal solicitation for proposals or abstracts. Your response to this notice will be treated as information only. EERE will review and consider all responses in its formulation of program strategies for the identified materials of interest that are the subject of this request. EERE will not provide reimbursement for costs incurred in responding to this RFI. Respondents are advised that EERE is under no obligation to acknowledge receipt of the information received or provide feedback to respondents with respect to any information submitted under this RFI. Responses to this RFI do not bind EERE to any further actions related to this topic.

Proprietary Information

Because information received in response to this RFI may be used to structure future programs and FOAs and/or otherwise be made available to the public, **respondents are strongly advised to NOT include any information in their responses that might be considered business sensitive, proprietary, or otherwise confidential.** If, however, a respondent chooses to submit business sensitive, proprietary, or otherwise confidential information, it must be clearly and conspicuously marked as such in the response.

Responses containing confidential, proprietary, or privileged information must be conspicuously marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The U.S. Federal Government is not liable for the disclosure or use of unmarked information, and may use or disclose such information for any purpose.

In addition, (1) the header and footer of every page that contains confidential, proprietary, or privileged information must be marked as follows: “Contains Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure” and (2) every line and paragraph

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containing proprietary, privileged, or trade secret information must be clearly marked with double brackets or highlighting.

Evaluation and Administration by Federal and Non-Federal Personnel

Federal employees are subject to the non-disclosure requirements of a criminal statute, the Trade Secrets Act, 18 USC 1905. The Government may seek the advice of qualified non-Federal personnel. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The respondents, by submitting their response, consent to EERE providing their response to non-Federal parties. Non-Federal parties given access to responses must be subject to an appropriate obligation of confidentiality prior to being given the access. Submissions may be reviewed by support contractors and private consultants.

Request for Information Categories and Questions

Category 1: Defining the Major Challenges in Geothermal Drilling

EERE is seeking input that will provide us with an assessment of the main barriers to achieving affordable geothermal drilling operations. Specifically, we seek feedback on the following questions:

1. There are various types and sizes of wellbores used in the geothermal industry drilled to various depths for various functions (for example, slimholes, temperature gradient holes, core holes, production/injection wells). Improvements to which of these categories of wellbores would provide highest impact to increase geothermal deployment? If multiple categories are identified, please comment on which type would have the greatest impact on drilling cost reduction.

2. Improving which operational factors during drilling could lead to the most significant reductions in drilling risk and cost, while ensuring operational safety?

3. What performance metrics best assess the impact on reducing risk and increasing the cost effectiveness of geothermal drilling? Is there a single metric that can assess both risk and cost effectiveness or is a separate metric needed for each category?

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Category 2: **Geothermal Drilling Research and Development Opportunities**

The development of innovative technologies can reduce the costs and risks associated with geothermal drilling. EERE is seeking input on the following questions to better understand the level of effort required to make substantial advancements in these areas, and to gauge the level of interest among respondents in conducting future research and development:

4. What drilling technologies and/or methodologies should GTO seek to improve or develop that could significantly reduce risk and/or increase the cost effectiveness of geothermal drilling operations?

5. Advancements to what materials or equipment (e.g., drilling fluids, high temperature coatings, automated drill rigs, etc.) used in geothermal drilling operations could significantly reduce drilling risk and increase cost effectiveness of geothermal drilling operations? Please include a description of the current state of commercial attainability for these materials and/or equipment advancements. If multiple improvements are recommended, please comment on how impactful each technology would be on drilling cost reduction.

Category 3: **Geothermal Drilling Process Improvement Opportunities**

Another method to address the high costs and risk in geothermal drilling is to focus on process improvements. EERE solicits comments on the following questions that can help identify areas for technology transfer and sharing of best practices:

6. What technology transfer opportunities exist from analogous industries that could significantly reduce drilling risk and/or increase cost effectiveness of geothermal drilling operations?

7. Improved training for geothermal drillers, rig crews, and service company employees might improve the efficiency of drilling operations, increase safety, and decrease costs. What topics would be the most beneficial to include in training modules to increase procedural discipline, that is to say the ability to identify issues early and react in a safe and efficient manner?

Request for Information Response Guidelines

Responses to this RFI must be submitted electronically to geothermal.comments@ee.doe.gov no later than 5:00pm (ET) on January 22, 2018. Responses must be provided as attachments to an email. It is recommended that attachments with file sizes exceeding 25MB be compressed

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(i.e., zipped) to ensure message delivery. Responses must be provided as a Microsoft Word (.docx) attachment to the email, and no more than 3 pages in length, 12 point font, 1 inch margins. Only electronic responses will be accepted.

Please identify your answers by responding to a specific question or topic if applicable. Respondents may answer as many or as few questions as they wish.

EERE will not respond to individual submissions or publish publicly a compendium of responses. A response to this RFI will not be viewed as a binding commitment to develop or pursue the project or ideas discussed.

Respondents are requested to provide the following information at the start of their response to this RFI:

- Company / institution name;
- Company / institution contact;
- Contact's address, phone number, and e-mail address.

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