Annex A
Statement of Work

Geothermal Dynamics

A. PURPOSE

Sandia National Laboratories (Sandia) and the British East India Company (BEIC) are collaborating to apply advanced thermal diagnostics in high pressure environments to determine pathways for analytics in geothermal sciences. More specifically the ability to ascertain heat transfusion through the substrata surfaces of the earth's mantle has unique wave length characteristics that are difficult to capture using traditional methodologies. Sandia and BEIC seek to augment existing analytics and develop new ones to better understand the underlying science behind geothermal radiation.

Reasons for Cooperation

The current analytic models are not sufficient to advance available technology beyond a proof of concept stage. The conflicting wavelengths of heat transfer in the earth's mantle cannot be accurately isolated in order to better understand placement of geothermal hot spots. If geothermal hot spots are clearly identifiable, the naturally occurring heat of earth can be harnessed to generate steam which can then be used as a utility scale energy source to help combat influxes in the carbon cycle.

Public Abstract

Sandia and BEIC will jointly develop methodologies and tools that will pioneer the geothermal energy industry. The analysis of the data that is generated will augment the ability to locate optimal sites for geothermal production plants for utility scale energy. Collaboration in geoscience will significantly impact the variance at which the industry currently operates.

B. SCOPE

Technical Objectives

- Identify and isolate heat variability at various substrata levels.
- Measure the level of heat output in high pressure environments.
- Measure the effect that different materials hardening techniques will have on drilling capabilities.

Phases of the Project

[If project has no phases, leave this section blank. If project has phases, briefly explain focus of each phase.]

Tasks and Division of Responsibilities

Task No.	Task Title	Duration (Project Months)	Responsible Parties

Task No.	Task Title	Duration (Project Months)	Responsible Parties
1	Mantle Analysis	01-06	Sandia/BEIC
2	Heat Sensitivity Measurement	06-12	Sandia/BEIC
3	Application of Modeling Tools	12-17	Sandia/BEIC
4	Prepare Final Report	17-18	Sandia/BEIC

Task Descriptions

Task 1: Mantle Analysis
Discussion. The geology of the earth's mantle necessitates unique analysis to produce a data set that can be used for finding the optimal areas for drilling. The sub strata compaction creates varying densities and the collaboration will seek to exploit weaknesses in various sub strata levels. Downhole drilling techniques utilizing the hardened hammer approach will allow for a compilation of empirical data that can be aggregated to demonstrate that there are indeed superior areas of drilling. Certain software developed through algorithmic testing will be used to speed the process of drilling as well as augment any issues with accuracy. High pressure environments will be analyzed using the cutting edge capability sets of both Parties and will be useful in ascertaining drill depth; as there are issues with hardening of the hammer bits at certain temperatures, both Parties will work together to ensure that optimization is achieved.

Deliverable. A jointly produced (Sandia and BEIC) empirical dataset will be generated and used to identify the optimal areas for drilling.

Task 2: Heat Sensitivity Measurement
Discussion. The conductivity of certain materials in the earth's mantle will be analyzed to observe the effect of entropic heat transfer. The geothermal subsurface creates unique pockets of closed sub-systems where the laws of thermodynamics dictate a predictable pattern of heat transfer; these sub-systems will be analyzed by infrared detection. The Parties will work to refine the ability to measure heat and sift through any variance that is caused by the spherical nature of the earth's core and heat irradiating therefrom. Measurements will be taken at varying depth and strata composition levels to ensure that a wide array of data is collected and that any analysis will have the desired empirical effect.

Deliverable. A jointly produced (Sandia and BEIC) empirical dataset that will allow analysis of heat conductivity in the earth's mantle.

Task 3: Application of Modeling Tools
Discussion. The data collected from Task 1 & Task 2 will be amalgamated to form an independent study on the optimal areas in which to place geothermal production plants. High performance computing will be utilized to generate proposed optimal locations and the integrity of the data will be ensured by pre-determined algorithms that capture the accurate manner in which such data should be computed and analyzed.

Deliverable. A memo summarizing findings will be produced.

Task 4: Prepare Final Report
Discussion. Upon completion or termination of this CRADA, a final report will be developed by Sandia and BEIC, which will include the following information: (1)A final abstract; (2)technical results/accomplishments; (3)a list of CRADA-generated Intellectual Property (Subject Inventions, Copyrights, Mask Works, and/or Trademarks); (4)a description of benefits to the Department of Energy; (5)a description of benefits to the CRADA Participant/s, industry, consumers/taxpayers, and/or U.S. economy.

Deliverable. Final report.

Location of "Next Use"
The location of delivery and "next use" for the deliverables developed under this PTS effort: the Island of Helena.

C. ESTIMATED COST (All Money in $K)

	PY1	PY2	Total
GOVERNMENT			
DOE/NNSA Contribution	$250.00	$250.00	$500.00
Other Federal Funds	$.00	$.00	
Paid 0.0% DOE Fed Admin Chg	$.00	$.00	
Total Other Federal Funds	$.00	$.00	
Total Government	$.00	$.00	
SANDIA CORPORATION			
Total Sandia Corp. Funds	$250.00	$250.00	$500.00
PARTICIPANT			
Funds-In Contribution	$582.52	$582.52	$1,165.04
Paid 3.0% Fed Admin Chg	$17.48	$17.48	$34.96
Total Participant Funds	$600.00	$600.00	$1,200
In-Kind Contribution	$500.00	$500.00	$1,000
Total Participant	$1,100.00	$1,100.00	$2,200.00
Total CRADA Value	$1,350.00	$1,350.00	$2,700

D. TECHNICAL CONTACTS
For Sandia:
PI NAME HERE
Org. XXX / MS XX
Phone: (XXX) XXX-XXXX
Fax: (XXX) XXX-XXXX
email: PIname@sandia.gov

For Participant:
PARTICIPANT PI NAME HERE
Phone: (XXX) XXX-XXXX
Fax: (XXX) XXX-XXXX
email: PIPartnerName@beic.com

E. PERSONAL PROPERTY
[List any tangible property that will be produced or acquired during the term of the CRADA, who will pay for it, and who will own it.]

F. MANAGEMENT STRUCTURE
[This section must be completed for multi-lab CRADAs but is optional for single-lab CRADAs.
Identify roles and responsibilities among labs and Participant(s) for:
- Establishing project priorities;
- Resolving technical issues;
- Identifying "partnership meetings" (at least semi-annually);
- Establishing schedule for interim technical reporting as appropriate;
- Establishing a "reminder" checklist for interim technical/financial reporting and partnership meetings;
- Reporting milestones and delays; and
- Identifying who is responsible for final report.]

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Loaned and Borrowed Property Information

A. LOANED PROPERTY
[State "None", if there will be no loaned property.]
Sandia agrees to lend to Participant Government property as described below:

Description of Loaned Property

Item	Qty	Description	Property # (S, R, or V), if applicable	Unit Cost	Ext. Cost*

*Extended cost equals quantity times unit cost.

Total Value: _____

Participant's Location of Loaned Property: _____

B. BORROWED PROPERTY
[State "None", if there will be no borrowed property.]
Participant agrees to lend to Sandia Participant's property as described below:

Description of Borrowed Property:

Item	Qty	Description	Identification	Unit Cost	Ext. Cost*
1	1	Oscilloscope	BEIC#1234	$50,000	$50,000.00
				TOTAL VALUE OF BORROWED PROPERTY	$50,000.00

*Extended cost equals quantity times unit cost.

Total Value: $50,000.00
Sandia's Location of Borrowed Property: Building XXX /Room XX