**CRADA Final Report Form**

**Date:** __3-30-20202__

**PI:** Ilan Gur

**CRADA AWD No.:** AWD00002582 **CRADA FP No.:** FP00005814

**LBNL Report Number:** _____ *(SPO to add)*

**OSTI Number:** _____ *(SPO to add)*

1. Parties: Marigold Power, Inc. and Lawrence Berkeley National Laboratory
   (Identify Parties to the CRADA)

2. Title of the Project: Thermophotovoltaic Heat Engine

3. Summary of the specific research and project accomplishments:
   (Were key major goals of the CRADA achieved?)
   *Note: Final Reports and Forms containing Protected CRADA Information are to be emailed directly to the SPO close out requestor, along with a confirmation of the public release date. Do not submit via eSRA. Also, please do not include any Proprietary Information* (defined below) in CRADA Final Reports and Forms.*

This project was aimed at developing a thermophotovoltaic device that efficiently converts thermal radiation to electrical power. Historically, TPV devices have been plagued by poor robustness; this project sought to overcome this by merging innovations in nanophotonics, photovoltaics, and robust thermal engineering. Efforts were focused on developing high efficiency TPV devices which may drastically alter the electricity sector by enabling efficient (> 20%), fuel-flexible (any combustion fuel), distributed (< 10 kW) power generation. The project research identified the technical performance limits, technology differentiator, and customer value proposition for TPV devices and established technical performance requirements for a minimum viable product. The participant constructed an experimental apparatus to accurately measure the optical properties of critical TPV surfaces at the extreme temperatures over long time periods in different environments. The project established a baseline TPV material set and design, conducted a failure modes analysis, and established a mitigation test plan. It characterized infrared optical properties of TPV material surfaces and validated impact on energy conversion efficiency and long-term stability. Finally, the participant constructed and tested a laboratory prototype device and compared it to technical performance requirement for a minimum viable product.

4. Deliverables:

| Deliverables met | Party (LBNL, Participant, Both) | Delivered to Other Party? |
|---|---|---|
| Project mentorship relative to Cyclotron Road program objectives. | LBNL | complete |
| Quarterly updates on progress against this Statement of Work will be presented to the cognizant LEEP Program Manager. | Participant | complete |
| A final report will be due upon conclusion of CRADA, including a list of intellectual property arising under this SOW | Participant | complete |

5. Identify (list below) and attach all publications or presentations at conferences directly related to the CRADA:
   None.

6. List of Subject Inventions and software developed under the CRADA: (Please provide identifying numbers or other information.)
   None.

7. A final abstract suitable for public release:
   (Very brief description of the project and accomplishments without inclusion of any proprietary information or protected CRADA information.)

   This project was aimed at developing a thermophotovoltaic device that efficiently converts thermal radiation to electrical power. Historically, TPV devices have been plagued by poor robustness; this project sought to overcome this by merging innovations in nanophotonics, photovoltaics, and robust thermal engineering. Efforts were focused on developing high efficiency TPV devices which may drastically alter the electricity sector by enabling efficient (> 20%), fuel-flexible (any combustion fuel), distributed (< 10 kW) power generation. The project research identified the technical performance limits, technology differentiator, and customer value proposition for TPV devices and established technical performance requirements for a minimum viable product.

8. Benefits to DOE, LBNL, Participant and/or the U.S. economy.

   This project was selected for the Cyclotron Road Program because it advanced the DOE's mission and strengthened U.S. economic competitiveness, energy security, and resource sustainability for the U.S. Taxpayer by:
   • Enabling and supporting top technology innovators (e.g. Marigold) in pursuit of breakthrough advanced energy materials and manufacturing technologies that are aligned with DOE's mission;
   • Strengthening the core scientific capabilities of the national lab by connecting Berkeley Lab scientists to a dynamic network of industry innovators, bridging an important link between fundamental science and real-world technology development challenges;

• Encouraging private sector collaboration with the national lab and investment in critical clean energy technologies; and
• Demonstrating a new model for translating hard science-based clean energy technologies from lab to market that can be replicated at national labs and academic R&D centers across the nation.

9. Financial Contributions to the CRADA:

| | |
|---|---|
| DOE Funding to LBNL | $100,000 |
| Participant Funding to LBNL | $0 |
| Participant In-Kind Contribution Value | $50,000 |
| Total of all Contributions | $150,000 |

** "Proprietary Information" means information, including data, which is developed at private expense outside of this CRADA, is marked as Proprietary Information, and embodies (i) trade secrets or (ii) commercial or financial information which is privileged or confidential under the Freedom of Information Act (5 U.S.C. 552 (b)(4)).*