

PMC-EF2a

(0.0402)

**U.S. DEPARTMENT OF ENERGY  
EERE PROJECT MANAGEMENT CENTER  
NEPA DETERMINATION**



RECIPIENT:NREL

STATE: CO

**PROJECT TITLE :** Enabling the CIGS Thin-Film PV Technology to Meet the DOE Goal of \$0.50/W Module Price; NREL Tracking No. 12-017

<b>Funding Opportunity Announcement Number</b>	<b>Procurement Instrument Number</b>	<b>NEPA Control Number</b>	<b>CID Number</b>
	DE-AC36-08GO28308	NREL-12-017	GO28308

Based on my review of the information concerning the proposed action, as NEPA Compliance Officer (authorized under DOE Order 451.1A), I have made the following determination:

**CX, EA, EIS APPENDIX AND NUMBER:**

Description:

<b>B3.6 Small-scale research and development, laboratory operations, and pilot projects</b>	Siting, construction, modification, operation, and decommissioning of facilities for smallscale research and development projects; conventional laboratory operations (such as preparation of chemical standards and sample analysis); and small-scale pilot projects (generally less than 2 years) frequently conducted to verify a concept before demonstration actions, provided that construction or modification would be within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible). Not included in this category are demonstration actions, meaning actions that are undertaken at a scale to show whether a technology would be viable on a larger scale and suitable for commercial deployment.
<b>DOE/EA 1440 (NREL STM)</b>	Final Site-Site Wide Environmental Assessment of the National Renewable Energy Laboratory's (NREL) South Table Mountain Complex (February 2003)
<b>A9 Information gathering, analysis, and dissemination</b>	Information gathering (including, but not limited to, literature surveys, inventories, site visits, and audits), data analysis (including, but not limited to, computer modeling), document preparation (including, but not limited to, conceptual design, feasibility studies, and analytical energy supply and demand studies), and information dissemination (including, but not limited to, document publication and distribution, and classroom training and informational programs), but not including site characterization or environmental monitoring. (See also B3.1 of appendix B to this subpart.)

Rational for determination:

**BACKGROUND**

In April 2011, the U.S. Department of Energy (DOE) Golden Field Office issued a Financial Assistance Funding Opportunity Announcement (FOA) titled "Foundational Program to Advance Cell Efficiency (F-PACE)." The purpose of this FOA is to identify and fund solar device physics and photovoltaic technology research and development that would improve Photovoltaic (PV) cell performance and reduce module cost for grid-scale commercial applications. The National Renewable Energy Laboratory (NREL), located in Golden, Colorado, has been awarded funding under this FOA. NREL's project under this award is entitled "Enabling the Copper Indium Gallium Selenide (CIGS) Thin-Film Photovoltaic Technology to Meet the DOE Goal of \$0.50/W Module Price." For this proposed project, NREL would be in a teaming arrangement with four universities: Colorado State University, University of Florida, University of Nevada Las Vegas, and the Institute of Energy Conversion (IEC) at the University of Delaware. NREL would provide funding to these universities through NREL subcontracts.

This project would enable CIGS technology to be on trajectory to meet the DOE goal of \$0.50/W by the end of this decade by addressing identified cost and efficiency barriers through advances in the photovoltaic (PV) science knowledge base, improved materials and processes for PV cell components, and innovative approaches for closing the gap between production module efficiency of 12% and laboratory cell efficiency of 20%, and between laboratory cell efficiency and the theoretical maximum of 29%.

No funding from NREL would be provided to any associated industry partners, or other DOE National Laboratories who may be involved in this project. The proposed project work would be completed using industry standard methods and protocols, and in accordance with all federal, state, and local regulations. Work is expected to occur from mid 2012 through mid 2015.

**PROPOSED ACTION**

Project work that would be performed by each partner is summarized below:

**NREL**

Project activities would be conducted in existing facilities at the NREL South Table Mountain campus, would be the same as work currently conducted at NREL using standard semi-conductor industry practices and processes. The

proposed NREL work would include fabrication of devices using a variety of bench-scale CIGS and cadmium sulfide (CdS) deposition techniques, including chemical bath deposition, atomic layer deposition, and sputtering. NREL would also characterize completed devices using a variety of X-ray diffraction, photoluminescence, cathodoluminescence, voltage measurements, and spectroscopic techniques

#### University of Florida

The University of Florida would conduct the characterization of solar cells using x-ray diffraction and microscopy techniques, and perform data analysis. The University would also work with the Oak Ridge National Laboratory (ORNL) who would conduct reaction pathways studies for absorber formation.

#### Colorado State University

Colorado State University would conduct solar cell electrical and optical measurements and analysis, characterize solar cells obtained from partner institutions using standard semi-conductor techniques and equipment, measure spatial variations in cell response using light-beam-induced-current (LBIC) response and electroluminescence (EL), and quantify performance differences between modules and small cell areas taken from modules.

#### University of Nevada, Las Vegas

The University of Nevada, Las Vegas would characterize surface and interfaces of solar cell layers using a variety of techniques (i.e., direct (XPS, UPS) and inverse photoemission (IPES) techniques, X-ray emission (XES) and absorption (XAS) spectroscopy), and work collaboratively with the Lawrence-Berkeley National Laboratory to derive the electronic and chemical properties of surfaces and interfaces in CIGS thin-film solar cells.

#### University of Delaware

The Institute of Energy Conversion (IEC) at the University of Delaware would fabricate high efficiency ACIGS thin film solar cells deposited by physical vapor deposition, including some processing by selenization and sulfurization in hydrogen selenide (H<sub>2</sub>Se) and hydrogen sulfide (H<sub>2</sub>S) gases, respectively, of sputtered metallic precursor films. They would also develop and optimize buffer layer materials processing, Investigate the electronic and chemical properties of surfaces and interfaces, characterize and compare properties of CIGS and ACIGS devices, and measure and characterize complete thin film solar cells made by thin film PV industry.

#### AFFECTED ENVIRONMENT

All work under this proposed NREL project would occur in existing laboratories in existing facilities using existing processes and chemicals with existing trained laboratory staff. No ground disturbing activities, laboratory expansion, facility improvements, etc., is included in the scope of this proposed project. NREL and its subrecipients have existing infrastructure and equipment to conduct this proposed work in a safe manner following established laboratory safety and chemical handling protocols. All facilities have the appropriate laboratory infrastructure, such as toxic gas monitors, fume hoods, emission abatement, safety interlock systems, fire suppression systems, etc., to conduct the proposed work. Additionally, all of the facilities possess the appropriate federal, state, and local permits to conduct this work, and no modification to any permits is anticipated as a result of this proposed work. Detailed information on each partners' facilities, safety protocols, permits, etc. can be found in the Environmental Checklists and Laboratory R&D Questionnaires uploaded to the PMC.

#### IMPACTS OF PROPOSED ACTION

Implementation of this proposed project would not result in any ground disturbing activities, and therefore, is not anticipated to impact stormwater, wetlands, floodplains, prime farmlands, critical habitats, threatened and endangered species, or cultural resources. The bench-scale laboratory work proposed under this action, would occur in existing laboratories with established safety and chemical management programs by trained staff employing standard industry protocols and processes. This proposed project would require the use of standard bench-scale quantities of hazardous materials, such as solvents, inorganics, acids, and bases. Implementation of this proposed project would result in the generation of small quantities of hazardous waste, which would be properly accumulated, characterized, and managed in accordance with applicable regulations, permits, and existing chemical management programs. Additionally, this project would result in de minimis quantities of air emissions, as all bench-scale laboratory work with the potential to result in air emissions would occur in existing laboratories with the proper emission abatement controls and scrubbers.

#### NEPA DETERMINATION

The proposed project actions to be conducted at the NREL STM campus is within the bounds of the Proposed Action analyzed and assessed in the Final Site-Wide Environmental Assessment of the National Renewable Energy Laboratory's South Table Mountain Complex (DOE/EA-1440) and its Finding of No Significant Impact (FONSI) dated July 2003. DOE/EA-1440 and its FONSI are hereby incorporated by reference, and no additional NEPA determination for this portion of the scope is required.

Based upon the information above, the proposed project scope that would occur at Colorado State University, the University of Florida, the University of Nevada Las Vegas, and the University of Delaware would qualify for Categorical Exclusions A9 and B3.6.

**NEPA PROVISION**

DOE has made a final NEPA determination for this award

Insert the following language in the award:

Note to Specialist :

EF2a created by Rob Smith on 06/22/2012

**SIGNATURE OF THIS MEMORANDUM CONSTITUTES A RECORD OF THIS DECISION.**

NEPA Compliance Officer Signature:  **Electronically Signed By: Lori Gray** / *Lori Gray* Date: 6/26/2012  
NEPA Compliance Officer

**FIELD OFFICE MANAGER DETERMINATION**

Field Office Manager review required

**NCO REQUESTS THE FIELD OFFICE MANAGER REVIEW FOR THE FOLLOWING REASON:**

- Proposed action fits within a categorical exclusion but involves a high profile or controversial issue that warrants Field Office Manager's attention.
- Proposed action falls within an EA or EIS category and therefore requires Field Office Manager's review and determination.

**BASED ON MY REVIEW I CONCUR WITH THE DETERMINATION OF THE NCO :**

Field Office Manager's Signature: \_\_\_\_\_ Date: \_\_\_\_\_  
Field Office Manager