

National Renewable Energy Laboratory
Solicitation for Letters of Interest (LOI) No. RAT-3-33624
Phase IB: “High Performance PV—Exploring and Accelerating Ultimate Pathways”

REQUEST FOR LETTERS OF INTEREST

READ THIS DOCUMENT CAREFULLY

This solicitation is being conducted under the streamlined procedures for competitive Letters of Interest established by the National Renewable Energy Laboratory (NREL). NREL will select a LOI for potential subcontract award based on the following.

- All requirements being met
- The best combination of:
 - Technical factors (based on qualitative merit criteria)
 - and
 - Evaluated cost

Issue Date: 02/14/03 Due Date: 04/25/03 Time Due: 4:00 P.M. Mountain Time

Technical Questions must be received in writing no later than 03/14/03

- | | |
|-----------------------------|--|
| 1. Solicitation Type | Best Value Letters of Interest |
| 2. NREL LOI Contact | William Algiene, Subcontract Administrator
MS 2713
National Renewable Energy Laboratory
1617 Cole Boulevard
Golden, CO 80401-3393
Phone: (303) 384-7423
Fax: (303) 384-7310
Email: william_algiene@nrel.gov |
- Submit LOI to and request information from the NREL LOI Contact

Electronic (PDF) copies of forms, sample subcontract, and appendices can be found at: <http://www.nrel.gov/contracts/index.html>

3. Background

The High-Performance Photovoltaic (HiPerf PV) Project was initiated by the U.S. Department of Energy to substantially increase the viability of PV for cost-competitive applications so that PV can contribute significantly to our nation's energy supply and environmental enhancement in the 21st century. The HiPerf PV Project aims at exploring the ultimate performance limits of existing PV technologies, approximately doubling their sunlight-to-electricity conversion efficiencies during its course, in order to accelerate and enhance their impact in the marketplace. Along with other key criteria for success (module manufacturing cost and reliability, which are central to other components of the DOE National PV Program), module sunlight-to-electricity conversion efficiency is the key parameter driving the economics of PV-generated electricity. Simply put, raising sunlight-to-electricity conversion efficiency reduces cost per unit of electrical output. The pathway to increased efficiency is via research on semiconductor materials and processes for creating PV cells and modules. By focusing on (1) PV technologies that have the greatest potential to meet low-cost targets and (2) their key efficiency challenges, the HiPerf PV Project directs Federal resources toward some of the most critical barriers to the widespread use of photovoltaics for energy-significant applications. This addresses one of the highest-priority goals for applied research in the *U.S. Photovoltaics Industry Roadmap*: “developing high-efficiency, low-cost materials and devices”[1].

PV technologies having a high potential to reach cost-competitiveness include: low-cost polycrystalline thin-film tandems for large-area, monolithically interconnected flat-plate modules; and concentrators using high-efficiency multijunction cells. Each of these technologies has the potential to reach the installed system cost goal of about $\$1/W_p$ with continued progress in efficiency, reliability, and manufacturing cost. Although concentrators have a great potential for low cost, they are limited somewhat to areas of high direct-beam sunlight (e.g., arid and semiarid climates). Thin films have a similar low-cost potential, but are not limited to high-sunlight climates. The HiPerf PV Project aims to focus research on raising the efficiency of these two mission-critical PV technologies so that they can compete with conventional, utility-generated electricity. This work includes bringing polycrystalline thin-film tandem cells and modules toward 25% and 20% efficiencies, respectively; and developing multijunction precommercial concentrator modules able to convert more than one-third of the sun's energy to electricity (i.e., 33% efficiency). To accomplish this, the NCPV directs in-house and subcontracted research in high-performance polycrystalline thin-film and multi-junction concentrator devices. During the project period, the alignment of these paths, toward established goals and extensive collaboration should produce significant contributions to the entire PV industry.

The first phase of the planned research project is critical because it provides a means to identify, explore, and accelerate the most promising paths for implementation, followed by commercial prototype products. These latter efforts constitute the second and third phases of this planned research project. The first of a two-part phase, Identifying Critical Pathways, investigated a wide range of complex issues in both the polycrystalline thin-film tandem area as well as the III-V multi-junction concentrator area. These investigations provided initial modeling and baseline experiments for several advanced concepts to clarify some of the challenges and identify critical paths for the longer-term development and application of high-performance PV technologies. The current solicitation, Phase IB, “High Performance PV—Exploring and Accelerating Ultimate Pathways,” is a continuation of Phase I and will address exploring and accelerating ultimate pathways to reach the project's long-term goals. It is thought that several promising approaches will be identified in each category during this phase to begin Phase II, “Implementation of Pathways.”

[1] *U.S. Photovoltaic Industry Roadmap, Chicago Illinois*, Facilitated by the NCPV for the U.S. PV Industry, Prepared by Energetics, Incorporated (Columbia, Maryland), May, 2001, 32 pp., URL: www.nrel.gov/ncpv/pdfs/30150/pdf

4. Objectives

The HiPerf PV Project is soliciting LOIs from universities, U.S. PV industries, and related industries to address HiPerf PV R&D long-term goals of bringing polycrystalline thin-film tandem cells and modules toward 25% and 20% efficiencies, respectively; and developing III-V multijunction precommercial concentrator modules able to convert more than one-third of the sun's energy to electricity (i.e., 33% efficiency).

In order to accelerate the achievement of the long-term project goal of a 25%-efficient polycrystalline thin-film tandem cell (combining high-band gap and low-band gap single-junctions), R&D needs to focus on a wide-bandgap top cell, integrated with the tunnel junction (interconnect). The wide-bandgap cell and the tunnel junction must be identified and developed together in advance of other issues because the rest of the tandem device structure and processing will be determined largely by this choice. The top cell materials require an optical bandgap (E_g) in the range of $1.45 < E_g < 1.8$ eV, and minimal sub-bandgap absorption. A practical range of acceptable bandgaps for this top cell may be wider than previously recognized. High bandgap alloys based on I-III-VI₂ and II-VI compounds, and other novel materials need to be explored further for the top cell. Low-band gap CIS and its alloys, thin Si and other novel approaches should be considered for the bottom cell. However, the device structure in terms of a monolithic integration or mechanical stack cannot be disregarded while exploring the top-cell and bottom-cell materials.

A 33% efficient concentrator module requires a very high-efficiency (probably >40%) solar cell. Theoretically, the efficiency of a four-junction concentrator cell could surpass 50%, implying that a >40% cell is realistic in the long-term. There are many potential approaches to achieving 40% efficiency, more than likely using single-crystal materials (crystalline). To achieve this, materials with appropriate band gaps, lattice constants, and quality must be identified. For example, the GaInP/GaAs/Ge cell that achieved 34% efficiency could reach 40% if a GaAs-lattice-matched, 1-eV material with good quality could be identified as the third component cell between Ge and GaAs subcells. NREL researchers are conducting fundamental research into III-V alloys, such as III-N-V, that might be incorporated into that structure. If the lattice-matching criterion is relaxed, more materials are available, but the challenges associated with growing high quality material with good yield are increased.

It may be easier to achieve 40% efficiency with a mechanical stack of solar cells grown on two different substrates. In this case, less work is required to develop new materials, but the fabrication of a 33% module will require learning how to stack the cells so that the temperature of the cell is kept low while still making appropriate electrical and optical interconnection of the cells. Techniques developed by the semiconductor industry for integrating Si, GaAs, and InP may be useful. Approaches requiring two single-crystal substrates are likely to be more expensive, increasing the concentration needed to make a cost-effective system, and, therefore, increasing the technical challenges associated with high flux. To reach 33% module efficiency, some of the R&D issues to be explored for the receiver package include thermal management, flux uniformity, cell protection, mounting and interconnect bonding, and optical efficiency. Collaboration between universities and/or companies is encouraged for cell/receiver integration.

This solicitation aims to explore and tackle the inherent complexities of the chosen cutting-edge technologies, both polycrystalline and crystalline materials, and capture a set of approaches that can then form a basis for further progress toward the long-term project goals. Therefore, the focus of the solicitation is exploring and accelerating the development of materials and devices for ultimate pathways of High Performance PV, as identified in the *U.S. Photovoltaics Industry Roadmap*[1].

5. Scope of Interest

This request for LOI, Phase IB, “High-Performance PV—Exploring and Accelerating Ultimate Pathways” is divided into two categories: HiPerf PV—Polycrystalline Thin-Film Tandem Cells, and—III-V Multijunction Concentrators. Responders may propose in either/both categories.

Category A— Polycrystalline Thin-Film Tandem Cells: Includes combining high-bandgap and low-bandgap single junctions. It should be possible to fabricate polycrystalline thin-film tandem cells with *efficiencies over 15% in the short-term and 25% in the long-term*. To explore and accelerate the development of pathways, critical requirements of the science base (needed, but not limited to) will focus on a high-efficiency wide-bandgap cell, $1.45 < E_g < 1.8$ eV with 15% efficiency. The approaches may include modified processing and control of electronic properties of I-III-VI₂ and II-VI alloy materials, and other novel absorber materials. With a monolithic configuration and/or possible alternative device structures and approaches, the processing limits of the top and bottom cells as well as the tunnel junction should be investigated. Additionally, incorporation of the thin-film tunnel junction (interconnect) to the top cell should be emphasized, including the role of defects and how they affect the transport properties of this junction as well as diffusion of impurities into the bulk. Characterization to accelerate the understanding of the limits of these devices to achieve the project goals would be a good accompaniment to the development of the devices. This characterization might be directed at novel approaches for analyzing multi-layers.

Letters of Interest may include combinations of these approaches, specific aspects of them, or even new ideas that are not included here, as long as they are aimed at the long-term project goals.

Category B— III-V Multijunction Concentrators: Includes exploring and accelerating R&D on III-V multijunction materials and devices that can be integrated into high-flux systems (refractive or reflective). Fundamental R&D in the cell area is needed to develop new materials and/or structures as well as perfect the quality of the materials. The responder may address, but is not limited to, R&D towards a 40% efficient device on any of the following device structures: mechanical, lattice-matched, monolithic integrated, wafer-bonded, and smart-cut approaches. Achievement of a 40% cell is no guarantee of a 33% module: integration of the cell into the module cannot be disregarded. Examples of issues in this area include losses associated with the optics or increased cell temperature, flux non-uniformity (including chromatic aberrations), cell protection, mounting and interconnect bonding, passivation of cell interconnects, development of secondary optics materials, heat sinking, and cell degradation/reliability issues. Progress in all of these areas may be facilitated by development of models and the associated computational resources.

The HiPerf PV Project will use a specific solar terrestrial spectrum for the characterization of concentrator cell efficiency. Module efficiencies will be qualified outdoors. This spectrum will be supplied by NREL, and can be obtained via the HiPerf’s PV project’s website (www.nrel.gov/highperformancepv), or upon request to the NREL Subcontract Administrator.

Letters of Interest may include combinations of these approaches, specific aspects of them, or even new ideas that are not included here, as long as they are aimed at the long-term project goals.

NREL is an acknowledged leader in high-efficiency PV. NREL will be well positioned to collaborate with awardees of this LOI.

In response to this request for LOIs, Responders may address either category A or category B or both. There will be no more than one award to any responder. The responder must clearly specify the applicable category A or B when the LOI is submitted.

6. **Qualification Requirements**

Responses will be accepted only if submitted by a U.S. organization (defined as an organization incorporated in the U.S.) or submitted by a team led by a U.S. organization. LOIs may be submitted independently by a Lead Responder (Subcontractor) or by a Lead Responder with team member participation (lower-tier subcontractors). While not a requirement of this LOI, Lead Responders are encouraged to team with other industry partners, universities, or colleges. Lead Responders must be U.S. industry, U.S. consultants, U.S. colleges and universities, or other U.S. business entities. Lead Responders (either independent or with team participation) may submit only one unique LOI for each category. Lead Responders may also participate as team members (lower-tier subcontractors) on LOIs led by a different Responder. Team members may participate in multiple responses under LOIs led by different Lead Responders.

No minimum cost sharing is required for an award, however it is strongly encouraged. Cost sharing is defined as a percentage of the total allowable **and** allocable cost under the subcontract, which may be met by direct cash contribution by the responder (called actual cost sharing) and by contributions from the subcontractor's lower-tier subcontractors or suppliers at no cost to NREL under the subcontract and which must be allowable and allocable direct costs under the terms of the Federal Acquisition Regulations and DOE Acquisition Regulations.

The subcontractor shall conduct its operations in an environmentally safe manner. The improvement of operations to further reduce waste streams and conduct operations in a safe work environment may be elements in the proposed work effort.

7. **Potential Subcontract Award and Available Project Funding**

It is the intent of NREL to award a total of approximately 12 cost reimbursable subcontracts under this solicitation. The intent is to make several awards in category A, HiPerf PV—Polycrystalline Thin-Film Tandem Cells, that largely address the exploration and acceleration of pathways to a 25%-efficient polycrystalline thin-film tandem cells, and several awards under category B, III-V Multijunction Concentrators, that primarily address exploring III-V materials and devices as well as the integrated receiver package toward a 40% cell and a 33% prototype module. The number of awards in each category and the total number of awards may vary due to the proposals received and the availability of funds. NREL reserves the right to make any number of awards or to make no awards under this solicitation. It is anticipated that the program funding available for all awards under this solicitation will be approximately \$3 million on an annual basis. Of that total, about one-half will be committed to category A and about one-half to category B. There is no commitment by NREL to award a particular number of subcontracts or to award a particular dollar value for any subcontracts awarded. No more than one LOI may be submitted for each category by a given responder.

Funding for potential awards is based on availability of DOE funding and on programmatic considerations as decided by DOE and NREL. It is the intent of NREL to make multiple, cost subcontract awards under this procurement. All subcontracts will be incrementally funded, in accordance with Federal funding provided on an NREL fiscal year basis.

This LOI is for R&D on HiPerf PV. It is not intended to fund the acquisition of research equipment. **There are no capital equipment funds available under this solicitation.** Capital equipment is defined as equipment with a unit value of \$5,000 or more, including applicable shipping and installation charges, and having a life expectancy of two years or more.

It is planned that any resultant subcontract will be for one of the following sets of conditions:

Category A– Polycrystalline Thin-Film Tandem Cells

Subcontracts under this category will be awarded for a period of performance of up to three (3) years. It is anticipated that the NREL funding level per subcontract under Category A will not exceed \$300,000 per 12-month period, with a maximum three-year total for the subcontract not to exceed \$900,000 (or a subcontract total of \$1.8M based on 50% cost sharing). If a LOI exceeds NREL's identified limit, any amount over the limit is expected to be at 100% cost share by the responder.

Category B– III-V Multijunction Concentrators

Subcontracts under this category will be awarded for a period of performance of up to three (3) years. It is anticipated that the NREL funding level per subcontract under Category B will not exceed \$300,000 per 12-month period, with a maximum three-year total for the subcontract not to exceed \$900,000 (or a subcontract total of \$1.8M based on 50% cost-sharing). If a LOI exceeds NREL's identified limit, any amount over the limit is expected to be at 100% cost share by the responder.

Individual subcontracts under this LOI will be awarded for up to three (3) years. They will be funded on a year-to-year basis and subject to available funding. Proposed efforts should be divided into distinct 12-month phases with well-defined tasks, milestones, and deliverables under each phase. Specific milestones and deliverables will be mutually agreed upon by the prospective subcontractor and NREL during negotiations for each year of the subcontract. Continued funding for the subsequent phase(s) will be based on research progress, the availability of funds, and programmatic needs. The subcontractor's failure to meet the negotiated milestones and deliverables could result in the follow-on phases not being authorized. It is NREL's intent to award any resultant subcontract on an incrementally funded basis, subject to the availability of fiscal year funding from DOE.

8. Competitive solicited Letters of Interest using Best Value Selection

This solicitation shall be conducted using Best Value Selection that results in the selection of LOIs for potential subcontract award that is most advantageous to NREL based on the best value combination of (a) highest evaluated qualitative merit and (b) lowest evaluated cost of the LOIs submitted.

Best Value Selection is based on the premise that, if all LOIs are of approximately equal qualitative merit, award will be made to the LOIs with the lowest evaluated cost. However, NREL will consider selecting an LOI with a higher evaluated cost if the offer demonstrates the difference in cost is commensurate with the higher qualitative merit. Conversely, NREL will consider selecting an LOI with a lower evaluated qualitative merit if the cost differential between it and other LOIs warrant doing so.

9. Qualitative Merit Criteria for Best Value Selection

The scope of interest (see item 5) and the qualification requirements (see item 6) in this solicitation serve as NREL's baseline requirements that must be met by each LOI.

The qualitative merit criteria (see item 9) establish what NREL considers the technical factors valuable in an LOI. These qualitative merit criteria are performance-based and permit selection of the LOIs that provide higher qualitative merit for a reasonable, marginal increase in price/cost.

Each qualitative merit criteria and its assigned weight are provided below.

9.1 Technical Approach, Planned Results, and Deliverables (50%)

This criterion includes the following considerations:

- § Is the technical plan (objective, approach, results, deliverables, etc.) clearly stated, achievable and technically reasonable?
- As demonstrated in the technical plan, what is the likelihood that the problem addressed in this response will be solved?
- What is the expected significance and quality of both the undertaking, and the success of this effort, including its planned results and deliverables?
- What is the potential of the LOI to achieve the goals defined for the HiPerf PV project and those identified in the responder's response?
- Will this research help to determine the direction to choose for the Implementation Phase II of the HiPerf PV Project?

9.2 Experience (25%)

This criterion includes the following considerations:

- What is the experience and record of success of the Responder(s) (supported by list of past projects including names and phone numbers of contacts)?
- What experience does the Responder(s) have in the proposed topic(s) in their LOI?

9.3 Capability (25%)

This criterion includes the following considerations:

- What is the capability of the Responder (supported by resumes of key personnel)?
- Does the Responder have the technical knowledge to accomplish the proposed objectives?
- Are the organization's resources adequate to implement the proposed project?
- If equipment is needed, is it currently available to the Responder?

10. Additional Factors for Evaluation

In addition to the qualitative merit criteria above, each LOI will be evaluated against the following evaluation factors to determine the competitive range and final negotiation rank order. These factors are not weighted.

10.1 Strategic and Program Policy Factors

This factor includes the following considerations:

- Relative mix of LOIs in relation to the proposed activities received in this solicitation; and, in relation to the ongoing HiPerf PV Project subcontracts and activities;
- Relative mix of LOIs in relation to the HiPerf PV Project short-term and long-term goals;
- Relative mix of LOIs, in relation to total funding available, and, in relation to relative mix of other LOIs requested funding; and
- Relative mix of team participation

11. Cost Evaluation for Best Value Selection

After evaluation of the qualitative merit criteria (and additional factors for evaluation), the following cost evaluation will be used to determine the best value of the LOI in meeting the objectives of the solicitation.

11.1 Cost

This factor includes the following considerations:

- Reasonableness of the total proposed cost and the individual cost elements that comprise the total cost;
- Responder's demonstrated understanding of the project based upon the proposed cost to perform the work;
- Reasonableness of the proposed cost in relation to the magnitude of the work to be performed; and
- Responder's level of cost sharing (not required).

The combined qualitative merit value will be considered substantially more important than the cost.

12. Evaluation process

NREL will evaluate LOIs in two general steps:

Step One—Initial evaluation

An initial evaluation will be performed to determine if all required information has been provided for an acceptable LOI. Responders may be contacted only for clarification purposes during the initial evaluation. Responders shall be notified if their LOI is determined not acceptable and the reasons for rejection will be provided. Unacceptable LOIs will be excluded from further consideration.

Step Two—Discussion and Selection

All acceptable LOIs will be evaluated against the scope of interest and the qualification requirements; the qualitative merit criteria, program policy factors, and cost evaluation listed above. Responders selected through the best value selection process will be contacted with the intent to negotiate an acceptable Statement of Work, based on the

Responder's LOI. Subsequently, NREL will issue a Request for Proposal for a technical and cost proposal based on this developed Statement of Work.

13. LOI preparation information

Each response to the LOI must contain the following:

- a. A title page, to include the LOI title, name of organization, and principal investigator (with postal address, telephone number, fax number, and e-mail address). The title should be succinct and capture the essence of the LOI. It should be clear as to which category the response to the LOI is for: Category A: High Performance PV— polycrystalline Thin-Film Tandem Cells, and/or Category B: High Performance PV — III-V Multijunction Concentrators
- b. A proposed Statement of Work (see www.nrel.gov/contracts/index.html for template) that forms the bulk of the response to the LOI should contain the major portion of the technical proposal. It will include the technical discussion of approaches and should be presented in sufficient detail to permit a comprehensive evaluation. It should also contain, as a minimum, the following sections:
 - Background
 - Objectives
 - Scope of Work
 - Statement of Expected Results
 - Program Plan (to include a list of team members, if applicable)
 - Milestones and Deliverables
- c. References and Bibliography. Relevant references may be cited, but do not include copies of reference articles in the submission.
- d. Summary of Capabilities
- e. Abbreviated Resumes (one page maximum) of one or two key personnel
- f. Selected list and brief description of Government or NREL contracts or subcontracts related to the field covered by this LOI that the Responder has been awarded in the past five (5) years, to include the contracting agency's name, the contract or subcontract amount, and a brief description of the project.
- g. One (1) original (no copies necessary) of a completed "Representations and Certifications".
- h. A completed "**Cost Estimate Sheet**" in an original and copies submitted with your LOI. The cost estimate should include support documentation for all categories of the proposed budget. A separate form should be submitted for each year and for the entire project. Your estimated budget and delivery terms must be valid for 60 days from the date your LOI.

- i. This solicitation does not allow the submittal of facsimile or electronic proposals.
- j. This solicitation does not commit NREL to pay costs incurred in the preparation and submission of a response to this request for LOI.

Responders should provide only the minimum amount of information required for proper evaluation. Keep your LOI as brief as possible and concentrate on substantive information. Follow the instructions below in preparing your LOI:

- Submit an original AND fifteen (15) copies of your LOI.
- Keep your proposed **Statement of Work to no more than 15 pages** (not including the title page).
- Keep your submitted LOI to no more than 25 pages total.
- A page is defined as one side of an 8 ½" x 11" sheet of paper.
- Use a 12-point font.
- Maintain at least 1-inch margins on all sides.
- Copies may be either single or double sided.

14. Solicitation Provisions

a. Late submissions, modifications, and withdrawals of LOIs

LOIs, or modifications to them, received from qualified organizations after the latest date specified for receipt may be considered if received prior to selection, and NREL determines that there is a potential budget, technical, or other advantage, as compared to the other LOIs received. However, depending on the circumstances surrounding the late submission or modification, NREL may consider a late LOI to be an indication of the Respondent's performance capabilities, resulting in downgrading of the LOI by NREL evaluators in the technical evaluation process. An LOI may be withdrawn by written notice or telegram (including mailgram) received at any time before selection. LOIs may be withdrawn in person by a Responder or an authorized representative, if the representative's identity is made known and the representative signs a receipt for the LOI before selection.

b. Restrictions on disclosure and use of data

Responders who include in their LOIs data that they do not want disclosed to the public for any purpose or used by the government or NREL, except for evaluation purposes shall—

1. Mark the title page with the following legend:
“This LOI includes data that shall not be disclosed outside the government or NREL and shall not be used or disclosed—in whole or in part—for any purpose other than to evaluate this LOI. If, however, a subcontract is

awarded to this responder as a result of—or in connection with—the submission of this data, the government or NREL shall have the right to use or disclose the data to the extent provided in the resulting subcontract. This restriction does not limit the government or NREL’s right to use information contained in this data if obtained from another source without restriction. The data subject to this restriction are contained on pages [insert page and line numbers or other identification of pages] of this LOI”; and

2. Mark each page of data it wishes to restrict with the following legend:
“Use or disclosure of data contained on this page is subject to the restriction on the title page of this LOI.”

c. Notice of right to receive patent waiver (derived from DEAR 952.227-84) and technical data requirements

Responders (and their prospective lower-tier subcontractors) in accordance with applicable statutes and Department of Energy Acquisition Regulations, (derived from DEAR 952.227-84) have the right to request a waiver of all or any part of the rights of the United States in inventions conceived or first actually reduced to practice in performance of the subcontract that may be awarded as a result of this solicitation, in advance of or within thirty (30) days after the effective date of subcontracting. Even where such advance waiver is not requested or the request is denied, the subcontractor will have a continuing right during the subcontract to request a waiver of the rights of the United States in identified, individual inventions.

Domestic small business firms, educational institutions, and domestic nonprofit organizations normally will receive the Patent rights clause—retention by the subcontractor—which permits the responder to retain title to subject inventions, except in subcontracts involving exceptional circumstances or intelligence activities. Therefore, domestic small business firms, educational institutions, and domestic nonprofit organizations normally need not request a waiver.

If a Responder’s proposal includes a lower-tier subcontract to another organization, that lower-tier organization's business type will determine the applicable intellectual property provisions that will apply to the lower-tier subcontract. Note that a lower-tier subcontractor may apply for a patent waiver under the same conditions as the Responder.

Under a research, development, and demonstration project, the Department of Energy and NREL are unable to ascertain, prior to receipt of LOIs, subsequent proposals, or performance of the project, their actual needs for technical data. It is believed that the requirements contained herein are the basic needs of the Department of Energy and NREL. However, if the Responder indicates in its LOI or subsequent proposal that proprietary data will be used or withheld under its proposed effort, the government and NREL reserve the right to negotiate appropriate rights to the proprietary data. The appropriate rights may include "Limited Rights in Proprietary Data" and/or "Subcontractor Licensing."

d. Disclaimer

NEITHER THE UNITED STATES; NOR THE DEPARTMENT OF ENERGY; NOR MIDWEST RESEARCH INSTITUTE, NATIONAL RENEWABLE ENERGY LABORATORY DIVISION; NOR ANY OF THEIR CONTRACTORS, SUBCONTRACTORS, OR THEIR EMPLOYEES MAKE ANY WARRANTY, EXPRESS OR IMPLIED, OR ASSUME ANY LEGAL LIABILITY OR RESPONSIBILITY FOR THE ACCURACY, COMPLETENESS, OR USEFULNESS FOR ANY PURPOSE OF ANY OF THE TECHNICAL INFORMATION OR DATA ATTACHED OR OTHERWISE PROVIDED HEREIN AS REFERENCE MATERIAL.

e. Solicitation disputes

The General Accounting Office and the Department of Energy do not accept or rule on disputes for solicitations for Letters of Interest issued by Management and Operating Contractors for the Department of Energy (operators of Department of Energy National Laboratories). Should a responder have any concerns regarding the NREL solicitation process or selection determination, the responder may contact Marty Noland, Advocate for Commercial Practices, at (303) 384-7550. NREL will address each concern received from a responder on an individual basis.

f. (Lower-Tier) Small Business Subcontracting Plan (derived from FAR 52.2199)

The following requirement does not apply to small business Responders.

The selected Responders to this solicitation shall include in their proposals a lower-tier subcontracting plan that separately addresses lower-tier subcontracting with small business, small disadvantaged business, and women-owned small business concerns. If the responder is submitting an individual subcontract plan, the plan must separately address lower-tier subcontracting with small business, small disadvantaged business, women-owned small business concerns, veteran-owned business, and Hubzones, with a separate part for the basic subcontract and separate parts for each option (if any). The plan shall be included in and made a part of the resultant subcontract. The lower-tier subcontracting plan shall be negotiated within the time specified by the NREL Subcontract Administrator. Failure to submit and negotiate a lower-tier subcontracting plan shall make the responder ineligible for award of a subcontract (see NREL website).

15. Solicitation Provisions—Incorporated by Reference

This solicitation incorporates one or more solicitation provisions by reference with the same force and effect as if they were given in full text. The following documents can be downloaded from the NREL **general access** website at http://www.nrel.gov/contracts/related_docs.html or the NREL LOI Contact (see item 2) will make full text available upon request.

- P NREL Representations and Certifications for Subcontracts
- P NREL Cost Estimate Sheet

Ⓟ NREL Small Business (Lower-tier) Subcontracting Plan Requirements (Does not apply to small businesses)

16. NAICS Code and Small Business Size Standard

a. The North American Industry Classification System (NAICS) code [formerly standard industrial classification (SIC)] for this solicitation is 54171.

b. The small business size standard for 54171 is 500 or fewer employees.

Proposed Statement of Work

Phase IB: High Performance PV—Exploring and Accelerating Ultimate Pathways

Title

(Indicate either Category A: High-Performance PV—Polycrystalline Thin-Film Tandem Cells, or Category B: High-Performance PV —III-V Multijunction Concentrators)

Date

1. **Background:** This section should contain information needed to place the Responder’s program in the proper context with respect to the Background Section of the Work Statement.
2. **Objective:** This section should contain a quantitative description of the major objectives of the proposed multi-year research effort.
3. **Statement of Expected Results and how they relate to the projects goals:** Indicate how the expected results will help to reach both the Phase IB project goals and the next research steps toward the long-term stated project goals.
4. **Scope of Work:** This section should contain the technical description of the work to be performed. These should be broken down by one year Tasks, with concise descriptions of the work to be done within each Task. Task efforts extending over more than one year must be divided into a separate task for each subcontract year. Because of annual funding constraints, tasks need to be given for each subcontract year of a proposed program. This section should also identify in which Task and in which year of the proposed effort each of the problems identified will be addressed. All Responders should give special attention in preparing their Scope of Work to assure that proposed tasks do not represent a duplication of work currently being funded by NREL or other government sources. Tasks identified as duplications of work currently being funded by NREL or other government sources will not be considered when the Responder’s proposal is being reviewed. Furthermore, any such identified duplication of effort will not be included in a subcontract with a winning offer.

YEAR I

During Year I, the following tasks will be performed:

4.1 Task 1 Title

Abbreviated task description.

4.2 Task 2 Title

Abbreviated task description.

Continue to list tasks as necessary.

YEAR II

During Year II, the following tasks will be performed:

4.3 Task 3 Title

Abbreviated task description.

4.4 Task 4 Title

Abbreviated task description.

Continue to list tasks as necessary.

YEAR III

During Year III, the following tasks will be performed:

4.5 Task 5 Title

Abbreviated task description.

4.6 Task 6 Title

Abbreviated task description.

Continue to list tasks as necessary.

- 5. Program Plan:** This section should contain the Responder’s proposed Program Plan, which divides the entire two-to-three-year program into work packages of finite segments. It should include the period of performance and the proposed duration of projects in months by 12-month phase and by Task, including time required for preparation and submission of required reports.

YEAR I

The following tasks and deliverables will be performed and completed during Year I according to the following schedule:

Months	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Task 1	<input type="checkbox"/>	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	<input type="checkbox"/>		
Task 2	<input type="checkbox"/>	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	<input type="checkbox"/>		
Task 3	<input type="checkbox"/>	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	<input type="checkbox"/>		
Etc.	<input type="checkbox"/>	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	<input type="checkbox"/>		
Monthly OR Quarterly Reports		– 15th												
Annual Report	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	– Draft 15th	•••	– Final 30th

YEAR II

The following tasks and deliverables will be performed and completed during Year II according to the following schedule:

Months	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Task 4	<input type="checkbox"/>	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	<input type="checkbox"/>		
Task 5	<input type="checkbox"/>	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	<input type="checkbox"/>		
Task 6	<input type="checkbox"/>	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	<input type="checkbox"/>		
Etc.	<input type="checkbox"/>	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	<input type="checkbox"/>		
Monthly OR Quarterly Reports	– 15th	– 15th	– 15th	– 15th	– 15th	– 15th	– 15th	– 15th	– 15th	– 15th	– 15th	– 15th		
Annual Report	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	– Draft 15th	•••	– Final 30th

YEAR III

The following tasks and deliverables will be performed and completed during Year III according to the following schedule (the last Monthly is replaced by the Final):

Months	J	F	M	A	M	J	J	A	S	O	N	D	J	F
Task 7	<input type="checkbox"/>	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	<input type="checkbox"/>		
Task 8	<input type="checkbox"/>	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	<input type="checkbox"/>		
Task 9	<input type="checkbox"/>	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	<input type="checkbox"/>		
Etc.	<input type="checkbox"/>	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	<input type="checkbox"/>		
Monthly OR Quarterly Reports	– 15th	– 15th	– 15th	– 15th	– 15th	– 15th	– 15th	– 15th	– 15th	– 15th	– 15th	•••		
Annual Report	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	•••	– Draft 15th	– Final 30th

- 6. **Milestones and Deliverables:** This section should contain a set of measurable and definable milestones and deliverables associated with each Task defined in the Scope of Work. This description should be in the form of a table and/or a Milestone and Deliverables

chart.

YEAR I

<u>Proposed Milestones/Deliverables</u>	<u>Due Date</u>	<u>Task #</u>
m-1.1.1 Description of first milestone or deliverable.		(Task #)
m-1.1.2 Description of second milestone or deliverable.		(Task #)
m-1.1.3 Continue to list as necessary...		(Task #)
m-1.1.4		(Task #)

YEAR II

<u>Proposed Milestones/Deliverables</u>	<u>Due Date</u>	
m-2.1.1 Description of first milestone or deliverable.		(Task #)
m-2.1.2 Description of second milestone or deliverable.		(Task #)
m-2.1.3 Continue to list as necessary...		(Task #)
m-2.1.4		(Task #)

YEAR III

<u>Proposed Milestones/Deliverables</u>	<u>Due Date</u>	
m-3.1.1 Description of first milestone or deliverable.		(Task #)
m-3.1.2 Description of second milestone or deliverable.		(Task #)
m-3.1.3 Continue to list as necessary...		(Task #)
m-3.1.4		(Task #)

7. Reporting and Presentation Requirements

In addition to the milestones/deliverables above, monthly reports will be submitted, in addition to a Final Report.

If a Responder receives an award, deliverables as well as annual and final reports as described in Section 8 below, would be sent to the NREL Technical Monitor, (TM) both hard and electronic copies, with a hard copy of the report sent to the NREL Subcontract Administrator:

Attendance at NREL Subcontractor Annual Review Meetings to be held in the United States at a place and time specified by NREL would be required if an award is received. Any other travel should be detailed here.

8. Presentations and Publications

The subcontractor is expected to attend one program and project (HiPerf) review meeting per year to be held at a place and time specified by the NREL TM and shall present a paper with a complete discussion of work performed under the subcontract. One reproducible master copy of the paper shall be submitted to the NREL TM, and one copy of the paper shall be submitted to the NREL Subcontract Administrator. For estimating purposes, plan one meeting per year at NREL for a duration of two (2) days. In addition, each subcontractor should plan to attend and present at the periodic IEEE PV Specialists conferences, NCPV review meetings, and an additional PV-related conference that occurs during the subcontract period.

Presentations at scientific meetings and publications of research results in scientific journals are encouraged by the HiPerf PV Project, but must be approved in advance by the NREL Subcontract

Administrator. Any costs to NREL that are to be incurred as a result of such presentations/publications must be included in the negotiated cost of the subcontract. Before a representative of the subcontractor submits or presents a publication, the subcontractor shall submit two (2) copies of any publication/presentation (e.g., abstract, reprint of manuscript, etc.) concerning the research effort under this subcontract to the NREL Technical Monitor and one (1) copy to each Technical Advisor. The subcontractor is responsible for obtaining NREL's technical approval. If the subcontractor is other than a small business concern, educational institution, or non-profit organization who qualifies under P.L. 98-620, the subcontractor must also obtain DOE patent clearance in accordance with Clause 1— Patent Rights (Long Form), prior to any publication or presentation concerning this subcontract effort. The subcontractor should allow at least sixty (60) days to obtain the appropriate technical and patent clearances for the publication or presentation.

Potential subcontractors are reminded that the technical approval and the patent clearance requirements also apply to reports requiring distribution outside of NREL. Submission of the final version and the reproducible master of reports indicates that the subcontractor has obtained DOE Patent Clearance.

Successful Responders should also be prepared to respond to requests for written information in summary form as required by the NREL Technical Monitor to meet obligations to DOE. Such requests include, but are not limited to Program Summaries (annually, 1-2 pages) and Summary Annual Reports (2-3 pages). These reports are in addition to the report requirements outlined in Paragraphs 8 and 9 below.

9. Performance Evaluation

The subcontractor's performance will be monitored and evaluated by means of:

- A. Monthly/Quarterly and/or Technical Status Reports consisting of a report of program status relative to milestone and program schedules (6-10 pages)
- B. Annual Technical Progress Reports covering all work done under the subcontract
- C. A Final Technical Report covering all work done under the subcontract
- D. At least one review per year by the HiPerf PV Project TM for this subcontract, and more typically two. These reviews shall entail oral presentations and demonstrations by the subcontractor and may include visits to the subcontractors' work site at the discretion of the HiPerf PV Project TM. These meetings will be critical program evaluation points. The progress of the subcontractor will be assessed at this time by reviewing past accomplishments and future program plans. Subcontractor progress will also be monitored by telephone conversations.

10. Electronic Reporting Requirements for Subcontract Report Deliverables

As set forth in Department of Energy Order 241.1A, NREL is required to submit in an electronic format all scientific and technical information, including subcontract report deliverables intended for public distribution, to the DOE Office of Scientific and Technical Information (OSTI). In addition, it is NREL's intention to post subcontract report deliverables containing publicly available information (e.g. non-confidential, non-protected, non-proprietary information) for distribution on the NREL Intranet or the Internet.

The Subcontractor shall provide the final approved version of report deliverables intended for public distribution as specified in the deliverable schedule of this Statement of Work in accordance with the following electronic reporting requirements:

- a. The Subcontractor shall submit all report deliverables intended for public distribution (including status, annual, or final reports) as electronic files, preferably with all graphics and images embedded within the document. The electronic files shall be submitted along with an accompanying hard (printed) copy (is) of the report. Limited exceptions allowing some graphics and images to be submitted as hard copies only may be granted on a case-by-case basis. The exceptions process for graphics and images is described in Paragraph E below. It shall be made clear in the deliverable transmittal letter that certain graphics and images are supplied in hard copy only.
- b. All final approved version submissions shall be delivered to NREL on PC or MAC-formatted media (3.5 inch disks, Zip and Jaz cartridges, or CD-ROM). Files of 1 Mb or less can be sent via e-mail to the 1) NREL technical monitor, 2) the NREL Subcontract Administrator or Associate (as specified in the Statement of Work).
- c. The preferred format is a single electronic file that includes all of the text, figures, illustrations, and high-resolution digital photographs (or photographs should be scanned and incorporated in the text). Acceptable file formats are:
 - Microsoft Word (v.6.0 or newer for PC or MAC)
 - WordPerfect (v.6.1 or newer for PC)
 - Microsoft PowerPoint
 - Microsoft Excel
- d. If it is not possible to include all of the graphics and images (figures, illustrations, and photographs) in the same file as the text, NREL will accept the text in one of the above formats and the graphics and images as separate electronic graphic or image files*. The native files for any page layout formats submitted shall be supplied. The following software is supported on both Mac and PC platforms:

• QuarkXPress (.qxd)	• Pagemaker (.pm)
• Photoshop (.psd)	• Illustrator (.ai)
• Freehand (.fh)	• Corel Draw (.cdr)
• Framemaker (.fm)	• Microsoft Publisher(.pub)

*The acceptable graphic or image file formats are: .eps, .tif, .gif, .jpg, .wpg, .wmf, .pct, .png, .bmp, .psd, .ai, .fh, .cdr. The preferred resolution for graphics or images is 150 to 300 dpi. Include all fonts that were used in creating the file.

- e. In the rare case that the graphics or images cannot be supplied electronically, either incorporated within the text or as a separate electronic file, original hard copies will be accepted. The Subcontractor shall obtain prior approval from the Subcontract Administrator before submitting graphics or images in hard copies. It shall be made clear in the deliverable transmittal letter that certain graphics and

images are supplied in hard copy only.

- f. For all calculations in support of subcontract reports that are conducted in ASPEN+, an electronic copy of INPUT, REPORT and BACKUP (if Model Manager is used) must be submitted with all reports. Additionally, if costing or sizing calculations are conducted in a spreadsheet [no process calculations (heat and material balances) in spreadsheet format are permitted], a copy of the fully documented MS Excel file shall be supplied. Note that vendor quotes and other non-original material can be supplied in hard copy.
- g. A fully executed release shall be supplied to NREL with all photographs, regardless of whether such photographs are delivered to NREL electronically or in hard copy. Such release shall certify that the National Renewable Energy Laboratory and the United States Government is granted a non-exclusive, paid-up, irrevocable, worldwide license to publish such photographs in any medium or reproduce such photographs or allow others to do so for United States Government purposes.
- h. The Subcontractor may contact NREL Publication Services at (303) 275-3644 with questions regarding technical guidance concerning the submission of subcontract report deliverables as electronic files or exceptions to electronic files for graphics and images.

Exhibit D

Letters of Interest COST Estimate Sheet for [Insert LOI #]

Description		Year I	Year II	Year III	3Year Total
A.	Direct Materials (\$)				
B.	Direct Labor (\$)				
1.	Labor Overhead & Fringe (\$)				
2.	Special Testing (\$)				
E.	Special Equipment + (List each piece of equipment and dollar amount)				
F.	Travel ⁺⁺⁺ (\$)				
G.	Consultants/Lower-tier Subcontractors (\$) (Identify Organization)				
H.	Other Direct Costs (\$) (e.g., Publications)				
I.	G&A (\$) (Specify rate)				
J.	TOTAL ESTIMATED COST (\$)				
K.	PROFIT/FIXED FEE				
L.	Responder's Cost Share				
M.	NREL's Cost Share				
+	List labor categories and total hours for each category				
++	Capital Equipment Funds are not available for this solicitation. Equipment can be included in respondent's Cost Share				
+++	List trips required and purpose. Note that foreign travel requires pre approval from DOE and special reporting requirements.				