

GENERATION 3 CONCENTRATING SOLAR POWER SYSTEMS

Funding Opportunity Announcement (FOA) Number: DE-FOA-0001697

Webinar Script 09/19/2017

Title Slide: Gen 3 CSP Laboratory Consortium Informational Webinar: Welcome, and thank you for joining us for the Generation 3 CSP Systems Funding Opportunity Announcement webinar. My name is Mark Lausten and during this webinar, I will provide a brief overview of this Generation 3 Concentrating Solar Power Systems Funding Opportunity Announcement (the Gen 3 CSP FOA) and the concept paper, application and review process. This presentation will not be recorded and live questions will not be taken. Instructions for submitting questions on this presentation and for the Gen 3 CSP FOA, will be provided at the end of the webinar.

Slide 1: Please bear in mind that the content included in the webinar is only intended to summarize the contents of the Gen 3 CSP FOA. Therefore, please note that any content within this presentation that appears discrepant from the FOA language is superseded by the language in the FOA. All Applicants are strongly encouraged to carefully read the FOA guidelines and adhere to them. Neither the U.S. Department of Energy (DOE) nor the employees associated with DOE working on this presentation shall be held liable for errors committed by applicants based on potentially incorrect or inaccurate information presented herein.

Agenda: The agenda for this presentation is as follows: To start things off, I will present an overview of the Gen 3 Concentrating Solar Power (CSP) initiative. We will discuss the objectives of Gen 3 CSP Systems Funding Opportunity Announcement, overview specific areas of interest, and discuss the way the FOA topics are structured. Then we will briefly go over the mandatory Concept Paper submission process, and the application and review schedule. There will be a second webinar focused on the Full Application phase after comments from the Concept Papers are released to the applicants. Finally, I will close the webinar by reviewing how an Applicant can submit questions regarding this FOA. Once again, applicants should read the FOA for more information on its objectives.

Gen3 CSP Initiative Overview: The Gen 3 CSP Initiative aims to decrease the cost of CSP electricity by increasing efficiency through higher temperature operation. Through this Initiative, the CSP SunShot program seeks to develop thermal systems capable of delivering heat to advanced power cycles. An example is supercritical CO₂ power cycles, which can offer high efficiency but at temperatures greater than the capability of current CSP thermal systems. Meanwhile it is necessary to assure these high temperature CSP Systems meet SunShot targets and are reliable.

Gen 3 Systems Background: CSP technology progression can be characterized by the operating temperature limit imposed by the heat transfer fluid (HTF). The first generation of CSP technology uses an oil based heat transfer fluid limited to 395°C. DOE funded research, development and demonstration in the 1990's led to the second generation of CSP technology using molten nitrate salts, capable of operating at 565°C. Today, over 6 GW of CSP technology is in commercial operation around the world. To reach the SunShot goal of 6 cents/kWh, further research is needed to increase operating temperatures and thereby increase efficiency.

Advanced Power Cycles: sCO₂: A brief word about the development of an advanced power cycle which shows promise for CSP and the broader power industry. Closed-loop, recuperated Brayton cycles, using super-critical carbon dioxide (CO₂) as a working fluid, are well-suited for operation at temperatures that appear to be optimal for CSP. The cycle efficiency favors high temperature, near iso-thermal heat input, which CSP can deliver. Important to CSP, the efficiency of the cycle is minimally impacted when scaled down to less than 150 MW, and it is suitable for environments with high ambient temperatures, without requiring evaporative cooling. This technology has seen rapid advancement, in part through the SunShot CSP Program, and with broad industry interest for fossil, oil & gas, nuclear, propulsion and combined heat and power (CHP) applications. Let it be noted, that this FOA does not seek innovations in power cycles, and that solutions pursued by projects in this FOA are not required to be compatible with this power cycle. However, applicants will be expected to demonstrate how their proposed solution integrates with a power cycle in a system capable of achieving SunShot Targets of 6 ¢/kWh(electric) or less.

Gen 3 CSP Pathways and High Temperature Challenges: In 2016, the CSP Program commissioned Sandia National Laboratory and the National Renewable Energy Laboratory to evaluate potential pathways for high temperature CSP thermal systems. Three pathways for Gen 3 thermal systems were evaluated in this study, grouped by three phases of matter. The resulting report, titled "Concentrating Solar Power Gen3 Demonstration Roadmap," identified several key barriers to each of the pathways evaluated. These barriers highlight some of the challenges that may be tackled by the Gen 3 CSP Initiative. The pathways evaluated are by no means the only pathways to achieve reliable, high efficiency, low cost power from CSP, nor are the identified barriers likely to be the only challenges that will be overcome through this initiative.

Gen3 Concentrating Solar Power System; Innovation: The figure on this slide shows the thermal systems which are the focus of this initiative. The thermal systems absorb concentrated sunlight from a collector field, transport and store the thermal energy, and deliver it to the working fluid of an advanced power cycle when needed. The Gen 3 FOA is intended to advance components and integrated systems. Note that this FOA does not seek innovations in solar collectors or power cycles. In parallel with the Gen 3 CSP Systems FOA, the SunShot Program intends to fund National Laboratory research, to advance the public's knowledge on material characteristics and to provide test and evaluation capability of material compatibility, its behavior under a wide range of operations, and interaction with test components.

Topic Areas and FOA Structure: The present FOA is made up of three topic areas that are further divided by phases. Topic Area 1 (TA1) calls for the design, development, engineering and procurement of an integrated test facility, success of which, can retire risks for the proposed pathway, and develop the requisite confidence for scale-up to commercial application. DOE reserve the right to fund zero, one or more distinct Gen 3 pathways. During Phase 1 of this topic, it is envisioned that the proposing team develops a conceptual design and cost estimate of a utility-scale plant; identify the risks and barriers to commercialization; develop a plan to retire risk via small scale tests or detailed testing campaign; develop essential components; and arrive at a detailed design of a 1-10 MWth facility by the end of Phase 2. Topic Area 2A (TA2A) calls for component development that may inform the design of TA1 facilities. Therefore TA2A projects are planned to be completed before the development of TA1 detailed system design. Topic Area 2B (TA2B) is for research and analysis relevant to one or more of the potential Gen3 integrated thermal systems. Research may be directed at gaining a broader understanding of specific physical characteristics of materials but must be applied to addressing issues related to an integrated thermal system.

Down selection to Phase 3: At the completion of Phase 2, EERE expects to down-select to a single Topic Area 1 award for continuation to Phase 3 activities – construction of the multi-MW, integrated system facility, and testing. EERE plans to use an external merit review panel to evaluate the technical merit of all projects requesting continuation to Phase 3. EERE may decide that no single pathway is appropriate for Phase 3 activities at that time. The downselect merit review will evaluate criteria as detailed in the FOA document.

Phase 3 – Integration Test Facility: The integration facility is intended to transfer 1-10 MWth from solar energy via a receiver to a thermal energy storage system and transfer that energy to a working fluid representative for an advanced thermal power cycle such as the SCO₂ cycle. While a power cycle is not required to be part of this facility; required to be included are the requisite pumps, heat exchangers, valves and control system. The working fluid thermodynamic conditions should be sufficient to attain the stated thermodynamic efficiency of the power cycle for which the technology is designed. Thermal energy storage must be provided such that full day tests can be conducted using approximately 6 hours of sun. The facility should include all subsystems and components of a CSP plant outside the collectors and power cycle. Solar operation is suggested, but if alternate methods of heating the HTF are provided while reasonable confidence in receiver subsystem design is indicated, such methods may be pursued. A receiver exit temperature of $\geq 700^{\circ}\text{C}$ is suggested; but lower receiver exit HTF temperatures may be parlayed against LCOE and capital costs if LCOE targets can be shown to be attained in a full scale plant.

Phase 3 – Integration Test Facility (continued): The integrated facility is primarily intended as a test bed to de-risk material and corrosion concerns; show that the technology pathway can be operated at representative conditions and scale for thousands of hours and; steady state and transient operations, startup and shutdown, can all be demonstrated in the facility. Components

need to be tested for performance over thousand+ hours. It is important that the proposal team clearly identify the scope of testing, and the boundaries of the test facility design such that the goals are satisfied.

Teaming Guidelines: Teaming is a key criteria for successful applications to this FOA. Various capabilities are suggested for team formation; the Principle Investigator will be responsible for program management and transitioning from Phase 1 through project completion. An integrator may provide the technical capability to design, build and startup the facility for the Phase 3 test campaign. A project developer may guide the team in overall system design, development and relevance to commercial plant scale. A systems analyst may evaluate the integrated performance of the solar field and power cycle to system concept over an annualized basis. Component and subsystem developers may form part of the team, or choose to apply standalone through Topic Area 2. For further details on suggested teaming characteristics, please see the FOA.

Awards Overview: To accomplish the goals of this funding opportunity, SunShot has made \$62 million dollars of funding available, and anticipates making between 8 and 12 awards for this funding opportunity. The number of awards can vary depending on the amount of money requested by the awards selected for negotiation and funds availability. The funding agreements will take the form of Cooperative Agreements. A Cooperative Agreement is a funding mechanism that means that there will be substantial involvement from DOE throughout the course of a project. More information on this can be found in Section II.B.1 of the funding opportunity. Awards for Topic Area 1 are expected to have periods of performance of up to five years, and have a minimum required cost share of 20%. Topic Area 2B awards are expected to have periods of performance of up to two years, and have a minimum required cost share of 20%. Topic Area 2B awards are expected to have periods of performance of up to two years, but may be extended if the work supports the continued progress of a successful TA1 project. As described in Section III.B of the funding opportunity, TA2B required cost share may be reduced from 20% to 10% determined according to the prime recipient entity when performing more than 50% of the project work. Required cost share is summarized as follows:

- 20% of R&D activities
- 50% of demonstration and commercial activities
- Topic Area 2B only: cost share requirement is reduced from 20% to 10% where:
 - The Prime Recipient is a domestic institution of higher education; domestic nonprofit entity; FFRDC; or U.S. State, local, or tribal government entity;
 - The Prime Recipient performs more than 50% of the project work, as measured by the Total Project Cost.

For further detail distinguishing R&D from demonstration and commercial activities please see the FOA.

Cost Share: There is often a bit of confusion when people calculate cost share. Therefore, the cost share equations have been displayed here. Take note that the cost share is a percentage of the *Total Costs* for each Task. The Total Task Cost includes the Federal and non-Federal contributions. Not proposing enough cost share, even due to a miscalculation of cost share, can render an application non-compliant. Therefore, Applicants should take care in accurately determining the cost share of their proposed budget.

Eligible Applicants: The eligible applicants to this funding opportunity are detailed in the full FOA text in Section III.A, which is summarized on this slide. This FOA is open to both for-profit and non-profit entities, including all National Laboratories and FFRDCs. Also note that Applicants may submit multiple concept papers, but each submission must be a unique and distinct project concept.

Concept Paper Overview: I will now go over the mandatory Concept Paper for applications. The purpose of the concept paper is to provide an early indication of the relevance of the proposal to the FOA. SunShot will make an assessment of each Concept Paper based on the criteria in Section V.A.1 of the funding announcement. SunShot will then either encourage or discourage Applicants to submit Full Applications

An applicant who receives a “discouraged” notification may still submit a Full Application. SunShot will review all compliant and responsive Full Applications. However, by discouraging the submission of a Full Application, SunShot intends to convey its lack of programmatic interest in the proposed project in an effort to save the Applicant the time and expense of preparing an application that is unlikely to be selected for award negotiations.

Reviewer comments from the Concept Paper will be provided to the applicant. The reviewers that are used for Concept Papers may differ from those used for the Full Application phases.

Again, as stated in the FOA, only applicants that submit a compliant concept paper are eligible to submit a Full Application. Being discouraged at the Concept Paper phase does not prohibit an Applicant from submitting a Full Application. However, an Applicant must submit a Concept Paper in order to submit a Full Application.

Concept Paper Contents: The Concept paper is broken into two sections: One section is for the Technology Description and one section for the Team Description. The Technology Description section is limited to 3 pages and the Team Description is limited to 2 pages. I’ve included the specific components that are requested in the two sections in these slides. The 3-page technology description should address the novelty of the proposed concepts and its potential impact. The team description should describe the ability of the team to support the proposed research plan.

Please review Section IV.C of the funding opportunity for more information on the required content of the Concept Paper.

Key Points: When constructing an application, please ensure that all the submitted materials adhere to the formatting criteria and page lengths stated in the FOA. Do not submit applications that are in excess of the stated page limits.

Of course, triple check your entries in Exchange and make sure that you click the submit button.

Also, when using the EERE Exchange system, please note that if you make any changes to your application after it has been submitted, the application becomes un-submitted in Exchange. If this occurs, the Applicant needs to ensure the Concept Paper is resubmitted before 5pm Eastern Time on November 3rd by clicking the submit button again.

Mandatory Concept Paper Deadline: Concept papers are due November 3rd at 5pm Eastern Time. Applicants are strongly encouraged to submit all application documents 1-2 days prior to the deadline to avoid and/or resolve any issues that may occur with EERE Exchange. If an Applicant has difficulties with EERE Exchange, the EERE Exchange support team can be contacted by email at EERE-ExchangeSupport@hq.doe.gov, as described in section VII of the FOA.

Concept Paper Review Criteria: Concept papers will be reviewed according to the specific review criteria listed in Section V.A.1 of the FOA. One criterion focuses on impact and the second focuses on scientific merit. Applicants are strongly encouraged to consider these criteria when constructing an Application, as they will be used by the reviewers when evaluating submitted Applications.

Concept Paper Review Process: After the Concept Paper review is complete, the applicants will be provided with the reviewer comments. SunShot expects to release these comments no later than December 1st, 2017. Full applications are due about two months later on January 19th, 2018. Please bear in mind that Concept Paper reviewers and Full Application reviewers may not be the same. SunShot will provide a second webinar after the Concept Paper phase, to be scheduled, in which the Full Application criteria will be discussed.

Timeline: I will now briefly go over the application timeline. Submitted concept papers will be reviewed and will either be encouraged or discouraged. Full applications will be due at 5pm eastern time on January 19th, 2018. After all submissions are received, Full Applications will be reviewed by at least 3 expert reviewers. The applicant will then have a short period of time (the funding announcement states at least 3 business days) to prepare a Reply to Reviewer Comments. The replies are then considered along with the applications when making selections.

A subset of Applicants may be selected for pre-selection clarification meetings. Selection for clarification does not mean that the Applicant has been selected for an award. Applicants may only receive a couple days' notice before such clarifications, which may take the form of written responses to questions, video or conference calls with DOE representatives and/or merit reviewers, in person-meetings, or presentations.

Gen 3 CSP Systems FOA: 9/19/17

Questions: Any questions about this FOA need to be sent to Gen3CSP@ee.doe.gov so that they can be answered in an equitable manner and posted online in the FAQ section for this funding announcement in EERE exchange. Please send all questions to this email address and EERE will attempt to answer questions within 3 business days.

The script and slides for this webinar will be posted in EERE Exchange shortly in the section for this FOA.

Thank you and have a good day.