

New Agreement EPC-17-046 (To be completed by CGL Office)

ERDD	David Chambers	43	916-327-2356
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SLAC National Accelerator Laboratory	94-1156365
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HiPAS GridLAB-D: High-performance Agent-based Simulation using GridLAB-D
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5/11/2018	3/31/2023	\$ 3,068,781
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 ARFVTP agreements under \$75K delegated to Executive Director.

Proposed Business Meeting Date	4/11/2018	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
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Business Meeting Presenter	Jamie Patterson	Time Needed:	5 minutes
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Please select one list serve. EPIC (Electric Program Investment Charge)

Agenda Item Subject and Description

DOE-SLAC NATIONAL ACCELERATOR LABORATORY. Proposed resolution approving Agreement EPC-17-046 with DOE's SLAC National Accelerator Laboratory for a \$3,068,781 grant to increase the speed of the open-source version of GridLAB-D.

1. Is Agreement considered a "Project" under CEQA?

 Yes (skip to question 2) No (complete the following (PRC 21065 and 14 CCR 15378)):

Explain why Agreement is not considered a "Project":

Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because

2. If Agreement is considered a "Project" under CEQA:

 a) Agreement **IS** exempt. (Attach draft NOE)

 Statutory Exemption. List PRC and/or CCR section number: _____

 Categorical Exemption. List CCR section number: Cal. Code Regs., tit 14, § 15306
 Common Sense Exemption. 14 CCR 15061 (b) (3)

Explain reason why Agreement is exempt under the above section:

Section 15306 Information Collection provides that projects which consist of basic data collection, research, experimental management, and resource evaluation activities, which do not result in a serious or major disturbance to an environmental resource are categorically exempt from the provisions of CEQA. This project will involve software development and testing which will not result in a serious or major disturbance to an environmental resource.

 b) Agreement **IS NOT** exempt. (Consult with the legal office to determine next steps.)

Check all that apply

 Initial Study

 Negative Declaration

 Mitigated Negative Declaration

 Environmental Impact Report

 Statement of Overriding Considerations

Exhibit A

Scope of Work

I. TASK ACRONYM/TERM LIST

A. Task List

Task #	CPR ¹	Task Name
1		General Project Tasks
2		Requirements Analysis
3	X	Software Implementation
4	X	Performance Analysis
5		Integrated Production Release
6		Evaluation of Project Benefits
7		Technology/Knowledge Transfer Activities

B. Acronym/Term List

Acronym/Term	Meaning
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
DOE	US Department of Energy
HIPAS	Project name "High-Performance Agent-based Simulation"
MTI	Multi-Thread Iterator
PNNL	Pacific Northwest National Laboratory
TAC	Technical Advisory Committee

II. PURPOSE OF AGREEMENT, PROBLEM/SOLUTION STATEMENT, AND GOALS AND OBJECTIVES

A. Purpose of Agreement

The purpose of this Agreement is to fund the development of High-Performance Agent-based Simulation (HIPAS), which will be a high-performance computing version of GridLAB-D. GridLAB-D is an open-source agent-based power system simulation tool developed by US Department of Energy's (DOE) Office of Electricity to study modern power systems with high renewables, energy storage and demand response at the distribution level.

B. Problem/ Solution Statement

Problem

GridLAB-D is an open-source agent-based power system simulation tool developed by US Department of Energy's (DOE) Office of Electricity to study modern power systems with high renewables, energy storage and demand response at the distribution level. GridLAB-D has been

¹ Please see subtask 1.3 in Part III of the Scope of Work (General Project Tasks) for a description of Critical Project Review (CPR) Meetings.

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available to the general public since 2008. GridLAB-D is highly scalable but has a number of important performance limitations for very large scale simulation studies. GridLAB-D is sometimes too slow for the kinds of planning studies larger utilities and regulatory agencies need to perform when considering distribution and tariff planning questions for renewable integration, energy storage and demand response.

Solution

This project will upgrade and augment the existing high-performance computing capabilities in GridLAB-D to meet the need identified by the user community in California. These include the ability to fully commit all the available processors to a single simulation on a desktop computer, as well as coordinate a large number of cloud computing assets to a group of simulations needed to explore a range of planning options. These upgrades will be integrated into the open-source production release of GridLAB-D and be freely available.

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Produce a widely usable and fully functional high-performance version of GridLAB-D.
- Deliver a broad range of high-performance agent-based simulation capabilities.
- Establish the foundation for long-term user and developer support of high-performance versions of GridLAB-D.

Ratepayer Benefits:² This Agreement will result in the ratepayer benefits of (1) greater electricity reliability, (2) lower electricity production costs, and (3) increased safety. Greater electricity reliability is achieved by ensuring that distributed renewable generation and energy storage is deployed properly and controlled well in distribution systems by allowing utilities to more quickly review and approve resource integration permit applications. Lower electricity production costs are achieved by facilitating the faster integration of distributed energy resources and demand response in distribution systems, thereby decreasing total system losses and enabling greater renewable resource integration. Increased safety is achieved by ensuring that renewable resource integration permitting reviews are completed more quickly and consistently for large numbers of customers seeking to use modern distributed generation resources.

² California Public Resources Code, Section 25711.5(a) requires projects funded by the Electric Program Investment Charge (EPIC) to result in ratepayer benefits. The California Public Utilities Commission, which established the EPIC in 2011, defines ratepayer benefits as greater reliability, lower costs, and increased safety (See CPUC “Phase 2” Decision 12-05-037 at page 19, May 24, 2012, http://docs.cpuc.ca.gov/PublishedDocs/WORD_PDF/FINAL_DECISION/167664.PDF).

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Technological Advancement and Breakthroughs:³ This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by enabling significantly increased use of the latest simulation and modeling tools in distribution system analysis by utilities, regulators and researchers in the study of electric systems with very high penetration of renewable energy resources, battery storage and demand response, particular within customer premises.

Agreement Objectives

The objectives of this Agreement are to:

- Identify the use cases and requirements for high-performance computing in GridLAB-D.
- Design and implement high-performance upgrades to GridLAB-D which are fully functional, made freely available and be fully supported for a period of at least two years from the end date of this Agreement.
- Evaluate the performance improvements obtained by the upgrades.
- Support a production release of the upgrades for the GridLAB-D user community.

III. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products

The goal of this subtask is to establish the requirements for submitting project products (e.g., reports, summaries, plans, and presentation materials). Unless otherwise specified by the Commission Agreement Manager (CAM), the Recipient must deliver products as required below by the dates listed in the **Project Schedule (Part V)**. Products that require a draft version are indicated by marking “**(draft and final)**” after the product name in the “Products” section of the task/subtask. If “(draft and final)” does not appear after the product name, only a final version of the product is required. With respect to due dates within this Scope of Work, “**days**” means working days.

The Recipient shall:

For products that require a draft version

- Submit all draft products to the CAM for review and comment in accordance with the Project Schedule (Part V). The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- Submit the final product to the CAM once agreement has been reached on the draft. The CAM will provide written comment of the final product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.

³ California Public Resources Code, Section 25711.5(a) also requires EPIC-funded projects to lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory and energy goals.

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- If the CAM determines that the final product does not sufficiently incorporate his/her comments, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

For products that require a final version only

- Submit the product to the CAM for review.
- If the CAM determines that the product requires revision, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

For all products

- Submit all data and documents required as products in accordance with the following Instructions for Submitting Electronic Files and Developing Software:

- **Electronic File Format**

Submit all data and documents required as products under this Agreement in an electronic file format that is fully editable and compatible with the Energy Commission's software and Microsoft (MS)-operating computing platforms, or with any other format approved by the CAM. Deliver an electronic copy of the full text of any Agreement data and documents in a format specified by the CAM, such as memory stick or CD-ROM.

The following describes the accepted formats for electronic data and documents provided to the Energy Commission as products under this Agreement, and establishes the software versions that will be required to review and approve all software products:

- Data sets will be in MS Access or MS Excel file format (version 2007 or later), or any other format approved by the CAM.
 - Text documents will be in MS Word file format, version 2007 or later.
 - Documents intended for public distribution will be in PDF file format. The Recipient must also provide the native Microsoft file format.
 - Project management documents will be in Microsoft Project file format, version 2007 or later.
 - Presentations documents will be in MS PowerPoint file format, with file save type as, PowerPoint Presentation (*.pptx).
- **Software Application Development**
Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:
 - Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
 - Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
 - Visual Studio.NET (version 2008 and up). Recommend 2010.
 - C# Programming Language with Presentation (UI), Business Object

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and Data Layers.

- SQL (Structured Query Language).
- Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
- Microsoft SQL Reporting Services. Recommend 2008 R2.
- XML (external interfaces).

Any exceptions to the Electronic File Format requirements above must be approved in writing by the CAM. The CAM will consult with the Energy Commission's Information Technology Services Branch to determine whether the exceptions are allowable.

MEETINGS

Subtask 1.2 Kick-off Meeting

The goal of this subtask is to establish the lines of communication and procedures for implementing this Agreement.

The Recipient shall:

- Attend a "Kick-off" meeting with the CAM, the Commission Agreement Officer (CAO), and any other Energy Commission staff relevant to the Agreement. The Recipient will bring its Project Manager and any other individuals designated by the CAM to this meeting. The administrative and technical aspects of the Agreement will be discussed at the meeting. Prior to the meeting, the CAM will provide an agenda to all potential meeting participants. The meeting may take place in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

The administrative portion of the meeting will include discussion of the following:

- Terms and conditions of the Agreement;
- Administrative products (subtask 1.1);
- CPR meetings (subtask 1.3);
- Match fund documentation (subtask 1.7);
- Permit documentation (subtask 1.8);
- Subcontracts (subtask 1.9);
- Technology/Knowledge Transfer Activities (Task 7); and
- Any other relevant topics.

The technical portion of the meeting will include discussion of the following:

- The CAM's expectations for accomplishing tasks described in the Scope of Work;
- An updated Project Schedule;
- Technical products (subtask 1.1);
- Progress reports and invoices (subtask 1.5);
- Final Report (subtask 1.6);
- Technical Advisory Committee meetings (subtasks 1.10 and 1.11); and
- Any other relevant topics.

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- Provide an *Updated Project Schedule*, *List of Match Funds*, and *List of Permits*, as needed to reflect any changes in the documents.

The CAM shall:

- Designate the date and location of the meeting.
- Send the Recipient a *Kick-off Meeting Agenda*.

Recipient Products:

- Updated Project Schedule (*if applicable*)
- Updated List of Match Funds (*if applicable*)
- Updated List of Permits (*if applicable*)

CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

The goal of this subtask is to determine if the project should continue to receive Energy Commission funding, and if so whether any modifications must be made to the tasks, products, schedule, or budget. CPR meetings provide the opportunity for frank discussions between the Energy Commission and the Recipient. As determined by the CAM, discussions may include project status, challenges, successes, advisory group findings and recommendations, final report preparation, and progress on technical transfer and production readiness activities (if applicable). Participants will include the CAM and the Recipient, and may include the CAO and any other individuals selected by the CAM to provide support to the Energy Commission.

CPR meetings generally take place at key, predetermined points in the Agreement, as determined by the CAM and as shown in the Task List on page 1 of this Exhibit. However, the CAM may schedule additional CPR meetings as necessary. The budget will be reallocated to cover the additional costs borne by the Recipient, but the overall Agreement amount will not increase. CPR meetings generally take place at the Energy Commission, but they may take place at another location, or may be conducted via electronic conferencing (e.g., WebEx) as determined by the CAM.

The Recipient shall:

- Prepare a *CPR Report* for each CPR meeting that: (1) discusses the progress of the Agreement toward achieving its goals and objectives; and (2) includes recommendations and conclusions regarding continued work on the project.
- Submit the CPR Report along with any other *Task Products* that correspond to the technical task for which the CPR meeting is required (i.e., if a CPR meeting is required for Task 2, submit the Task 2 products along with the CPR Report).
- Attend the CPR meeting.
- Present the CPR Report and any other required information at each CPR meeting.

The CAM shall:

- Determine the location, date, and time of each CPR meeting with the Recipient's input.

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- Send the Recipient a *CPR Agenda* and a *List of Expected CPR Participants* in advance of the CPR meeting. If applicable, the agenda will include a discussion of match funding and permits.
- Conduct and make a record of each CPR meeting. Provide the Recipient with a *Schedule for Providing a Progress Determination* on continuation of the project.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, or budget for the remainder of the Agreement. If the CAM concludes that satisfactory progress is not being made, this conclusion will be referred to the Deputy Director of the Energy Research and Development Division.
- Provide the Recipient with a *Progress Determination* on continuation of the project, in accordance with the schedule. The Progress Determination may include a requirement that the Recipient revise one or more products.

Recipient Products:

- CPR Report(s)
- Task Products (draft and/or final as specified in the task)

CAM Products:

- CPR Agenda
- List of Expected CPR Participants
- Schedule for Providing a Progress Determination
- Progress Determination

Subtask 1.4 Final Meeting

The goal of this subtask is to complete the closeout of this Agreement.

The Recipient shall:

- Meet with Energy Commission staff to present project findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement. This meeting will be attended by the Recipient and CAM, at a minimum. The meeting may occur in person or by electronic conferencing (e.g., WebEx), with approval of the CAM.

The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the CAM's discretion.

- The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
- The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
 - Disposition of any state-owned equipment.
 - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
 - The Energy Commission's request for specific "generated" data (not already provided in Agreement products).

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- Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
 - "Surviving" Agreement provisions such as repayment provisions and confidential products.
 - Final invoicing and release of retention.
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- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
 - Prepare a *Schedule for Completing Agreement Closeout Activities*.
 - Provide *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.

Products:

- Final Meeting Agreement Summary (*if applicable*)
- Schedule for Completing Agreement Closeout Activities
- All Draft and Final Written Products

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices

The goals of this subtask are to: (1) periodically verify that satisfactory and continued progress is made towards achieving the project objectives of this Agreement; and (2) ensure that invoices contain all required information and are submitted in the appropriate format.

The Recipient shall:

- Submit a monthly *Progress Report* to the CAM. Each progress report must:
 - Summarize all Agreement activities conducted by the Recipient for the preceding month, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. See the Progress Report Format Attachment for the recommended specifications.
 - Provide a synopsis of the project progress, including accomplishments, problems, milestones, products, schedule, fiscal status, and any evidence of progress such as photographs.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the "Payment of Funds" section of the terms and conditions. In addition, each invoice must document and verify:
 - Energy Commission funds received by California-based entities;
 - Energy Commission funds spent in California (*if applicable*); and
 - Match fund expenditures.

Products:

- Progress Reports
- Invoices

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Subtask 1.6 Final Report

The goal of this subtask is to prepare a comprehensive Final Report that describes the original purpose, approach, results, and conclusions of the work performed under this Agreement. The CAM will review the Final Report, which will be due at least **two months** before the Agreement end date. When creating the Final Report Outline and the Final Report, the Recipient must use a Style Manual provided by the CAM.

Subtask 1.6.1 Final Report Outline

The Recipient shall:

- Prepare a *Final Report Outline* in accordance with the *Style Manual* provided by the CAM.
- Submit a draft of the outline to the CAM for review and comment.
- Once agreement has been reached on the draft, submit the final outline to the CAM. The CAM will provide written comment of the final outline within 10 days of receipt.

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

- Style Manual

Subtask 1.6.2 Final Report

The Recipient shall:

- Prepare a *Final Report* for this Agreement in accordance with the Final Report Outline and the Style Manual provided by the CAM.
- Submit a draft of the report to the CAM for review and comment. Once agreement on the draft report has been reached, the CAM will forward the electronic version for Energy Commission internal comment. Once the CAM receives comment, he/she will provide written comment to the Recipient.
- Submit one bound copy of the Final Report to the CAM.

Products:

- Final Report (draft and final)

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

The goal of this subtask is to ensure that the Recipient obtains any match funds planned for this Agreement and applies them to the Agreement during the Agreement term.

While the costs to obtain and document match funds are not reimbursable under this Agreement, the Recipient may spend match funds for this task. The Recipient may only spend match funds during the Agreement term, either concurrently or prior to the use of Energy

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Commission funds. Match funds must be identified in writing, and the Recipient must obtain any associated commitments before incurring any costs for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a *Match Funds Status Letter* that documents the match funds committed to this Agreement. If no match funds were part of the proposal that led to the Energy Commission awarding this Agreement and none have been identified at the time this Agreement starts, then state this in the letter.

If match funds were a part of the proposal that led to the Energy Commission awarding this Agreement, then provide in the letter:

- A list of the match funds that identifies:
 - The amount of cash match funds, their source(s) (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied.
 - The amount of each in-kind contribution, a description of the contribution type (e.g., property, services), the documented market or book value, the source (including a contact name, address, and telephone number), and the task(s) to which the match funds will be applied. If the in-kind contribution is equipment or other tangible or real property, the Recipient must identify its owner and provide a contact name, address, telephone number, and the address where the property is located.
- A copy of a letter of commitment from an authorized representative of each source of match funding that the funds or contributions have been secured.
- At the Kick-off meeting, discuss match funds and the impact on the project if they are significantly reduced or not obtained as committed. If applicable, match funds will be included as a line item in the progress reports and will be a topic at CPR meetings.
- Provide a *Supplemental Match Funds Notification Letter* to the CAM of receipt of additional match funds.
- Provide a *Match Funds Reduction Notification Letter* to the CAM if existing match funds are reduced during the course of the Agreement. Reduction of match funds may trigger a CPR meeting.

Products:

- Match Funds Status Letter
- Supplemental Match Funds Notification Letter (*if applicable*)
- Match Funds Reduction Notification Letter (*if applicable*)

Subtask 1.8 Permits

The goal of this subtask is to obtain all permits required for work completed under this Agreement in advance of the date they are needed to keep the Agreement schedule on track. Permit costs and the expenses associated with obtaining permits are not reimbursable under this Agreement, with the exception of costs incurred by University of California recipients. Permits must be identified and obtained before the Recipient may incur any costs related to the use of the permit(s) for which the Recipient will request reimbursement.

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The Recipient shall:

- Prepare a *Permit Status Letter* that documents the permits required to conduct this Agreement. If no permits are required at the start of this Agreement, then state this in the letter. If permits will be required during the course of the Agreement, provide in the letter:
 - A list of the permits that identifies: (1) the type of permit; and (2) the name, address, and telephone number of the permitting jurisdictions or lead agencies.
 - The schedule the Recipient will follow in applying for and obtaining the permits.

The list of permits and the schedule for obtaining them will be discussed at the Kick-off meeting (subtask 1.2), and a timetable for submitting the updated list, schedule, and copies of the permits will be developed. The impact on the project if the permits are not obtained in a timely fashion or are denied will also be discussed. If applicable, permits will be included as a line item in progress reports and will be a topic at CPR meetings.

- If during the course of the Agreement additional permits become necessary, then provide the CAM with an *Updated List of Permits* (including the appropriate information on each permit) and an *Updated Schedule for Acquiring Permits*.
- Send the CAM a *Copy of Each Approved Permit*.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CAM within 5 days. Either of these events may trigger a CPR meeting.

Products:

- Permit Status Letter
- Updated List of Permits (*if applicable*)
- Updated Schedule for Acquiring Permits (*if applicable*)
- Copy of each Approved Permit (*if applicable*)

Subtask 1.9 Subcontracts

The goals of this subtask are to: (1) procure subcontracts required to carry out the tasks under this Agreement; and (2) ensure that the subcontracts are consistent with the terms and conditions of this Agreement.

The Recipient shall:

- Manage and coordinate subcontractor activities in accordance with the requirements of this Agreement.
- Incorporate this Agreement by reference into each subcontract.
- Include any required Energy Commission flow-down provisions in each subcontract, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subcontract terms.
- If required by the CAM, submit a draft of each *Subcontract* required to conduct the work under this Agreement.
- Submit a final copy of the executed subcontract.
- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

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Products:

- Subcontracts (*draft if required by the CAM*)

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)

The goal of this subtask is to create an advisory committee for this Agreement. The TAC should be composed of diverse professionals. The composition will vary depending on interest, availability, and need. TAC members will serve at the CAM's discretion. The purpose of the TAC is to:

- Provide guidance in project direction. The guidance may include scope and methodologies, timing, and coordination with other projects. The guidance may be based on:
 - Technical area expertise;
 - Knowledge of market applications; or
 - Linkages between the agreement work and other past, present, or future projects (both public and private sectors) that TAC members are aware of in a particular area.
- Review products and provide recommendations for needed product adjustments, refinements, or enhancements.
- Evaluate the tangible benefits of the project to the state of California, and provide recommendations as needed to enhance the benefits.
- Provide recommendations regarding information dissemination, market pathways, or commercialization strategies relevant to the project products.

The TAC may be composed of qualified professionals spanning the following types of disciplines:

- Researchers knowledgeable about the project subject matter;
- Members of trades that will apply the results of the project (e.g., designers, engineers, architects, contractors, and trade representatives);
- Public interest market transformation implementers;
- Product developers relevant to the project;
- U.S. Department of Energy research managers, or experts from other federal or state agencies relevant to the project;
- Public interest environmental groups;
- Utility representatives;
- Air district staff; and
- Members of relevant technical society committees.

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The Recipient shall:

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, phone numbers summaries of relevant experience and descriptions of potential values added to project for each potential member. The list will be discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.
- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.11.
- Prepare a *List of TAC Members* once all TAC members have committed to serving on the TAC.
- Submit *Documentation of TAC Member Commitment* (such as Letters of Acceptance) from each TAC member.

Products:

- List of Potential TAC Members
- List of TAC Members
- Documentation of TAC Member Commitment

Subtask 1.11 TAC Meetings

The goal of this subtask is for the TAC to provide strategic guidance for the project by participating in regular meetings, which may be held via teleconference.

The Recipient shall:

- Discuss the TAC meeting schedule with the CAM at the Kick-off meeting. Determine the number and location of meetings (in-person and via teleconference) in consultation with the CAM.
- Prepare a *TAC Meeting Schedule* that will be presented to the TAC members during recruiting. Revise the schedule after the first TAC meeting to incorporate meeting comments.
- Prepare a *TAC Meeting Agenda* and *TAC Meeting Back-up Materials* for each TAC meeting.
- Organize and lead TAC meetings in accordance with the TAC Meeting Schedule. Changes to the schedule must be pre-approved in writing by the CAM.
- Prepare *TAC Meeting Summaries* that include any recommended resolutions of major TAC issues.

Products:

- TAC Meeting Schedule (draft and final)
- TAC Meeting Agendas (draft and final)
- TAC Meeting Back-up Materials
- TAC Meeting Summaries

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IV. TECHNICAL TASKS

Products that require a draft version are indicated by marking “**(draft and final)**” after the product name in the “Products” section of the task/subtask. If “(draft and final)” does not appear after the product name, only a final version of the product is required. **Subtask 1.1 (Products)** describes the procedure for submitting products to the CAM.

TASK 2 Requirements Analysis

The goal of this task is to identify the requirements for the HIPAS GridLAB-D release.

The Recipient shall:

- Prepare the *HIPAS GridLAB-D Release Requirements Presentation* to include a description of the requirements needed for each of the following subtasks:
 - (1) Subtask 2.1 Use Case Requirements presentation,
 - (2) Subtask 2.2 Performance and Baseline Analysis presentation,
 - (3) Subtask 2.3 Software Upgrade Design presentation,
 - (4) Subtask 2.4 Performance Specifications presentation,
 - (5) Subtask 2.5 Testing Plan presentation, and
 - (6) Subtask 2.6 Software Design presentation.

Product:

- HIPAS GridLAB-D Release Requirements Presentation

Subtask 2.1 Use Case Requirements

The goal of this subtask is to identify the use cases for which the performance of GridLAB-D must be enhanced.

The Recipient shall:

- Solicit input and work with users, the TAC, and other stakeholders to identify the principal use-cases for which the performance of GridLAB-D will be enhanced. The software must be flexible to model real world conditions such as allowing unlocked voltage regulating devices.
- Characterize the performance metrics used to measure the performance GridLAB-D for each identified use-case.
- Develop the performance goals for each identified use-case.
- Prepare the *Use Case Requirements Presentation*. The presentation shall document: (1) the use-cases selected, (2) the performance metrics for each use-case, and (3) the performance improvement goals for each use-case.

Product:

- Use Case Requirements Presentation

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Subtask 2.2 Performance and Baseline Analysis

The goals of this subtask are (1) to develop the performance metrics for high-performance computing capabilities in GridLAB-D, (2) implement test procedures to determine GridLAB-D's high-performance computing capabilities, and (3) establish a baseline measurement of the high-performance computing capabilities of the current version of GridLAB-D.

The Recipient shall:

- Develop the methods and performance metrics to be used to measure the high-performance computing characteristics of GridLAB-D.
- Implement the methods and standard models used to measure the performance data of GridLAB-D versions.
- Run the implemented test procedures to obtain the performance data for the baseline version of GridLAB-D.
- Prepare the *Performance and Baseline Analysis Presentation*. The presentation shall document: (1) the methods used to measure the performance of both the baseline and HIPAS versions of GridLAB-D, (2) the test procedures used to obtain the performance data for GridLAB-D versions, and (3) the performance data for the baseline version of GridLAB-D.

Product:

- Performance and Baseline Analysis Presentation

Subtask 2.3 Software Upgrade Design

The goal of this subtask is to develop the software design needed to upgrade the functionality of GridLAB-D. This task will focus on both existing functionality that needs to be improved, as well as new functionality that is required.

The Recipient shall:

- Develop a software design for the upgrades to GridLAB-D core solvers and affected modules. The software must use a modern programming language that is taught in computer science curriculums at major universities within California.
- Document the software design in the online documentation for GridLAB-D.
- Respond to review comments from the GridLAB-D developer team, if any.
- Prepare the *Software Upgrade Design Presentation* which will inform the Commission Agreement Manager of the activities performed under this subtask.

Product:

- Software Upgrade Design Presentation

Exhibit A

Scope of Work

Subtask 2.4 Performance Specifications

The goal of this subtask is to develop the performance specifications for the HIPAS version of GridLAB-D.

The Recipient shall:

- Develop high-performance computing performance specifications for the HIPAS version of GridLAB-D.
- Document the performance specifications in the online documentation for GridLAB-D.
- Respond to review comments from the GridLAB-D developer team, if any.
- Prepare the *Performance Specifications Presentation* which will describe the performance specifications and review comments and responses.

Product:

- Performance Specifications Presentation

Subtask 2.5 Testing Plan

The goal of this subtask is to develop the testing plan for the HIPAS version of GridLAB-D.

The Recipient shall:

- Develop the testing plan for the HIPAS version of GridLAB-D.
- Document the testing plan in the online documentation for GridLAB-D.
- Respond to review comments from the GridLAB-D developer team, if any.
- Prepare the *Testing Plan presentation* which will describe the testing plan and review comments and responses.

Product:

- Testing Plan Presentation

Subtask 2.6 Software Design

The goal of this subtask is to produce the software design documentation for the HIPAS version of GridLAB-D, including the draft development documentation and user documentation.

The Recipient shall:

- Reconcile any discrepancies between the documents prepared under TASK 2 “Requirements Analysis”.
- Prepare the *Software Design Presentation* describing the software design.

Product:

- Software Design Presentation

Exhibit A

Scope of Work

TASK 3 Software Implementation

The goal of this task is to implement the software design requirements produced under Task 2 “Requirements Analysis”.

The Recipient shall:

- Produce the multi-threading iterations (MTI) source code.
- Produce the job control source code.
- Produce the multithreaded solvers source code.
- Produce the stochastic property source code.
- Produce the large data access source code.
- Produce the online documentation for source code.
- Produce *Email Notification of Release Candidate 1 to CAM* notifying the CAM by email of the Release of Candidate 1.
- Prepare the *Software Design Implementation CPR Report*.
- Prepare the *Software Implementation Presentation* to include a description of software development for the following subtasks pursuant to the software design from Task 2:
 - (1) Subtask 3.1 Multi-threading Iterators source code presentation,
 - (2) Subtask 3.2 Job Control source code presentation,
 - (3) Subtask 3.3 Multi-threaded Solvers source code presentation,
 - (4) Subtask 3.4 Stochastic Properties source code presentation,
 - (5) Subtask 3.5 Fast Data Access source code presentation,
 - (6) Subtask 3.6 Fast Powerflow Solver source code presentation, and
 - (7) Subtask 3.7 Online Documentation source code presentation.

Products:

- Email Notification of Release Candidate 1 to CAM
- Software Design Implementation CPR Report
- Software Implementation Presentation

Subtask 3.1 Multi-threading Iterators

The goal of this subtask is to improve and deploy the multi-threading iterators (MTI) throughout GridLAB-D, including in the runtime modules.

The Recipient shall:

- Identify all components of GridLAB-D that already use MTI.
- Verify the baseline functionality of the existing MTI components using the standard GridLAB-D validation system.
- Correct any functionality problem with the existing MTI components.
- Identify all components of GridLAB-D that need to use MTI.
- Add the MTI functionality where needed.
- Verify that the new MTI components use the standard GridLAB-D validation system.
- Give source code updates to the GridLAB-D development team to incorporate the corrected and added MTI functionality.

Exhibit A

Scope of Work

- Prepare a *Multi-threading Iterators Source Code Presentation* covering the functions of the Multi-threading Iterators.

-

Product:

- Multi-threading Iterators Source Code Presentation

Subtask 3.2 Job Control

The goal of this subtask is to make fully function the job control system for Monte-Carlo simulations.

The Recipient shall:

- Upgrade the job control components of GridLAB-D to enable parameter simulations.
- Upgrade the job control system to allow dispatching simulation using cloud computing assets.
- Verify the job control functionality using the standard GridLAB-D validation system.
- Give source code updates to the GridLAB-D development team to incorporate the upgraded job control functionality.
- Prepare a *Job Control Source Code Presentation* covering the functions of the Job Control.

Product:

- Job Control Source Code Presentation

Subtask 3.3 Multi-threaded Solvers

The goal of this subtask is to implement multi-threading in the various numerical solvers available in GridLAB-D, including those used in modules.

The Recipient shall:

- Upgrade the multi-threaded solver components of GridLAB-D.
- Upgrade the multi-threaded solvers to improve powerflow, market, and thermal model performance.
- Verify the multi-threaded solver components using the standard GridLAB-D validation system.
- Give source code updates to the GridLAB-D development team to incorporate the upgraded multi-threaded solver component functionality.
- Prepare a *Multi-threaded Solvers Source Code Presentation* covering the functions of the Multi-threaded Solvers.

Product:

- Multi-threaded Solvers Source Code Presentation

Exhibit A

Scope of Work

Subtask 3.4 Stochastic Properties

The goal of this subtask is to implement and deploy stochastic properties in GridLAB-D.

The Recipient shall:

- Add the stochastic property support of GridLAB-D to facilitate the implementation of stochastic models.
- Verify the stochastic property support functionality using the standard GridLAB-D validation system.
- Give source code updates to the GridLAB-D development team to incorporate the stochastic property support functionality.
- Prepare a Stochastic Properties Source Code Presentation covering the functions of the Stochastic Properties.

Product:

- Stochastic Properties Source Code Presentation

Subtask 3.5 Fast Data Access

The goal of this subtask is to implement large-scale parallelized data access support in modules that read and write external data source.

The Recipient shall:

- Add the data access modules in GridLAB-D to allow concurrent data access operations.
- Verify the concurrent data access functionality using the standard GridLAB-D validation system.
- Give source code updates to the GridLAB-D development team to incorporate the concurrent data access functionality.
- Prepare a Fast Data Access Source Code Presentation covering the functions of the Fast Data Access.

Product:

- Fast Data Access Source Code Presentation

Subtask 3.6 Fast Powerflow Solver

The goal of this subtask is to upgrade the powerflow solver to use machine learning techniques to avoid re-solving powerflows that have known or easily estimated solutions.

The Recipient shall:

- Implement machine learning powerflow solution method(s) in GridLAB-D's powerflow module.

Exhibit A Scope of Work

- Verify that the machine learning powerflow solution method(s) provide sufficient accuracy to be useful for the identified uses cases.
- Give source code updates to the GridLAB-D development team to incorporate machine learning powerflow functionality.
- Prepare a Fast Powerflow Solver Source Code Presentation covering the functions of the Fast Powerflow Solver.

Product:

- Fast Powerflow Solver Source Code Presentation

Subtask 3.7 Online Documentation

The goal of this subtask is to update the existing online documentation for GridLAB-D with the improvements implemented in Subtask 3.1 through 3.6.

The Recipient shall:

- Update the online documentation of GridLAB-D to document the capabilities added under Subtasks 3.1 through 3.6.
- Prepare an *Online Documentation Source Code Presentation* describing the updates to the existing online documentation for GridLAB-D.

Product:

- Online Documentation Source Code Presentation

Subtask 3.8 Release Candidate 1

The goal of this subtask is to produce the Release Candidate 1 of the HIPAS version of GridLAB-D.

The Recipient shall:

- Produce the Release Candidate 1 of the HIPAS version of GridLAB-D.
- Produce Email Notification of Release Candidate 1 to CAM to notify CAM of the Release Candidate 1.
- Prepare the *Software Design Implementation CPR Report*, in accordance with subtask 1.3 (CPR Meetings)

TASK 4 Performance Analysis

The goals of this task are to: (1) evaluate the performance of Release Candidate 1, (2) identify any performance issues in Release Candidate 1 and track their resolutions, (3) analyze the performance of Release Candidate 1, (4) produce Release Candidate 2, and (5) produce a presentation on the performance of Release Candidate 2.

Exhibit A Scope of Work

The Recipient shall:

- Perform the Release Candidate 1 performance evaluation.
- Document the Release Candidate 1 performance issues.
- Develop the Release Candidate 1 performance analysis.
- Produce the Release Candidate 2 of the HIPAS version of GridLAB-D based on the performance evaluation and performance analysis of Release Candidate 1.
- Produce *Email Notification of Release Candidate 2 to CAM* to notify CAM of the Release Candidate 2.
- Perform the Release Candidate 2 performance evaluation.

- Prepare the *Performance Evaluation Presentation* to include:
 - (1) Subtask 4.1 Release Candidate 1 performance evaluation presentation,
 - (2) Subtask 4.2 Release Candidate 1 performance issues presentation,
 - (3) Subtask 4.3 Release Candidate 1 performance analysis presentation and
 - (4) Subtask 4.4 Release Candidate 2 performance evaluation presentation.
- Attend CPR Meeting 2.
- Prepare *Performance Analysis CPR Report, in accordance with subtask 1.3 (CPR Meetings)*

Products:

- Email Notification of Release Candidate 2 to CAM
- Performance Evaluation Presentation
- Performance Analysis CPR Report

Subtask 4.1 Performance Evaluation 1

The goal of this subtask is to evaluate the performance of *Release Candidate 1*.

The Recipient shall:

- Including TAC input, run the performance analysis test from TASK 2 “Requirement Analysis” on Release Candidate 1.
- Analyze and evaluate the performance of Release Candidate 1.
- Produce the *Release Candidate 1 Performance Evaluation Presentation* describing the results of the performance analysis test and the analysis and evaluation of the performance.

Product:

- Release Candidate 1 Performance Evaluation Presentation

Subtask 4.2 Issue Tracking and Resolution

The goal of this subtask is to identify performance issues in Release Candidate 1 and track their resolutions.

Exhibit A

Scope of Work

The Recipient shall:

- Identify performance issues with Release Candidate 1.
- Resolve performance issues where possible.
- Document unresolved issues for later disposition.
- Prepare the *Release Candidate 1 Performance Issues Presentation*.

Product:

- Release Candidate 1 Performance Issues Presentation

Subtask 4.3 Analysis

The goal of this subtask is to analyze the performance of Release Candidate 1.

The Recipient shall:

- Analyze identified performance issues in Release Candidate 1.
- Determine causes and required remedies of performance issues.
- Dispatch resolutions for disposition under Subtask 4.2 “Issue Tracking and Resolution”
- Prepare the *Release Candidate 1 performance Analysis Presentation*.
- Implement remedies into and prepare a Release Candidate 2.

Product:

- Release Candidate 1 Performance Analysis Presentation

Subtask 4.4 Performance Evaluation 2

The goal of this subtask is to produce a presentation on the performance of Release Candidate 2.

The Recipient shall:

- Run the performance analysis test from TASK 2 “Requirement Analysis” on Release Candidate 2.
- Analyze and evaluate the performance of Release Candidate 2.
- Prepare the *Release Candidate 2 Performance Evaluation Presentation*.

Product:

- Release Candidate 2 Performance Evaluation Presentation

Subtask 4.5 Release Candidate 2

The goal of this subtask is to produce *Email Notification of Release Candidate 2 to CAM*.

Exhibit A Scope of Work

The Recipient shall:

- Email Notification of Release Candidate 2 to CAM notifying the CAM of the production of Release Candidate 2.

TASK 5 Integrated Production Release

The goal of this task is to integrate Release Candidate 2 with the next general release of GridLAB-D. Activities include: (1) support the production release, (2) produce the final online product documentation, and (3) produce the Final Production Release Presentation.

The Recipient shall:

- Support release production.
- Update final product documentation.
- Produce the *Final Production Release Presentation* describing the production release and updated documentation and the details regarding how the tool will be fully functional, made freely available and be fully supported for a period of at least two years from the end date of this Agreement.

Products:

- Final Production Release Presentation

Subtask 5.1 Support Release Production

The goal of this subtask is to support the production release activities.

The Recipient shall:

- Deliver all code recommendations and documentation for production of the software to be posted on GitHub or similar platform.

Subtask 5.2 Final Product Documentation

The goal of this subtask is to produce the final online development and user documentation of the HIPAS version of GridLAB-D.

The Recipient shall:

- Release the online final product (including user) documentation update for all HIPAS GridLAB-D capabilities.

Subtask 5.3 Final Release Product

The goal of this subtask is to produce the final production release presentation,

Exhibit A Scope of Work

The Recipient shall:

- Produce a release of HIPAS version of GridLAB-D.
- Produce the Final Production Release Presentation.

TASK 6 Evaluation of Project Benefits

The goal of this task is to report the benefits resulting from this project.

The Recipient shall:

- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*; (2) *Mid-term Benefits Questionnaire*; and (3) *Final Meeting Benefits Questionnaire*.
- Provide all key assumptions used to estimate projected benefits, including targeted market sector (e.g., population and geographic location), projected market penetration, baseline and projected energy use and cost, operating conditions, and emission reduction calculations. Examples of information that may be requested in the questionnaires include:
 - For Product Development Projects and Project Demonstrations:
 - Published documents, including date, title, and periodical name.
 - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
 - Greenhouse gas and criteria emissions reductions.
 - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
 - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.
 - A discussion of project product downloads from websites, and publications in technical journals.
 - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
 - Additional Information for Product Development Projects:
 - Outcome of product development efforts, such copyrights and license agreements.
 - Units sold or projected to be sold in California and outside of California.
 - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
 - Investment dollars/follow-on private funding as a result of Energy Commission funding.
 - Patent numbers and applications, along with dates and brief descriptions.
 - Additional Information for Product Demonstrations:
 - Outcome of demonstrations and status of technology.
 - Number of similar installations.
 - Jobs created/retained as a result of the Agreement.

Exhibit A Scope of Work

- For Information/Tools and Other Research Studies:
 - Outcome of project.
 - Published documents, including date, title, and periodical name.
 - A discussion of policy development. State if the project has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.
 - The number of website downloads.
 - An estimate of how the project information has affected energy use and cost, or have resulted in other non-energy benefits.
 - An estimate of energy and non-energy benefits.
 - Data on potential job creation, market potential, economic development, and increased state revenue as a result of project.
 - A discussion of project product downloads from websites, and publications in technical journals.
 - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Respond to CAM questions regarding responses to the questionnaires.

The Energy Commission may send the Recipient similar questionnaires after the Agreement term ends. Responses to these questionnaires will be voluntary.

Products:

- Kick-off Meeting Benefits Questionnaire
- Mid-term Benefits Questionnaire
- Final Meeting Benefits Questionnaire

TASK 7 Technology/Knowledge Transfer Activities

The goal of this task is to develop a plan to make the knowledge gained, experimental results, and lessons learned available to the public and key decision makers.

The Recipient shall:

- Submit a monthly Updated Progress Power Point Slide that will be used by CAM for internal Energy Commission knowledge transfer activities (template supplied by CAM).
- Prepare a CAM Site Visit Schedule for 2 site visits per year for the CAM to observe project progress and verify installations.
- Prepare an *Initial Fact Sheet* at start of the project that describes the project. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses results. Use the format provided by the CAM.
- Prepare a *Technology/Knowledge Transfer Plan* that includes:
 - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
 - A description of the intended use(s) for and users of the project results.

Exhibit A Scope of Work

- Published documents, including date, title, and periodical name.
- Copies of documents, fact sheets, journal articles, press releases, and other documents prepared for public dissemination. These documents must include the Legal Notice required in the terms and conditions. Indicate where and when the documents were disseminated.
- A discussion of policy development. State if project has been or will be cited in government policy publications, or used to inform regulatory bodies.
- The number of website downloads or public requests for project results.
- Additional areas as determined by the CAM.
- Conduct technology transfer activities in accordance with the Technology/Knowledge Transfer Plan. These activities will be reported in the Progress Reports.
- When directed by the CAM, develop *Presentation Materials* for an Energy Commission-sponsored conference/workshop on the results of the project.
- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.

Products:

- Updated Progress Power Point Slide
- CAM Site Visit Schedule
- Initial Fact Sheet (draft and final)
- Final Project Fact Sheet (draft and final)
- Presentation Materials (draft and final)
- Technology/Knowledge Transfer Plan (draft and final)
- Technology/Knowledge Transfer Report (draft and final)

V. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: DOE-SLAC NATIONAL ACCELERATOR LABORATORY

RESOLVED, that the State Energy Resources Conservation and Development Commission (Energy Commission) adopts the staff CEQA findings contained in the Agreement or Amendment Request Form (as applicable); and

RESOLVED, that the Energy Commission approves Agreement EPC-17-046 from GFO-17-305 with DOE's SLAC National Accelerator Laboratory for \$3,068,781, to increase the speed of the open-source version of GridLAB-D; and

FURTHER BE IT RESOLVED, that the Executive Director or his/her designee shall execute the same on behalf of the Energy Commission.

CERTIFICATION

The undersigned Secretariat to the Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the California Energy Commission held on April 11, 2018.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

Cody Goldthrite,
Secretariat