

GRANTS/CONTINGENT AWARD REQUEST



To: Grants and Loans Office

Date: 3/26/2013

Project Manager: Bradley Meister

Phone Number: 916-327-1722

Office: Energy Efficiency Research Office

Division: Energy Research and Development

MS- 51

Project Title: Advanced Envelope Systems for Factory Built Homes

Type of Request: (check one)

New Agreement: (include items A-F from below) Agreement Number: PIR-12-028

Program: PIER NG / Buildings End-Use Energy Efficiency

PON-12-503-07 (Building Energy Efficiency Research and Technology

Solicitation Name and/or Number: Grant Program

Legal Name of Recipient: The Levy Partnership, Inc.

Recipient's Full Mailing Address: 10630 TOWN CENTER DR STE 120

RANCHO CUCAMONGA, CA 91730-6889

Recipient's Project Officer: Emanuel Levy Phone Number: 916- 817- 3385

Agreement Start Date: 6/30/2013 Agreement End Date: 9/30/2016

Amendment: (Check all that apply) Agreement Number: _____

Term Extension – New End Date: _____

Work Statement Revision (include Item A from below)

Budget Revision (include Item B from below)

Change of Scope (include Items A – F as applicable from below)

Other: _____

ITEMS TO ATTACH WITH REQUEST:

- A. Work Statement
- B. Budget
- C. Recipient Resolution, if applicable. (Resolution may be requested in Special Conditions if not currently available.)
- D. Special Conditions, if applicable.
- E. CEQA Compliance Form
- F. Other Documents as applicable
 - Copy of Score Sheets
 - Copy of Pre-Award Correspondence
 - Copy of All Other Relevant Documents

California Environmental Quality Act (CEQA)

CEC finds, based on recipient's documentation in compliance with CEQA:

Project exempt: 14 CCR 15303 & 14 CCR 15306 NOE filed: _____

Environmental Document prepared: _____ NOD filed: _____

Other: _____

CEC has made CEQA finding described in CEC-280, attached

Funding Information:

*Source #1: NG Amount: \$ 1,304,261.00 Statute: 11- FY: 12-13 Budget List #: 501.001F

*Source #2: PIER-E Amount: \$ 129,307.00 Statute: 11- FY: 12-13 Budget List #: 501.027J

*Source #3: _____ Amount: \$ _____ Statute: _____ FY: _____ Budget List #: _____

If federally funded, specify federal agreement number: _____

* Source Examples include ERPA, PIER-E, PIER-NG, FED, GRDA, ARFVT, OTHER.

Business Meeting Approval: (refer to Business Meeting Schedule)

Proposed Business Meeting Date: 6/12/2013 Consent Discussion

Business Meeting Participant: Bradley Meister Time Needed: 5 minutes

Agenda Notice Statement: (state purpose in layperson terms)

Possible approval of a Grant / Contingent Award to...

Possible approval of this agreement with The Levy Partnership, Inc. to develop cost-effective advanced envelop systems for factory built homes in the amount of \$1,433,568.00. This agreement includes \$299,781 in match funding. (PIER electricity and natural gas funding) Contact: Bradley Meister

Project Manager _____ Date _____ Office Manager _____ Date _____ Deputy Director _____ Date _____

Exhibit A Scope of Work

TECHNICAL TASK LIST

| Task | CPR | Task Name |
|------|-----|---|
| 1 | | ADMINISTRATION |
| 2 | | SPECIFICATION AND DESIGN |
| 2.1 | | Design Specifications |
| 2.2 | | Design–Development |
| 2.3 | X | Advanced Design–Development |
| 3 | | PROTOTYPING AND TESTING |
| 3.1 | | Component Prototyping |
| 3.2 | X | Development and Testing of a Manufacturing Plan |
| 3.3 | | Code and Market Evaluation |
| 3.4 | | Laboratory Testing and Physical Evaluation |
| 3.5 | | Full-Scale Prototyping and Testing |
| 3.6 | X | Data Collection and Analysis |
| 4 | | TECHNOLOGY TRANSFER AND OUTREACH |
| 4.1 | | Technology Transfer Activities |
| 4.2 | | Production Readiness Plan and Outreach |

KEY NAME LIST

| Task | Key Personnel | Key Subcontractor(s) | Key Partner(s) |
|------|---|----------------------|----------------|
| 1 | Emanuel Levy—The Levy Partnership Gwynne Koch—The Levy Partnership | | |
| 2 | Emanuel Levy—The Levy Partnership Senior Building Scientist | | |
| 3 | Emanuel Levy—The Levy Partnership Senior Building Scientist | | |
| 4 | Emanuel Levy—The Levy Partnership Senior Building Scientist | | |

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GLOSSARY

| Term/ Acronym | Definition |
|------------------|---|
| ASTM | American Society for Testing and Materials |
| CCM | Commission Contract Manager |
| CEC | California Energy Commission |
| CMHI | California Manufactured Housing Institute |
| CPM | Commission Project Manager |
| CPR | Critical Project Review |
| HUD | Housing and Urban Development, U.S. Department of |
| kWh | Kilo-Watt hours |
| MMBtu | Million Btu |
| MWP | Management Work Plan |
| OEM | Original Equipment Manufacturers |
| PM | Project Manager |
| PIER | Public Interest Energy Research |
| SBRA | Systems Building Research Alliance |
| SIP | Structural Composite panel |
| SOW | Scope of Work |
| TLP | The Levy Partnership, Inc. |
| TSC | Technical Steering Committee |

Problem Statement

While the energy efficiency of residential construction in California continues to set the standard for the nation, factory building—specifically, manufactured housing envelope construction—has not changed appreciably in the last fifteen years. Despite its importance to homebuilding in the state and the intrinsic value of reducing energy use for manufactured homes buyers that make up a major portion of the affordable housing market, innovation in the industry lags the rest of the building industry. The reasons are legion and include:

- **Scientific and technological**—current methods of building envelope systems are antiquated and improvements in design require collaborative research. Currently, technologies are developed by product producers that pursue the proprietary advantages for individual materials. They are not equipped to take an integrated approach to redesigning entire envelope components, such as roofs and walls, the subject of this proposal. It's left to the building companies themselves to patch together materials and products, a task that they are not well-positioned to master. This stymies innovation.

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- **Institutional**—the home building industry generally, and manufactured housing specifically, has no tradition of research and product innovation, except in meeting code requirements.
- **Institutional**—the standards that guide manufactured housing are set by the U.S. Department of Housing of Urban Development (HUD), not the state. The standards, including the energy portions, were last updated in 1994.
- **Institutional**—code agencies are similarly reluctant to accept new building methods and need objective engineering analysis to support any proposed changes.
- **Market**—the market is conservative and reluctant to accept and suspicious of change. Individual companies that attempt to bring new technologies to market face significant obstacles that would be easily overcome if they worked in concert with other companies.
- **Cost and financial hurdles**—factory builders target affordable home buyers where cost is king and increasing first cost is likely to depress sales. This creates a negative feedback loop where home producers are reluctant to add costs even though the result is likely to be increased home affordability (increased energy efficiency saving more than offsetting the increase in loan costs) for fear of losing market share.

These barriers are not addressed because there is no entity that brings together these potentially common interests to work toward shared solutions. Without an external impetus and focus on concrete goals, such as dramatic improvements in energy performance, these companies have no mechanism for moving forward together.

This work is timely. The state has laid out ambitious energy goals and achieving those goals will be difficult, if not impossible, without the participation of the factory built home industry. There is also momentum behind this work. The U.S. Department of Energy through the Building America program is underwriting basic analysis work that will provide a starting point for the proposed effort.

Goals of the Agreement

The goal of this Agreement is to develop new and innovative methods for building roof and wall systems that dramatically reduce energy use in factory built homes and take steps to transition the market in California to the new methods. The goal will be accomplished through a concurrent engineering approach that involves key industry leaders and all of the factory home producers in the state. The effort will involve important product suppliers in a way that will align project success with their commercial interests.

Objectives of the Agreement

The objectives of this Agreement are to create new roof and wall system solutions that achieve the following:

- Develop for factory use roof and wall designs that use continuous exterior insulation, such as structural composite panels.
- Have an annualized energy cost (total cost of ownership) markedly lower than current construction methods (i.e. monthly energy savings exceed monthly incremental loan costs) for homebuyers.

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- Reduce annual energy use per home by, an estimated 1500 kilowatt hours (kWh) per year for cooling and fan use and 140 therms per year for heating when compared to current manufactured home construction. Energy savings will be based on both simulation and testing of full-scale prototype homes.
- The new technologies will reduce CO₂e emissions by an estimated 1.3 metric tons per year per home and reduce cooling equipment size, and associated load, by between ½ and 1 ton.
- Build a demonstration home that showcases the construction techniques developed for the new envelope technologies and the associated energy savings.
- At the conclusion of the research, it is expected that one or more factory builders will, with the technical guidance of the project team, begin tooling up to use the new designs.

TASK 1 ADMINISTRATION

Instructions for Submitting Electronic Files and Developing Software

Electronic File Format

The Recipient will deliver an electronic copy (CD ROM or memory stick or as otherwise specified by the Commission Project Manager (CPM)) of the full text of any Agreement products in a compatible version of Microsoft Word (.doc).

The following describes the accepted formats of electronic data and documents provided to the Energy Commission as products and establishes the computer platforms, operating systems, and software versions that will be required to review and approve all software deliverables.

- Data sets will be in Microsoft (MS) Access or MS Excel file format.
- PC-based text documents will be in MS Word file format.

- Documents intended for public distribution will be in PDF file format, with the native file format provided as well.
- Project management documents will be in MS Project file format.

Software Application Development

If this Scope of Work includes any software application development, including but not limited to databases, websites, models, or modeling tools, the Recipient will use the following standard Application Architecture components in compatible versions:

- 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 and Data Layers.
- SQL (Structured Query Language).
- Microsoft SQL Server 2008, Stored Procedures Recommend 2008 R2.

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- 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 Energy Commission's Information Technology Services Branch.

Task 1.1 Attend Kick-off Meeting

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

The Recipient shall:

- Attend a "Kick-Off" meeting with the Commission Project Manager (CPM), the Grants Officer, and a representative of the Accounting Office. The Recipient shall bring its Project Manager, Agreement Administrator, Accounting Officer, and others designated by the CPM to this meeting. The administrative and technical aspects of this Agreement will be discussed at the meeting. Prior to the kick-off meeting, the CPM will provide an agenda to all potential meeting participants.

The administrative portion of the meeting shall include, but not be limited to, the following:

- Discussion of the terms and conditions of the Agreement
- Discussion of Critical Project Review (Task 1.2)
- Match fund documentation (Task 1.6) *No work may be performed until this documentation is in place.*
- Permit documentation (Task 1.7)
- Discussion of subcontracts needed to carry out project (Task 1.8)

The technical portion of the meeting shall include, but not be limited to, the following:

- The CPM's expectations for accomplishing tasks described in the Scope of Work
- An updated Schedule of Products
- Discussion of Progress Reports (Task 1.4)
- Discussion of Technical Products (Product Guidelines located in Section 5 of the Terms and Conditions)
- Discussion of the Final Report (Task 1.5)

The CPM shall designate the date and location of this meeting.

- Submit an updated Schedule of Products, List of Match Funds, and List of permits to the CPM.

Recipient Products:

- Updated Schedule of Products
- Updated List of Match Funds

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- Updated List of Permits

Commission Project Manager Product:

- Kick-Off Meeting Agenda

Task 1.2 Critical Project Review (CPR) Meetings

The goal of this task is to determine if the project should continue to receive Energy Commission funding to complete this Agreement and to identify any needed modifications to the tasks, products, schedule, or budget.

CPRs provide the opportunity for frank discussions between the CPM and the Recipient. The CPM may schedule CPRs as necessary, and CPR costs will be borne by the Recipient.

Participants include the CPM and the Recipient, and may include the Commission Grants Officer, the Energy Research and Development Division technical lead, other Energy Commission staff and Management, and any other individuals selected by the CPM to provide support to the Energy Commission.

The Commission Project Manager shall:

- Determine the location, date, and time of each CPR meeting with the Recipient. These 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 Commission Project Manager.
- Send the Recipient the agenda and a list of expected participants in advance of each CPR. If applicable, the agenda shall include a discussion of both match funding and permits.
- Conduct and make a record of each CPR meeting. One of the outcomes of this meeting will be a schedule for providing the written determination described below.
- Determine whether to continue the project, and if so whether modifications are needed to the tasks, schedule, products, and/or budget for the remainder of the Agreement. If the CPM 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 written determination in accordance with the schedule. The written response may include a requirement for the Recipient to revise one or more products that were included in the CPR.

The Recipient shall:

- Prepare a CPR Report for each CPR that discusses the progress of the Agreement toward achieving its goals and objectives. This report shall include recommendations and conclusions regarding continued work on the

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project. This report shall be submitted along with any other products identified in this Scope of Work. The Recipient shall submit these documents to the CPM and any other designated reviewers at least 15 working days in advance of each CPR meeting.

- Present the required information at each CPR meeting and participate in a discussion about the Agreement.

Commission Project Manager Products:

- Agenda and a list of expected participants
- Schedule for written determination
- Written determination

Recipient Product:

- CPR Report(s)

Task 1.3 Final Meeting

The goal of this task is to close out this Agreement.

The Recipient shall:

- Meet with Energy Commission staff to present the project findings, conclusions, and recommendations. The final meeting must be completed during the closeout of this Agreement.

This meeting will be attended by, at a minimum, the Recipient, the Commission Grants Office Officer, and the CPM. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be divided into two separate meetings at the discretion of the CPM.

The technical portion of the meeting shall involve the presentation of an assessment of the degree to which project and task goals and objectives were achieved, in addition to findings, conclusions, recommended next steps (if any) for the Agreement, and recommendations for improvements. The CPM will determine the appropriate meeting participants.

The administrative portion of the meeting shall involve a discussion with the CPM and the Grants Officer about the following Agreement closeout items:

- Disposition of any equipment purchased with Energy Commission funds
- Energy Commission's request for specific "generated" data (not already provided in Agreement products)
- Need to document Recipient's disclosure of "subject inventions" developed under the Agreement
- "Surviving" Agreement provisions

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- Final invoicing and release of retention
- Prepare written documentation of any agreements made between the Recipient and Commission staff during the meeting.
- Prepare a schedule for completing the closeout activities for this Agreement.

Products:

- Written documentation of meeting agreements
- Schedule for completing closeout activities

Task 1.4 Monthly Progress Reports

The goal of this task is to periodically verify that satisfactory and continued progress is made towards achieving the research objectives of this Agreement on time and within budget.

The objectives of this task are to summarize activities performed during the reporting period, to identify activities planned for the next reporting period, to identify issues that may affect performance and expenditures, and to form the basis for determining whether invoices are consistent with work performed.

The Recipient shall:

- Prepare a Monthly Progress Report that summarizes all Agreement activities conducted by the Recipient for the reporting period, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. Each progress report is due to the CPM within 10 days of the end of the reporting period. The recommended specifications for each progress report are contained in the Terms and Conditions of this Agreement.
- In each Monthly Progress Report and invoice, document and verify:
 - Energy Commission funds received by California-Based Entities (CBEs)
 - Energy Commission funds spent in California; and Match fund expenditures
 - Provide synopsis of project progress

Product:

- Monthly Progress Reports

Task 1.5 Final Report

The goal of the Final Report is to assess the project's success in achieving its goals and objectives, advancing science and technology, and providing energy-related and other benefits to California.

The objectives of the Final Report are to clearly and completely describe the project's purpose, approach, activities performed, results, and advancements in science and

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technology; to present a public assessment of the success of the project as measured by the degree to which goals and objectives were achieved; to make insightful observations based on results obtained; to draw conclusions; and to make recommendations for further projects and improvements.

The Final Report shall be a public document. If the Recipient has obtained confidential status from the Energy Commission and will also prepare a confidential version of the Final Report, the Recipient shall perform the following activities for both the public and confidential versions of the Final Report.

The Recipient shall:

- Prepare an Outline of the Final Report.
- Prepare a Final Report following the approved outline and the latest version of the Final Report guidelines which will be provided by the CPM. The CPM shall provide written comments on the Draft Final Report within 15 working days of receipt. The Final Report must be completed at least 90 days before the end of the Agreement Term.
- Submit one bound copy of the Final Report with the final invoice.

Products:

- Draft Outline of the Final Report
- Final Outline of the Final Report
- Draft Final Report
- Final Report

Task 1.6 Identify and Obtain Match Funds

The goal of this task is to ensure that the match funds planned for this Agreement are obtained and applied to this Agreement during the term of this Agreement.

The costs to obtain and document match fund commitments are not reimbursable through this Agreement. Although the Energy Commission budget for this task will be zero dollars, the Recipient may utilize match funds for this task. Match funds shall be spent concurrently or in advance of Energy Commission funds for each task during the term of this Agreement. Match funds must be identified in writing and the associated commitments obtained before the Recipient can incur any costs for which the Recipient for which the Recipient will request reimbursement.

The Recipient shall:

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the CPM at least 2 working days prior to the kick-off meeting. 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 such in the letter. If match funds were a part of the proposal that led to the Energy Commission awarding this

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Agreement, then provide in the letter a list of the match funds that identifies the:

- Amount of each cash match fund, its source (including a contact name, address and telephone number), and the task(s) to which the match funds will be applied.
- Amount of each in-kind contribution, a description, documented market or book value, its 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 shall identify its owner and provide a contact name, address, telephone number, and the address where the property is located.
- Provide a copy of the letter of commitment from an authorized representative of each source of cash match funding or in-kind contributions that these funds or contributions have been secured. For match funds provided by a grant a copy of the executed grant shall be submitted in place of a letter of commitment.
- Discuss match funds and the implications to the Agreement if they are reduced or not obtained as committed, at the kick-off meeting. 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 letter including the appropriate information to the CPM if during the course of the Agreement additional match funds are received.
- Provide a letter to the CPM within 10 days if during the course of the Agreement existing match funds are reduced. Reduction in match funds must be approved through a formal amendment to the Agreement and may trigger an additional CPR.

Products:

- A letter regarding match funds or stating that no match funds are provided
- Copy(ies) of each match fund commitment letter(s) (if applicable)
- Letter(s) for new match funds (if applicable)
- Letter that match funds were reduced (if applicable)

Task 1.7 Identify and Obtain Required Permits

The goal of this task 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. Although the Energy Commission budget for this task will be zero dollars, the Recipient shall budget match funds for any expected expenditures associated with obtaining permits. Permits must be identified in writing and obtained before the Recipient can make any expenditure for which a permit is required.

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The Recipient shall:

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the CPM at least 2 working days prior to the kick-off meeting. If there are no permits required at the start of this Agreement, then state such in the letter. If it is known at the beginning of the Agreement that permits will be required during the course of the Agreement, provide in the letter:
 - A list of the permits that identifies the:
 - Type of permit
 - Name, address and telephone number of the permitting jurisdictions or lead agencies
 - The schedule the Recipient will follow in applying for and obtaining these permits
- Discuss the list of permits and the schedule for obtaining them at the kick-off meeting and develop a timetable for submitting the updated list, schedule, and copies of the permits. The implications to the Agreement 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 the Progress Reports and will be a topic at CPR meetings.
- If during the course of the Agreement additional permits become necessary, provide an updated list of permits (including the appropriate information on each permit) and an updated schedule to the CPM.
- As permits are obtained, send a copy of each approved permit to the CPM.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the CPM within 5 working days. Either of these events may trigger an additional CPR.

Products:

- Letter documenting the permits or stating that no permits are required
- Updated list of permits as they change during the term of the Agreement (if applicable)
- Updated schedule for acquiring permits as changes occur during the term of the Agreement (if applicable)
- A copy of each approved permit (if applicable)

Task 1.8 Obtain and Execute Subcontracts

The goal of this task is to ensure quality products and to procure subcontracts required to carry out the tasks under this Agreement consistent with the terms and conditions of this Agreement and the Recipient's own procurement policies and procedures. This task will also provide the Energy Commission an opportunity to review the subcontracts to ensure that the tasks are consistent with this Agreement, and that the budgeted expenditures are reasonable and consistent with applicable cost principles.

The Recipient shall:

- Manage and coordinate subcontractor activities.

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- Submit a draft of each subcontract required to conduct the work under this Agreement to the Commission Agreement Manager for review.
- Submit a final copy of the executed subcontract.
- If the Recipient decides to add new subcontractors, it shall notify the Commission Agreement Manager.
- Subcontract Letter-Letter describing the subcontracts needed or stating that no subcontracts are required.
-

Products:

- Subcontracts Letter
- Draft subcontracts
- Final subcontracts

Task 1.9 Establish and Convene Meetings of a Technical Steering Committee (TSC)

The goal of this task is to create a Project Technical Steering Committee (TSC) that provides timely and insightful guidance on the research products and conduct meetings of the TSC to solicit feedback on the work.

The TSC shall be composed of professionals drawn from the factory building industry that possess technical expertise and a deep knowledge of and experience with the construction of factory built homes, including engineering, building science and home production. The TSC will assist in establishing design criteria, product design constraints, cost parameters, and other factors that help frame the scope of the design work; provide guidance in research direction, including approach to the research, product needs and design constraints and coordination with other efforts; critique interim products, evaluate barriers to implementation and suggest design directions; assist in identifying plants willing to serve as demonstration/ prototyping partners; create a dialogue within their company about how the technology will be adopted; review deliverables and provide specific recommendations for needed refinements; and, provide recommendations regarding information dissemination, market pathways or commercialization strategies relevant to the research products.

The TSC will consist of eight to 10 members. The PM and one TSC member shall act as co-chairs of the TSC. The purpose of the TSC is to:

- Provide guidance in research direction. The guidance may include: the scope of research; technical directions, research methodologies; timing; and coordination with other research.
- Review deliverables. Provide specific suggestions and recommendations for needed adjustments, refinements, or enhancement of the deliverables.
- Evaluate tangible benefits to California of this research and provide recommendations, as needed, to enhance tangible benefits.
- Provide recommendations regarding information dissemination, market pathways or commercialization strategies relevant to the research products.

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The Recipient shall:

- Recruit TSC members and ensure that each individual understands the member obligations described above.
- Convene the TSC approximately every three months either by conference call or face-to-face meetings. The in person meetings will occur four times during the project at strategic points during the research including at each Stage Gate, the end of critical phases of the research (See introduction to Technical Tasks below for a discussion of the Stage Gate process).
- Prepare materials for review by the TSC members.
- Prepare TSC meeting agenda(s) with back-up materials for agenda items.
- Organize and lead TSC meetings in accordance with the schedule.
- Record TSC input and including recommending resolutions of major TSC-identified issues.
- Prepare TSC meeting summaries and include in the project Monthly and Final reports.

Products:

- List of TSC Members
- TSC Meeting Schedule
- TSC Meeting Agenda(s) with Supporting Materials
- Written TSC meeting summaries, including recommended resolution of major TSC issues

TECHNICAL TASKS

The major technical tasks are described here along with goal, research activities and products. The effort is further divided into Stages, sets of tasks that together lead to important decision points or Stage Gates. At each Stage Gate—the end of Tasks 2.3, 3.2 and 3.6—researchers along with the TSC will select specific technologies that advance to the next stage. These Stage Gates will be accompanied by a meeting of the TSC.

TASK 2 SPECIFICATIONS AND DESIGN

Task 2.1 Design Specifications

The goal of this task is to develop a set of detailed, preliminary specifications for the design of a new roof system that incorporates continuous insulation and other measures that when compared with current construction, results in significantly improved thermal and energy performance. (Note: While the project will also develop new wall system designs, wall design specifications were developed previously by the proposing team using seed funding from other sources. As a result, the budget required for this task will be for roof systems only.)

The Recipient shall:

- Develop and prepare Draft Roof Performance Specifications for design of a new and innovative roof system that among other attributes will result in significantly improved thermal and energy performance. The specifications shall be comprehensive taking into consideration all of the functions performed by the roof

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system. The specifications will provide a metric for measuring the overall value and performance of alternative solutions.

- Vet the specifications with the TSC through an iterative review and refinement process and provide a summary of TSC comments.
- Provide the interim specifications to Key Partners, particularly the product manufacturers (e.g., insulation companies, etc.) for review and comment. Feedback from these companies will be used to refine the specifications.
- Prepare and provide Final Roof Performance Specifications.

Products:

- Draft Roof Performance Specifications
- Summary of TSC review
- Final Roof Performance Specifications

Task 2.2 Design–Development

The goal of this task is to develop preliminary roof designs for factory built homes based on the specifications developed in Task 2.1. Up to six design concepts will be developed. The solutions will be compared using the design specifications as screening criteria. At the end of this preliminary design development task, the TSC will meet to agree on the solutions to be moved forward for advanced design development. (Note: while the project will also develop new wall system designs, establishing preliminary wall designs was completed previously by the proposing team using seed funding from other sources. As a result, the resources needed for this task will be for roof systems only.)

The Recipient shall:

- Develop and provide up to six alternative roof design drawings that meet the performance specifications established in Task 2.1.
- Prepare a roof design performance assessment report that includes but is not limited to the following:
 - Assessment of the relative performance of each design relative to the performance criteria and compared against the performance of the current (baseline) designs.
 - Documentation of the preliminary designs including details of connections to attached building components (e.g., wall to floor connections) and products (vents), materials, equipment/tools and methods of component fabrication, and preliminary approach to integrating other building systems (electrical and mechanical).
 - Preliminary analysis of the structural and thermal performance of the designs, contrasted with standard frame/truss construction, including a discussion of design limits and performance of the system under various loading conditions. Energy analysis will include performance in various climate zones across California, associated energy and load reduction estimates.
 - Commentary on each design describing the critical opportunities/challenges presented by the new concepts so that they can be exploited/mitigated and

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suggest design enhancements. This information will help establish the potential of each concept.

- Submit the designs, supporting material (e.g., drawings, material properties, cost, production implications, etc.) and commentary about the designs to the TSC for review.
- Convene a TSC meeting to review the short listed roof system design(s) for further development.
- Prepare a TSC design review report that discusses the results of the TSC review.

- **Products:**
- Preliminary designs of up to six roof systems
- Roof design performance assessment report
- Report on TSC design review

Task 2.3 Advanced Design–Development

The goal of this task is to continue the development of selected wall and roof designs based on the input of the TSC, refine the designs developed in earlier tasks and select two wall and two roof designs that achieve the project goals and provide the greatest market potential. This will involve a detailed specification of the designs including drawings showing all key component intersections, specification of materials and attachment methods (fastening systems), integration of other building systems and related analysis (structural, thermal, moisture, etc.). This task also includes a detailed cost analysis and identification of barriers that exist to commercial entry. This task will conclude Stage 1, design–development with a TSC decision on which concepts will pass to the next stage of development.

The Recipient shall:

- Complete design–development of the wall and roof concepts under consideration, including an assessment report of how effectively each concept fulfills the goals outlined in the technology specifications and a qualitative assessment of the commercial potential of the concepts.
- Develop and provide a Draft Design Report that includes, but is not limited to the following information:
 - the preliminary designs showing materials and basic properties, such as, vapor retarder class, R- and U-value, structural capacity (as appropriate), fastening issues, water control, air barrier qualities, etc.
 - analysis of the designs identifying strengths and weaknesses
 - conclusions
 - recommendations subject to review by the TSC
- Convene the TSC for the purpose of selecting concepts for further development, and prepare a report discussing TSC's comments, suggestions and recommendations. (Stage Gate 1)
- Participate in a CPR Meeting and prepare a CPR Report as per Task 1.2

Products:

- Assessment report

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- Draft Design Report
- Report on TSC review
- Final Design Report
- CPR Report

TASK 3 PROTOTYPING AND TESTING

Task 3.1 Component Prototyping

The goal of this task is to build samples of each of the four concepts (two wall and two roof designs), approved through Task 2.3, for the purpose of evaluating issues associated with system assembly, including issues that may arise with joining materials, detailing at building intersections (windows to walls, vents on roofs, wall to roof connections, etc.).

The Recipient shall:

- Prepare and provide the Draft Component Test Plan. The Test Plan shall include, but is not limited to:
 - a description of the components to be tested and associated materials
 - the rationale for why the tests are required
 - predicted performance based on calculations or other analyses
 - test objectives and technical approach
 - a test matrix showing the number of test conditions and replicated runs
 - a description of the facilities, equipment, instrumentation required to conduct the tests
 - a description of test procedures, including parameters to be controlled and how they will be controlled; parameters to be measured and instrumentation to measure them; calibration procedures to be used; recommended calibration interval; and maintenance of the test log
 - a description of the data analysis procedures
 - a description of quality assurance procedures
 - contingency measures to be considered if the test objectives are not met
- Prepare a report discussing the TSC's review of the Draft Component Test Plan.
- Produce a Final Component Test Plan based on input from the TSC.
- Following the Test Plan, fabricate the wall and roof designs in two production facilities.
- Prepare a design change summary to document and evaluate the fabrication process identifying the need to modify the designs and the impact of the design on how the wall and roof systems will be fabricated in the plant.
- Execute the Final Component Test Plan in partnership with up to four separate manufacturing plants.
- Develop a Component Test Report on building issues discovered through the prototyping effort and their resolution. The Component Test Report shall include, but is not limited to, the following:
 - the Final Component Test Plan
 - test results

Exhibit A

Scope of Work

- analysis
- conclusions
- recommendations
- photographs as appropriate
- Modify the analysis of the designs (thermal, structural, etc.) to reflect any changes.

Products:

- Draft Component Test Plan
- Report on TSC review
- Final Component Test Plan
- Summary of design change
- Draft Component Test Report
- Final Component Test Report

Task 3.2 Development and Testing of a Manufacturing Plan

The goal of this task is to develop a manufacturing strategy for the preliminary wall and roof design(s) that, by streamlining overall production, substantially reduces total cost. This will be achieved by examining the fundamentals of each production activity and eliminating any waste found. The task will seek to lower total cost in three ways: (1) reducing the cost of fabricating and assembling exterior walls and roof assemblies; (2) reducing the cost of other production activities related to the walls and roof (collateral impacts, such as reducing inventory and therefore storage related costs); and, (3) leveraging these improvements to increase the overall plant production rate and reduce overhead.

The Recipient shall:

- Secure up to two plant locations in California for prototyping and testing of the new wall and roof designs and prepare a report discussing the selected location(s).
- Prepare and provide a Draft Manufacturing Process Plan for wall and roof component stations, focusing on production performance and resolution of key production issues. The Manufacturing Process Plan shall include, but is not limited to:
 - a description of the process
 - predicted performance based on calculations or other analyses
 - a description of each manufacturing activity, specifying materials, tools/equipment, layout, methods and labor requirements
 - identification of the value-added production activities associated with fabricating assembling and finishing each concept
 - identification and characterization of indirect activities and impacts, such as material handling, storage and inspection
 - identification of key unresolved production issues for each concept
 - a description of quality assurance procedures
- Prepare a report discussing the TSC's review and comments of the Manufacturing Process Plan
- Produce a Final Manufacturing Process Plan
- Evaluate the Final Manufacturing Plan including the following steps:

Exhibit A

Scope of Work

- Creating mock-ups of the wall and roof work stations, focusing on key production flow issues, such as the assembly of the primary floor components, relationship of the wall and roof build stations to the main line, and intersection of the wall and roof components with the major building systems (e.g., wiring and plumbing).
- Constructing a prototype of the design to assess production issues, such as construction sequence, joinery methods, material handling, equipment requirements and skills needed, production bottlenecks, and other important performance and assembly attributes.
- Evaluating the production process, collecting data related to key metrics (cycle time, process duration, through-put, embedded labor hours, material wastage, finish quality, safety issues, etc.). Simulate overall production flow using ProModel simulation software to identify and address bottlenecks in the line by visually describing proposed production flows.
- Prepare and refine Production Plan Assessment Report that will include but is not limited to a discussion of the following:
 - strategies for integrating wall and roof production with other parts of the manufactured home building process
 - updated inventory/material needs
 - work station requirements
 - staging areas
 - work flow and other descriptive material needed to characterize the production needs associated with the wall and roof production.
 - design changes that improve product and system performance and speed production
- Revise the design drawings and specifications as required.
- Develop and provide a Draft Manufacturing Process Report for review by the TSC. The Report shall include, but is not limited to, the following:
 - the Manufacturing Process Plan
 - mock-up results
 - analysis
 - conclusions
 - recommendations
 - photographs of wall and roof mock-ups as appropriate
- Convene the TSC for the purpose of selecting concepts for further development and prepare a summary discussing recommendations. (Stage Gate 2).
- Prepare a Final Manufacturing Process Report incorporating TSC feedback.
- Participate in a CPR Meeting and prepare a CPR Report as per Task 1.2.

Products:

- Report on selection and securing of plant(s)
- Draft Manufacturing Process Plan
- Report on TSC review of the Manufacturing Process Plan
- Final Manufacturing Process Plan
- Refined Production Plan and Assessment Report
- Revised set of design drawings and specifications

Exhibit A

Scope of Work

- Draft Manufacturing Process Report
- Final Manufacturing Process Report
- TSC summary of technologies to move forward
- CPR Report

Task 3.3 Code and Market Evaluation

The goal of this task is to assess and formulate a strategy for addressing major barriers to commercial entry and routine use of the innovative wall and roof designs. These major barriers are likely to fall into two areas: approvals for using the designs under the HUD standards (manufactured homes) and California systems building standards, including Title 24 (modular homes).

The Recipient shall:

- Prepare and provide a Draft Code Compliance Report which includes but is not limited to:
 - a detailed assessment of hurdles to using the designs under the codes and standards that regulate the construction of factory built homes.
 - a discussion of the issues likely to be encountered include: fire rating, structural properties, thermal performance (heat flow and air barrier), moisture flow and potential for condensation and durability, particularly and during site erection.
- Prepare a report discussing TSC review of the Draft Code Compliance Report.
- Produce a Final Code Compliance Report.
- Through discussions with the marketing staff and survey with the factory builders in the state and selected home retailers and builders, identify the market barriers to the use of the wall and roof designs. This survey will help identify any opportunities for branding homes built with the new components in ways that will help accelerate demand in the market. (Direct marketing to consumers is the responsibility of the companies themselves and not part of the proposed effort. This subtask will help companies accurately frame their marketing approach.).
- Based on this analysis and the code compliance work, prepare a Draft Code and Market Assessment Report.
- Prepare a report discussing TSC review of the Draft Code and Market Assessment Report.
- Prepare a Final Code and Market Assessment Report. The Report shall include, but is not limited to, the following:
 - the assessment of the technology hurdles, including tests required for code compliance
 - the Code Compliance Report
 - analysis of market barriers
 - results of survey with marketing staff and factory builders regarding market barriers to the use of wall and roof designs and opportunities for branding homes
 - conclusions
 - recommendations

Exhibit A

Scope of Work

Products:

- Draft Code Compliance Report
- Final Code Compliance Report
- Draft Code and Market Assessment Report
- Report TSC review of Code Compliance and Code and Market Assessment Report
- Final Code and Market Assessment Report

Task 3.4 Laboratory Testing and Physical Evaluation

The goal of this task is to prepare and execute a test plan based on the findings of Task 3.3. The specific tests required will depend on the nature of the design and the kinds of materials specified. Therefore, the full scope of the testing will only be apparent after the design decisions are set. The scope of this task, however, includes only tests that will be required for manufactured and modular systems approvals regardless of the final designs.

The Recipient shall:

- Prepare and provide a Laboratory Test Plan(s), facilitate a TSC review of the test plans and modify the test plans, as appropriate. The Draft Laboratory Test Plan(s) will include, but is not limited to:
 - Description of the tests to be conducted in gaining approval for the component technologies under the relevant building codes (Manufactured Housing Standards and International Residential Code)
 - Identification of the location where tests are to be conducted
 - Number and type of tests
 - Resources required
 - Schedule of tests
 - Anticipated results
 - Participating organizations and their roles and contributions
- Carry out the laboratory and field tests as required. While the exact test regimen will depend on the designs to be evaluated, the following are anticipated to be required at minimum and are included in the proposed budget:
 - American Society of Testing and Materials (ASTM) E330, Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference, this test determines the transverse strength of walls. (3) 4'x8' walls are tested.
 - ASTM E72, Transverse Load Test: Conducting Strength Panels for Building Construction, E72 is used to determine the structural properties of segments of wall, floor, and roof constructions. Typically (3) 4'x8' walls are tested.
 - ASTM E72, Racking Shear Test: Conducting Strength Panels for Building Construction, E72 is used to determine the structural properties of segments of wall, floor, and roof constructions. This test method determines the shear properties of a wall section. Typically (3) 8'x8' walls are tested.
 - ASTM E72, Axial Load Test: Conducting Strength Panels for Building Construction, E72 is used to determine the structural properties of segments of wall, floor, and roof constructions. This test method determines the axial load carrying capacity of the wall. Typically (3) 4'x8' or higher walls are tested.

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- ASTM E72, Concentrated Load Test: Conducting Strength Panels for Building Construction, Determines the ability of the floor or roof to withstand a 300 lbs. concentrated load applied on a 3 inch diameter disk.
- ASTM E283, Determining Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors, Determines the amount of air that passes through a 30"x30" sample, both as air infiltration and air exfiltration.
- ASTM E2178, Air Permeance of Building Materials, Similar to the test above, methodology and test procedure differs slightly.
- ASTM D5206, Wind Load Resistance of Rigid Plastic Siding, Determines the ability of vinyl siding to stay attached to the wall under a negative wind load. (3) 4'x4' walls are tested.
- HUD 3280.401, Proof Load Tests, Determines the transverse load carrying capacity of the wall.
- Prepare and provide the Final Laboratory Test Plan(s) which shall include, but not be limited to:
 - a description of the components to be tested
 - the rationale for why the tests are required
 - predicted performance based on calculations or other analyses
 - test objectives and technical approach
 - a test matrix showing the number of test conditions and replicated runs
 - a description of the facilities, equipment, instrumentation required to conduct the tests
 - a description of test procedures, including parameters to be controlled and how they will be controlled, parameters to be measured and instrumentation to measure them, calibration procedures to be used, recommended calibration interval and maintenance of the test log
 - a description of the data analysis procedures
 - a description of quality assurance procedures
 - contingency measures to be considered if the test objectives are not met
- After tests have been completed, prepare a Laboratory Test Report. The Laboratory Test Report shall include, but is not limited to, the following:
 - the Final Laboratory Test Plan
 - test results
 - analysis
 - conclusions
 - recommendations
 - photographs as appropriate
- Conduct TSC review of Test Plan and Test Report

Products:

- Draft Laboratory Test Plan(s)
- Final Laboratory Test Plan(s)
- Laboratory Test Report
- Report on TSC review

Exhibit A

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Task 3.5 Full-Scale Prototyping and Testing

The goal of this task is to construct and test a full-scale prototype home built with the wall and roof component designs developed through this project.

The Recipient shall:

- Secure a plant location in California for prototyping and testing of an entire home using the new wall and roof designs and prepare a report discussing the selected location.
- Develop and provide a full-scale Draft Prototype Test Plan for evaluating in the field the final wall and roof technologies. The Prototype Test Plan shall include, but not be limited to:
 - a description of the prototype to be tested
 - the rationale for why the tests are required
 - predicted performance based on calculations or other analyses
 - test objectives and technical approach
 - a test matrix showing the number of test conditions and replicated runs
 - a description of the facilities, equipment, instrumentation required to conduct the tests
 - a description of test procedures, including parameters to be controlled and how they will be controlled; parameters to be measured and instrumentation to measure them; calibration procedures to be used; recommended calibration interval; and maintenance of the test log
 - a description of the data analysis procedures
 - a description of quality assurance procedures
 - contingency measures to be considered if the test objectives are not met.
- Prepare a report discussing TSC review of the Draft Prototype Test Plan
- Produce a Final Prototype Test Plan
- Carry out the Final Prototype Test Plan, including the following steps:
 - Factory build a full-scale prototype of a home constructed with the wall and roof designs. The home will be built for a customer by one of the plants participating in the project.
 - Identify a home of similar size and design (control home) built by the same plant using current wall and roof construction methods to be used for comparison.
 - Estimate the performance of both homes using EnergyPro software. Modeling will be based on assumptions of key variables, such as envelope tightness, that will be verified in later tests.
- Develop and provide a Prototype Test Report describing building issues discovered through the prototyping effort and their resolution. The Prototype Test Report shall include, but is not limited to, the following:
 - Prototype Test Plan
 - Test results-including HUD Transportation Test, (Section 3280.903 of the HUD Standards). This test is observational and performed to identify the cumulative effect of highway transportation including shock, vibration etc.
- Provide design drawings for full scale prototype
 - Document lessons learned in the construction process, results of side-by-side tests of energy performance comparing the home built with the new wall and

Exhibit A

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roof designs against a home with conventionally built walls and roof. The report will include findings on the performance testing and resulting recommended design and production changes.

- Results of the following performance tests on both the new and control home:
 - Pressurization (blower door and duct-blaster) tests. The purpose of these tests is to determine the impact that construction has on air leakage rates and identify leakage paths. The data and identification of leakage paths will help suggest needed changes in the joinery details and floor assembly methods. This information also will be used to calibrate the energy savings estimates, providing a better measure of the benefits associated with using the wall and roof designs.
 - Thermographic analysis. Thermographic imaging will be used to identify gaps in the thermal barriers and thermal bridging as verification of both the integrity of the detailing and the construction challenges associated with properly installing insulation. Of particular interest are the intersections between floor, wall and roof components, and around openings, common sites for thermal bridging. The results of this analysis may necessitate changes in the construction detailing and/or production process.
- Recommendations for full-scale prototype home with the selected wall and roof design drawings
- photographs of finished home with the new walls and roof designs as appropriate
- Prepare a summary of TSC review of the prototype Test Report for selected designs and recommendations for select technologies to move forward
- Full-scale prototype home with the selected wall and roof design drawings

Products:

- Selection of Plant(s) Location Report
- Draft Prototype Test Plan
- Final Prototype Test Plan
- Report on TSC review of Prototype Test Plan and Prototype Test Report
- Draft Prototype Test Report
- Final Prototype Test Report

Task 3.6 Data Collection and Analysis

The goals of this task are to collect operational data, analyze the data for economic and environmental impacts, and include the data and analysis in the Final Report.

The Recipient shall:

- Develop a data collection plan based on input from the CPM. The plan will include, but not be limited to, a discussion of the following:
 - energy savings and estimated cost savings
 - greenhouse gas reductions
 - other non-energy benefits
- Prepare a Data Analysis Report that will include, but not be limited to:

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- data on potential job creation, market potential, economic development, and increased state revenue as a result of expected future expansion.
- estimate of the project's energy savings and other benefits and potential statewide energy savings once market potential has been realized.
- Compare project performance and expectations provided in the Objectives of the Agreement Section to actual project performance and accomplishments.
- Convene the TSC for the purpose of selecting concepts to be moved forward for further development, and report on the results. (**Stage Gate 3**).
- Participate in a CPR Meeting and prepare a CPR Report as per Task 1.2.

Products:

- Data Collection Plan
- Draft Data Analysis Report
- Report on TSC review
- CPR Report
- Final Data Analysis Report

TASK 4 TECHNOLOGY TRANSFER AND OUTREACH

Task 4.1 Technology Transfer Activities

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

The Recipient shall:

- Prepare and provide a Draft and Final Technology Transfer Plan that explains how the knowledge gained in this project will be made available to the public. The level of detail expected is least for research-related projects and highest for demonstration projects. Key elements from this report will be included in the Final Report.
- Conduct technology transfer activities in accordance with the Technology Transfer Plan. These activities will be reported in the Monthly Progress Reports.
- Indicate the intended use(s) for and users of the project results.
- Prepare a report discussing the results of TSC review of the Technology Transfer Plan

Products:

- Draft Technology Transfer Plan
- Report on TSC review
- Final Technology Transfer Plan including Technology Transfer Activities conducted

Task 4.2 Production Readiness Plan and Outreach

The goal of the plan is to determine the steps that will lead to the manufacturing of the technologies developed in this project and to the commercialization of the project's results.

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The Recipient shall:

- Prepare and provide a Draft and Final Production Readiness Plan. The degree of detail in the plan will be proportional to the complexity of producing or commercializing the proposed product and its state of development. As appropriate, the plan will include, but not be limited to, a discussion of the following:
 - Critical production processes, equipment, facilities, personnel resources, and support systems needed to produce a commercially viable product
 - Internal manufacturing facilities, supplier technologies, capacity constraints imposed by the design under consideration, design-critical elements, and the use of hazardous or non-recyclable materials. The product manufacturing effort may include “proof of production processes”
 - A projected “should cost” for the product when in production
 - The expected investment threshold to launch the commercial product
 - An implementation plan to ramp up to full production
 - Prepare a report discussing the results of the TSC review of the Production Readiness Plan

Products:

- Draft Production Readiness and Commercialization Plan
- Report TSC review of the Production Readiness Plan
- Final Production Readiness and Commercialization Plan



Award Number: PIR-12-028

Date: 03 / 26 / 2013

Note: The Energy Commission Project Managers Manual includes detailed instructions on how to complete this section, with examples of grants that are “Projects” and are not “Projects”. When the Project Manager is completing this section, if questions arise as to the appropriate answers to the questions below, please consult with the Energy Commission attorney assigned to review grants or loans for your division.

1. Is grant/loan considered a “Project” under CEQA? Yes (skip to question #2) No (continue with question #1)

Please complete the following: [Public Resources Code (PRC) 21065 and 14 California Code of Regulations (CCR) 15378]:

Explain why the grant/loan is **not** considered a “Project”? The grant/loan will not cause a direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because grant/loan involves:

2. If grant/loan is considered a “Project” under CEQA: (choose either **IS** or **IS NOT**)

Grant/loan **IS** exempt:

Statutory Exemption: (List PRC and/or CCR section numbers) _____

Categorical Exemption: (List CCR section number) 14 CCR 15303 & 14 CCR 15306

Common Sense Exemption. (14 CCR 15061(b)(3))

Explain reason why the grant/loan is exempt under the above section:

Class 3 - New construction of limited small new facilities; installation of small, new equipment and facilities in small structures; and conversion of the use of small existing structures (e.g., construction of three or fewer single-family homes in urban areas)

Class 6 - Basic data collection, research, experimental management, and resource evaluation activities that do not result in major disturbances to an environmental resource.

Please attach draft Notice of Exemption (NOE). Consult with the Energy Commission attorney assigned to your division for instructions on how to complete the NOE.

Grant/loan **IS NOT** exempt. The Project Manager needs to consult with the Energy Commission attorney assigned to your division and the Siting Office regarding a possible initial study.