

**CONTRACT REQUESTS FORM (CRF)**

CEC-94 (Revised 5/11)

CALIFORNIA ENERGY COMMISSION



New Contract \_\_\_\_\_  Amendment to Existing Contract: 500-08-044 Amendment Number: 1

Division	Contract Manager:	MS-	Phone	CM Training Date
Energy Research and Development	Chris Scruton	51	916-327-2341	8/1/2001

Contractor's Legal Name	Federal ID Number
The Regents of the University of California, Center for the Built Environment	94-6002123

Title of Project
Advanced Building Systems Technology Development

Term	Start Date	End Date	Amount
New/Original Contract	6/30/2009	5/30/2013	\$ 2,100,000

Line up the Amendment information as best as possible within the following table.

Amendment #	End Date (mm/dd/yy)	Amount
Amendment 1	3/13/2015	\$600,000

#### Business Meeting Information

Proposed Business Meeting Date	5/9/2012	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
Business Meeting Presenter	Chris Scruton	Time Needed:	5 minutes

#### Agenda Item Subject and Description

Possible approval of Amendment 1 to Contract 500-08-044 with the University of California Berkeley Center for the Built Environment to add \$600,000.00 and extend the term of the agreement for 22 months to field demonstrate efficient personal comfort systems and to develop operational strategies for space-conditioning in near-zero energy commercial buildings. (PIER electricity and natural gas funding.) Contact: Chris Scruton. (5 minutes)

**Business Meeting approval is not required for the following types of contracts:** *Executive Director's signature is required in all cases.*

- Contracts less than \$10k (*Policy Committee's signature is also required*)
- Amendment for a no-cost time extension. Must be first extension, less than one year and original contract less than \$100k.
- Contracts less than \$25k for Expert Witness in Energy Facility licensing cases and amendments.

#### Purpose of Contract or Purpose of Amendment, if applicable

The purpose of this amendment is to help develop, demonstrate, and bring to market Personal Comfort Systems that can improve comfort and reduce energy use in buildings, and to reduce barriers to near-Zero Energy Buildings by developing control strategies and validating performance for low-energy heating and cooling systems.

#### California Environmental Quality Act (CEQA) Compliance

- Is Contract considered a "Project" under CEQA?
 

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

Explain why contract is not considered a "Project":
- If contract is considered a "Project" under CEQA:
 

a) Contract **IS** exempt. (Draft NOE required)

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

Categorical Exemption. List CCR section number: 14 CCR 15306

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

Explain reason why contract is exempt under the above section:

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

b) Contract **IS NOT** exempt. The Contract Manager needs to consult with the Energy Commission attorney assigned to their division and the Siting Office regarding a possible Initial Study.

**CONTRACT REQUESTS FORM (CRF)**



Budgets Information								
Contract Amount Funded		Breakdown by FY			Funding Sources			
Funding Source	Amount	FY	Amount	Approved?	Funding Source	FY	Budget List No.	Amount
ARFVTF	\$	11-12	\$600,000	Yes	NG Subaccount, PIERDD	10-11	501.001E	\$300,000
ECAA	\$		\$		PIER-E	11-12	501.027J	\$300,000
State- ERPA	\$		\$					\$
Federal	\$		\$					\$
PIER - E	\$300,000		\$					\$
PIER - NG	\$300,000		\$					\$
Reimbursement	\$		\$					\$
Other	\$		\$					\$
<b>TOTAL:</b>	<b>\$600,000</b>	<b>TOTAL:</b>	<b>\$600,000</b>				<b>TOTAL:</b>	<b>\$600,000</b>
Reimbursement Contract #:					Federal Agreement			

Contractor's Administrator/ Officer		Contractor's Project Manager	
Name:	Jyl Baldwin	Name:	Ed Arens
Address:	2150 Shattuck Ave. Suite 313	Address:	Center For Environmental Design Research 390 Wurster Hall #1839
City, State, Zip:	Berkeley, CA 94704	City, State, Zip:	BERKELEY, CA 94720-0001
Phone/ Fax:	510-642-8110 / 510-642-8236	Phone/ Fax:	510-642-1158 / 510-643-5571
E-Mail:	spoawards@berkeley.edu	E-Mail:	earens@berkeley.edu

**Contractor Is**

Private Company (including non-profits)

CA State Agency (including UC and CSU)

Government Entity (i.e. city, county, federal government, air/water/school district, joint power authorities, university from another state)

**Selection Process Used**

Solicitation Select Type Solicitation #: \_\_\_\_\_ # of Bids: \_\_\_\_\_ Low Bid?  No  Yes

Non Competitive Bid (Attach CEC 96)

Exempt Interagency

**Civil Service Considerations**

Not Applicable (Contract is with a CA State Entity or a membership/co-sponsorship)

Public Resources Code 25620, et seq., authorizes the Commission to contract for the subject work. (PIER)

The Services Contracted:

- are not available within civil service
- cannot be performed satisfactorily by civil service employees
- are of such a highly specialized or technical nature that the expert knowledge, expertise, and ability are not available through the civil service system.

The Services are of such an:

- urgent
- temporary, or
- occasional nature

that the delay to implement under civil service would frustrate their very purpose.

**Justification:**  
Public Resources Code 25620, et seq., authorizes the Commission to contract for the subject work. (PIER)

**CONTRACT REQUESTS FORM (CRF)**



Payment Method			
<input checked="" type="checkbox"/> A. Reimbursement in arrears based on:			
<input type="checkbox"/> Itemized Monthly	<input checked="" type="checkbox"/> Itemized Quarterly	<input type="checkbox"/> Flat Rate	<input type="checkbox"/> One-time
<input type="checkbox"/> B. Advanced Payment			
<input type="checkbox"/> C. Other, explain:			

Retention			
1. Is contract subject to retention?		<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes
If Yes, Do you plan to release retention prior to contract termination?		<input type="checkbox"/> No	<input type="checkbox"/> Yes

Justification of Rates	
The overhead rates charged in this contract are the standard negotiated rates between the Energy Commission and the University of California. All other rates are standard published rates for the UC.	

Disabled Veteran Business Enterprise Program (DVBE)	
1. <input checked="" type="checkbox"/> Not Applicable	
2. <input type="checkbox"/> Meets DVBE Requirements	DVBE Amount:\$ _____ DVBE %: _____
<input type="checkbox"/> Contractor is Certified DVBE	
<input type="checkbox"/> Contractor is Subcontracting with a DVBE: _____	
3. <input type="checkbox"/> Requesting DVBE Exemption (attach CEC 95)	

Is Contractor a certified Small Business (SB), Micro Business (MB) or DVBE?		<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes
If yes, check appropriate box:		<input type="checkbox"/> SB	<input type="checkbox"/> MB <input type="checkbox"/> DVBE

Is Contractor subcontracting any services?		<input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes
If yes, give company name and identify if they are a Small Business (SB), Micro Business (MB) and/or DVBE:			
Taylor Engineering		<input checked="" type="checkbox"/> No	<input type="checkbox"/> SB <input type="checkbox"/> MB <input type="checkbox"/> DVBE

Miscellaneous Contract Information			
1. Will there be Work Authorizations?		<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes
2. Is the Contractor providing confidential information?		<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes
3. Is the contractor going to purchase equipment?		<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes
4. Check frequency of progress reports			
<input checked="" type="checkbox"/> Monthly		<input type="checkbox"/> Quarterly	<input type="checkbox"/> _____
5. Will a final report be required?		<input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes
6. Is the contract, with amendments, longer than a year? If yes, why?		<input type="checkbox"/> No	<input checked="" type="checkbox"/> Yes
The Department of General Services has agreed to give the Commission blanket authority to execute multi-year contracts to support the Commission's RD&D Programs.			

# CONTRACT REQUESTS FORM (CRF)



The following items should be attached to this CRF			
1. Scope of Work, Attach as Exhibit A.	<input type="checkbox"/> N/A	<input checked="" type="checkbox"/> Attached	
2. Budget Detail, Attach as Exhibit B.	<input type="checkbox"/> N/A	<input checked="" type="checkbox"/> Attached	
3. CEC 96, NCB Request	<input checked="" type="checkbox"/> N/A	<input type="checkbox"/> Attached	
4. CEC 30, Survey of Prior Work	<input checked="" type="checkbox"/> N/A	<input type="checkbox"/> Attached	
5. CEC 95, DVBE Exemption Request	<input checked="" type="checkbox"/> N/A	<input type="checkbox"/> Attached	
6. Draft CEQA Notice of Exemption (NOE)	<input type="checkbox"/> N/A	<input checked="" type="checkbox"/> Attached	
7. Resumes	<input type="checkbox"/> N/A	<input checked="" type="checkbox"/> Attached	
8. CEC 105, Questionnaire for Identifying Conflicts		<input checked="" type="checkbox"/> Attached	
9. CEC 106, IT Component Reporting Form		<input checked="" type="checkbox"/> Attached	

\_\_\_\_\_  
 Contract Manager                      Date                      Office Manager                      Date                      Deputy Director                      Date

The following signatures are only required when contract approval is delegated to the Executive Office and not approved at a Business Meeting. See Business Meeting Information Section.

\_\_\_\_\_  
 Presiding Policy Committee                      Date                      Associate Policy Committee                      Date                      Executive Director                      Date

**Exhibit A  
SCOPE OF WORK**

**TECHNICAL TASK LIST**

<b>Task #</b>	<b>CPR</b>	<b>Task Name</b>
1.0	N/A	Administration
2.0		Monitoring, Commissioning, and Benchmarking Tools Development
2.1	X	Advanced Integrated Systems Design and Performance Analysis
2.2	X	Monitoring and Commissioning Wireless Hardware Devices and Procedures
2.3	X	Building Performance Feedback Systems
3.0		Advanced Integrated Systems Research and Development
3.1	X	Integrated Systems Modeling and Technology Development
3.2	X	Integrated Systems Performance and Control Analysis
3.3	X	Thermal Comfort Research
4.0	X	Technology Transfer Activities
5.0		<del>Production Readiness Plan</del> <b>Personal Comfort Systems (PCS)</b>
<b>6.0</b>		<b>Space Conditioning in Near Zero-Net-Energy (ZNE) Buildings</b>

**KEY NAME LIST**

<b>Task #</b>	<b>Key Personnel</b>	<b>Key Subcontractor(s)</b>	<b>Key Partner(s)</b>
1			
2			
3			
4			
5			

**GLOSSARY**

*Specific terms and acronyms used throughout this work statement are defined as follows:*

<b>Acronym</b>	<b>Definition</b>
ACM	Alternative Calculation Method
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
BMS	Building Management System
CBE	Center for the Built Environment, UC Berkeley
Energy Commission	California Energy Commission
CIBSE	Chartered Institute of Building Services Engineers (UK)
CPR	Critical Project Review

<b>Acronym</b>	<b>Definition</b>
DV	Displacement Ventilation
EPA	US Environmental Protection Agency
<b>FLEX</b>	<b>Facility for Low Energy eXperiments in Buildings</b>
HVAC	Heating, ventilating, and air-conditioning
IEQ	Indoor Environmental Quality
IES<VE>	Design software from Integrated Environmental Solutions, Ltd.
ISO	International Organization for Standardization
<b>LBNL</b>	<b>Lawrence Berkeley National Laboratory</b>
LEED	Leadership in Energy and Environmental Design
MM	Mixed Mode
MRT	Mean radiant temperature
NSF	National Science Foundation
NV	Natural ventilation, including mixed-mode
PAC	Project Advisory Committee
<b>PCS</b>	<b>Personal Comfort System</b>
PEC	Personal Environmental Control
PIER	Public Interest Energy Research, administered by CEC
PMV	Predicted Mean Vote
SSPC	Standing Standards Project Committee
UCB	University California, Berkeley
UCC.1	Uniform Commercial Code (Financing Statement)
UFAD	Underfloor Air Distribution
USGBC	US Green Buildings Council
<b>ZNE</b>	<b>Zero-Net-Energy</b>

### **Problem Statement**

The State of California is calling for radical improvements in building energy efficiency. The goals will not be met without an integrated approach involving new designs, new technologies, new ways of operating buildings, new tools for design, commissioning and monitoring, and new understanding of what comprises a comfortable and productive indoor environment. Many of these new developments are being worked on at the Center for the Built Environment and elsewhere, but the pace is not adequate to support the great changes rightfully being demanded of the building industry.

These new systems – natural-ventilation and mixed-mode building conditioning; underfloor air distribution; displacement ventilation; radiant heating/cooling and personal environmental conditioning – have the potential to dramatically improve traditional levels of energy efficiency, increase occupant satisfaction and thermal comfort and increase the flexibility and useful life of the conditioning systems. All of them function by producing thermally asymmetric environments, which require new operation approaches, and a reexamination of how comfort performance is quantified in standards and design tools. They also require a higher level of sensing and feedback to produce the efficiency gains they are capable of. Finally, the building professions need training

to be aware of and gain proficiency in these new developments. This Agreement is entirely focused on the above-mentioned problems.

### **Goals of the Agreement**

The goal of this Agreement is to support the building industry to overcome barriers in creating energy efficient buildings of high indoor environmental quality.

### **Objectives of the Agreement**

The objectives of this Agreement are to create a number of tools, information sources, and standards that encourage the adoption of improved techniques and technologies for the planning, design, and operation of buildings. The deliverables will support the energy-efficiency goals being prescribed for buildings by the State. The work will be performed in close collaboration with a broad consortium of building industry partners, and be appropriately interdisciplinary in scope.

## **TASK 1.0 ADMINISTRATION**

### **MEETINGS**

#### **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 Contractor shall:**

- Attend a “kick-off” meeting with the Commission Contract Manager, the Contracts Officer, and a representative of the Accounting Office. The Contractor shall bring their Project Manager, Contracts Administrator, Accounting Officer, and others designated by the Commission Contract Manager to this meeting. The administrative and technical aspects of this Agreement will be discussed at the meeting. Prior to the kick-off meeting, the Commission Contract Manager will provide an agenda to all potential meeting participants.

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

- Terms and conditions of the Agreement
- CPRs (Task 1.2)
- Match fund documentation (Task 1.7)
- Permit documentation (Task 1.8)

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

- The Commission Contract Manager’s expectations for accomplishing tasks described in the Scope of Work;
- An updated Schedule of Deliverables

- Progress Reports (Task 1.4)
- Technical Deliverables (Task 1.5)
- Final Report (Task 1.6)
- Establish the PAC (Task 1.10)
- PAC Meetings (Task 1.11)

The Commission Contract Manager shall designate the date and location of this meeting.

**Contractor Deliverables:**

- An Updated Schedule of Deliverables
- An Updated List of Match Funds
- An Updated List of Permits
- Schedule for Recruiting PAC Members

**Commission Contract Manager Deliverables:**

- Final Report Instructions

**Task 1.2 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 if it should, are there any modifications that need to be made to the tasks, deliverables, schedule or budget.

Critical Project Reviews (CPRs) provide the opportunity for frank discussions between the Energy Commission and the Contractor. CPRs generally take place at key, predetermined points in the Agreement, as determined by the Commission Contract Manager and as shown in the Technical Task List above and in the Schedule of Deliverables. However, the Commission Contract Manager may schedule additional CPRs as necessary, and, if necessary, the budget will be reallocated to cover the additional costs borne by the Contractor, but the overall contract amount will not increase.

Participants include the Commission Contract Manager and the Contractor, and may include the Commission Contracts Officer, the Public Interest Energy Research (PIER) Program Team Lead, other Energy Commission staff and Management as well as other individuals selected by the Commission Contract Manager to provide support to the Energy Commission.

**The Commission Contract Manager shall:**

- Determine the location, date and time of each CPR meeting with the Contractor. These meetings generally take place at the Energy Commission, but they may take place at another location.

- Send the Contractor the agenda and a list of expected participants in advance of each CPR. If applicable, the agenda shall include a discussion on 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 continuing, whether or not to modify the tasks, schedule, deliverables and budget for the remainder of the Agreement, including not proceeding with one or more tasks. If the Commission Contract Manager concludes that the project needs a formal amendment or that satisfactory progress is not being made and the project needs to be ended, these conclusions will be referred to the Commission's Research, Development and Demonstration Policy Committee for its concurrence.
- Provide the Contractor with a written determination in accordance with the schedule. The written response may include a requirement for the Contractor to revise one or more deliverable(s) that were included in the CPR.

**The Contractor 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 of the projects. This report shall be submitted along with any other deliverables identified in this Scope of Work. Submit these documents to the Commission Contract Manager 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.

**Contractor Deliverables:**

- CPR Report(s) – These will take the form of the “Annual Framework Documents.”
- CPR deliverables identified in the Scope of Work

**Commission Contract Manager Deliverables:**

- Agenda and a List of Expected Participants
- Schedule for Written Determination
- Written Determination

### **Task 1.3 Final Meeting**

The goal of this task is to closeout this Agreement.

#### **The Contractor shall:**

- Meet with the Energy Commission to present the 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 Contractor, the Commission Contracts Officer, and the Commission Contract Manager. The technical and administrative aspects of Agreement closeout will be discussed at the meeting, which may be two separate meetings at the discretion of the Commission Contract Manager.

The technical portion of the meeting shall present findings, conclusions, and recommended next steps (if any) for the Agreement. The Commission Contract Manager will determine the appropriate meeting participants.

The administrative portion of the meeting shall be a discussion with the Commission Contract Manager and the Contracts Officer about the following Agreement closeout items:

- What to do with any state-owned equipment (Options)
  - Need to file UCC.1 form re: Energy Commission's interest in patented technology
  - Energy Commission's request for specific "generated" data (not already provided in Agreement deliverables)
  - Need to document Contractor's disclosure of "subject inventions" developed under the Agreement
  - "Surviving" Agreement provisions, such as repayment provisions and confidential deliverables
  - Final invoicing and release of retention
- Prepare a schedule for completing the closeout activities for this Agreement.

#### **Deliverables:**

- Written documentation of meeting agreements and all pertinent information
- Schedule for completing closeout activities

### **REPORTING**

**See Exhibit D, Reports/Deliverables/Records.**

#### **Task 1.4 Quarterly 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.

##### **The Contractor shall:**

- Prepare progress reports which summarize all Agreement activities conducted by the Contractor 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 Commission Contract Manager within 10 working days after the end of the reporting period. Attachment A-2, Progress Report Format, provides the recommended specifications.

##### **Deliverables:**

- Quarterly Progress Reports

#### **Task 1.5 Test Plans, Technical Reports and Interim Deliverables**

The goal of this task is to set forth the general requirements for submitting test plans, technical reports and other interim deliverables, unless described differently in the Technical Tasks. When creating these deliverables, the Contractor shall use and follow, unless otherwise instructed in writing by the Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

<http://www.energy.ca.gov/contracts/pier/contractors/index.html>

##### **The Contractor shall:**

- Unless otherwise directed in this Scope of Work, submit a draft of each deliverable listed in the Technical Tasks to the Commission Contract Manager for review and comment in accordance with the approved Schedule of Deliverables. The Commission Contract Manager will provide written comments back to the Contractor on the draft deliverable within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 5 working days of receipt. Key elements from this deliverable shall be included in the Final Report for this project.

#### **Task 1.6 Final Report**

The goal of this task is to prepare a comprehensive written Final Report that describes the original purpose, approach, results and conclusions of the work done under this Agreement. The Commission Contract Manager will review and approve the Final Report. The Final Report must be completed on or before the termination date of the Agreement. When creating these deliverables, the Contractor shall use and follow,

unless otherwise instructed in writing by the Commission Contract Manager, the latest version of the PIER Style Manual published on the Energy Commission's web site:

<http://www.energy.ca.gov/contracts/pier/contractors/index.html>

The Final Report shall be a public document. If the Contractor has obtained confidential status from the Energy Commission and will be preparing a confidential version of the Final Report as well, the Contractor shall perform the following subtasks for both the public and confidential versions of the Final Report.

### **Task 1.6.1 Final Report Outline**

#### **The Contractor shall:**

- Prepare a draft outline of the Final Report.
- Submit the draft outline of Final Report to the Commission Contract Manager for review and approval. The Commission Contract Manager will provide written comments back to the Contractor on the draft outline within 10 working days of receipt. Once agreement has been reached on the draft, the Contractor shall submit the final outline to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final outline within 10 working days of receipt.

#### **Deliverables:**

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

### **Task 1.6.2 Final Report**

#### **The Contractor shall:**

- Prepare the draft Final Report for this Agreement in accordance with the approved outline.
- Submit the draft Final Report to the Commission Contract Manager for review and comment. The Commission Contract Manager will provide written comments within 10 working days of receipt.

Once agreement on the draft Final Report has been reached, the Commission Contract Manager shall forward the electronic version of this report for Energy Commission internal approval. Once the approval is given, the Commission Contract Manager shall provide written approval to the Contractor within 10 working days.

- Submit one bound copy of the Final Report with the final invoice.

**Deliverables:**

- Draft Final Report
- Final Report

**MATCH FUNDS, PERMITS, AND ELECTRONIC FILE FORMAT****Task 1.7 Identify and Obtain Matching Funds**

The goal of this task is to ensure that the match funds planned for this Agreement are obtained for 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. While the PIER budget for this task will be zero dollars, the Contractor may utilize match funds for this task. Match funds shall be spent concurrently or in advance of PIER funds during the term of this Agreement. Match funds must be identified in writing, and the associated commitments obtained before the Contractor can incur any costs for which the Contractor will request reimbursement.

**The Contractor shall:**

- Prepare a letter documenting the match funding committed to this Agreement and submit it to the Commission Contract Manager at least 2 working days prior to the kick-off meeting:
  1. 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.
  2. 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 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, and 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 Contractor shall identify its owner and provide a contact name, address and telephone number, and the address where the property is located.
    - 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.

- Discuss match funds and the implications to the Agreement if they are significantly 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 the appropriate information to the Commission Contract Manager if during the course of the Agreement additional match funds are received.
- Notify the Commission Contract Manager within 10 working days if during the course of the Agreement existing match funds are reduced. Reduction in match funds may trigger an additional CPR.

**Deliverables:**

- A letter regarding Match Funds or stating that no Match Funds are provided
- Letter(s) for New Match Funds
- A copy of each Match Fund commitment letter
- Letter that Match Funds were Reduced (if applicable)

**Task 1.8 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 reimbursable under this Agreement. Permits must be identified in writing before the Contractor can incur any costs related to the use of the permit(s) for which the Contractor will request reimbursement.

**The Contractor shall:**

- Prepare a letter documenting the permits required to conduct this Agreement and submit it to the Commission Contract Manager at least 2 working days prior to the kick-off meeting:
  1. If there are no permits required at the start of this Agreement, then state such in the letter.
  2. 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

- Schedule the Contractor will follow in applying for and obtaining these permits.
- The list of permits and the schedule for obtaining them will be discussed at the kick-off meeting, and a timetable for submitting the updated list, schedule and the copies of the permits will be developed. 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, then provide the appropriate information on each permit and an updated schedule to the Commission Contract Manager.
- As permits are obtained, send a copy of each approved permit to the Commission Contract Manager.
- If during the course of the Agreement permits are not obtained on time or are denied, notify the Commission Contract Manager within 5 working days. Either of these events may trigger an additional CPR.

**Deliverables:**

- A letter documenting the Permits or stating that no Permits are required
- Updated list of Permits as they change during the Term of the Agreement
- Updated schedule for acquiring Permits as it changes during the Term of the Agreement
- A copy of each approved Permit

**Task 1.9 Electronic File Format**

The goal of this task is to unify the formats of electronic data and documents provided to the Energy Commission as contract deliverables. Another goal is to establish the computer platforms, operating systems and software that will be required to review and approve all software deliverables.

**The Contractor shall:**

- Deliver documents to the Commission Contract Manager in the following formats:
  - Data sets shall be in Microsoft (MS) Access or MS Excel file format.
  - PC-based text documents shall be in MS Word file format.
  - Documents intended for public distribution shall be in PDF file format, with the native file format provided as well.
  - Project management documents shall be in MS Project file format.
- Request exemptions to the electronic file format in writing at least 90 days before the deliverable is submitted.

**Deliverables:**

- A letter requesting exemption from the Electronic File Format (if applicable)

**PAC**

**Task 1.10 Establish the PAC**

The goal of this task is to create an advisory committee for this Agreement.

The PAC should be composed of diverse professionals. The number can vary depending on potential interest and time availability. The Contractor's Project Manager and the Commission Contract Manager shall act as co-chairs of the PAC. The exact composition of the PAC may change as the need warrants. PAC members serve at the discretion of the Commission Contract Manager.

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

- Researchers knowledgeable about the project subject matter
- Members of the trades who 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 project subject matter
- U.S. Department of Energy Research Manager
- Public Interest Environmental Groups
- Utility Representatives
- Members of the relevant technical society committees

The purpose of the PAC is to:

- Provide guidance in research direction. The guidance may include scope of research; research methodologies; timing; coordination with other research. The guidance may be based on:
  - technical area expertise
  - knowledge of market applications
  - linkages between the agreement work and other past, present or future research (both public and private sectors) they are aware of in a particular area.
- 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.

**The Contractor shall:**

- Prepare a draft list of potential PAC members that includes name, company, physical and electronic address, and phone number and submit it to the Commission Contract Manager at least 2 working days prior to the kick-off meeting. This list will be discussed at the kick-off meeting and a schedule for recruiting members and holding the first PAC meeting will be developed.
- Recruit PAC members and ensure that each individual understands the member obligations described above, as well as the meeting schedule outlined in Task 1.11.
- Prepare the final list of PAC members.
- Submit letters of acceptance or other comparable documentation of commitment for each PAC member.

**Deliverables:**

- Draft List of PAC Members
- Final List of PAC Members
- Letters of acceptance, or other comparable documentation of commitment for each PAC Member

**Task 1.11 Conduct PAC Meetings**

The goal of this task is for the PAC to provide strategic guidance to this project by participating in regular meetings or teleconferences.

**The Contractor shall:**

- Discuss the PAC meeting schedule at the kick-off meeting. The number of face-to-face meetings and teleconferences and the location of PAC meetings shall be determined in consultation with the Commission Contract Manager. This draft schedule shall be presented to the PAC members during recruiting and finalized at the first PAC meeting.
- Organize and lead PAC meetings in accordance with the schedule. Changes to the schedule must be pre-approved in writing by the Commission Contract Manager.
- Prepare PAC meeting agenda(s) with back-up materials for agenda items.
- Prepare PAC meeting summaries, including recommended resolution of major PAC issues.
- Conduct PAC meetings according to the schedule.

**Deliverables:**

- Final PAC Meeting Schedule. The PAC meetings will coincide with the semi-annual CBE Industry Advisory Board Meetings, scheduled as follows:
  - 1<sup>st</sup> PAC Meeting: October 2009
  - 2<sup>nd</sup> PAC Meeting: April 2010
  - 3<sup>rd</sup> PAC Meeting: October 2010
  - 4<sup>th</sup> PAC Meeting: April 2011

- 5<sup>th</sup> PAC Meeting: October 2011
- 6<sup>th</sup> PAC Meeting April 2012
- 7<sup>th</sup> PAC Meeting October 2012
- 8<sup>th</sup> PAC Meeting April 2013
- 9<sup>th</sup> PAC Meeting October 2013
- 10<sup>th</sup> PAC Meeting April 2014
- 11<sup>th</sup> PAC Meeting October 2014
- PAC Meeting Agenda(s) with Back-up Materials for Agenda Items
- Written PAC meeting summaries, including recommended resolution of major PAC issues

## **TECHNICAL TASKS**

The Contractor shall prepare all deliverables in accordance with the requirements in Task 1.5. Deliverables not requiring a draft version are indicated by marking “(no draft)” after the deliverable name.

### **Task 2.0 Monitoring, Commissioning, and Benchmarking Tools Development**

The overall goal of this task is to develop, test, and implement new building performance measurement and feedback systems in operational buildings using advanced integrated systems design. Through a series of case studies, we will demonstrate the feasibility and importance of applying these innovative monitoring, commissioning, and benchmarking tools to reduce energy use, improve indoor environmental quality, and learn valuable lessons about the design and operation of advanced building technologies.

### **Task 2.1 Advanced Integrated Systems Design and Performance Analysis**

The goal of this task is to conduct a series of case studies using the measurement and feedback systems developed in Tasks 2.2 and 2.3. These case studies will be aimed at advanced integrated system designs that are appropriate for California’s climates, and include a range of building types.

#### **The Contractor shall:**

Select buildings for field evaluation that cover the range of key advanced integrated building technologies, including but not limited to each of the following: radiant cooling, underfloor air distribution (UFAD) and displacement ventilation (DV), naturally ventilated (NV) and mixed-mode (MM).

- Develop building performance measurement protocols appropriate for each building and system type that address energy use, occupant satisfaction, indoor environmental quality, and system control and operation.
- Write a draft Annual Case Study Framework Document #1. This document shall be submitted to the Commission Contract Manager in accordance with the procedure for Critical Project Reviews. This document shall provide updated information on the

following: description of selected case study sites, and field measurement results and analysis.

- Participate in the 1st Critical Project Review.
- Modify the draft Annual Case Study Framework Document #1 in accordance with comments received during the Critical Project Review. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 10 working days of receipt. Key elements from this document shall be included in the Final Report for this project.
- Write a draft Annual Case Study Framework Document #2. This document shall be submitted to the Commission Contract Manager in accordance with the procedure for Critical Project Reviews. This document shall provide updated information on the following: description of selected case study sites, and field measurement results and analysis.
- Participate in the 2nd Critical Project Review.
- Modify the draft Annual Case Study Framework Document #2 in accordance with comments received during the Critical Project Review. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 10 working days of receipt. Key elements from this document shall be included in the Final Report for this project.
- Conduct field studies of integrated buildings to evaluate and demonstrate their overall performance to the design professions.
- Prepare brief Case Study Reports for each studied building.

**Deliverables:**

- Final Report on Building Performance Measurement Protocols
- Final Annual Case Study Framework Documents (1)
- Final Annual Case Study Framework Documents (2)
- Final Case Study Reports
- CPR Report 1 and 2

**Task 2.2 Monitoring and Commissioning Wireless Hardware Devices and Procedures**

The goal of this task is to further develop our monitoring, diagnosing, and commissioning tools with additional analysis capability and wireless mesh networking, in order to expand the number and effectiveness of their applications. Real-time remote monitoring and feedback are essential for the efficient commissioning and operation of buildings, and demonstrating the effectiveness of these wireless tools is essential in encouraging their adoption by the industry.

**The Contractor shall:**

- Develop portable hardware and software platforms which are “practitioner ready,” and easily deployed that will form the basis of the Advanced Mobile Field-Portable Wireless Monitoring and Commissioning Toolset.

- Create “reference” design specifications to facilitate commercialization.
- Investigate the feasibility of universal mapping of sensor coordinates, animated playback of mapped sensor data, data-mining and reporting tools, and real-time comfort modeling.
- Investigate wireless device interfacing to building controls and automation systems to improve system commissioning.
- Investigate and promote control and occupant feedback opportunities.
- Write a draft Annual Wireless Hardware Device Framework Document #1. This document shall be submitted to the Commission Contract Manager in accordance with the procedure for Critical Project Reviews. This document shall contain products of research relevant to this task, including but not limited to publications, software and hardware documentation, and technology transfer activities for the design professions.
- Participate in the 1st Critical Project Review.
- Modify the draft Annual Wireless Hardware Device Framework Document #1 in accordance with comments received during the Critical Project Review. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 10 working days of receipt. Key elements from this document shall be included in the Final Report for this project.
- Write a draft Annual Wireless Hardware Device Framework Document #2 during year two of this agreement. This document shall be submitted to the Commission Contract Manager in accordance with the procedure for Critical Project Reviews. This document shall contain products of research relevant to this task, including but not limited to publications, software and hardware documentation, and technology transfer activities for the design professions.
- Participate in the 2nd Critical Project Review.
- Modify the draft Annual Wireless Hardware Device Framework Document #2 in accordance with comments received during the Critical Project Review. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 10 working days of receipt. Key elements from this document shall be included in the Final Report for this project.
- Demonstrate Prototype Mobile Field-Portable Wireless Monitoring and Commissioning Toolsets
- Prepare a Wireless Hardware Device Report summarizing the work performed in this task.

**Deliverables:**

- Demonstrate Prototype Mobile Field-Portable Wireless Monitoring and Commissioning Toolsets Report
- Reference specifications for wireless toolset devices
- Final Annual Wireless Hardware Device Framework Documents (1)
- Final Annual Wireless Hardware Device Framework Documents (2)
- CPR Report 1 and 2
- Final Wireless Hardware Device Report

**Task 2.3 Building Performance Feedback Systems**

The goal of this task is to identify the optimal methods for displaying building performance information, using building “dashboards,” touch screens, scorecards, or other devices, in order to influence commercial building occupants to reduce energy and water use, as well as assist building operators in achieving improved building performance. An additional goal is to build on previous work conducted at Center for Built Environment, Berkeley (CBE) on occupant comfort and workplace satisfaction, and develop ways to include occupant feedback in these information displays.

**The Contractor shall:**

- Review literature and other Energy Commission research products to assess the potential for occupant feedback to reduce energy use in buildings. Included will be a review and evaluation of benchmarking methods that may be appropriate for these devices.
- Conduct surveys and interviews to characterize subgroups of building occupants and investigate optimal ways to influence occupant behavior to reduce energy and water consumption.
- Review commercially available building dashboard and other products to understand capabilities and constraints of these types of hardware and software tools.
- Prepare report summarizing results of literature and product reviews, benchmarking methods, and occupant interviews.
- Write a draft Annual Dashboard Framework Document #1. This document shall be submitted to the Commission Contract Manager in accordance with the procedure for Critical Project Reviews. This document shall contain products of research relevant to this task, including but not limited to proposed information displays and mock-ups, and results of any human subject testing completed to date.
- Participate in the 1st Critical Project Review.
- Modify the draft Annual Dashboard Framework Document #1 in accordance with comments received during the Critical Project Review. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 10 working days of receipt. Key elements from this document shall be included in the Final Report for this project.
- Develop new information displays to encourage energy conservation, and test these ideas with human subjects using low-fidelity mockups and on-screen prototypes.

- Collaborate with CBE Industry Partners, other companies and institutions to identify prospective buildings and funding opportunities to implement fully functional informational displays, and to evaluate the outcomes of their use.
- Prepare final report on results of human subject mockup tests.

**Deliverables:**

- Final report summarizing results of literature and product reviews and occupant interviews
- Final Annual Dashboard Framework Document #1
- CPR Report 1
- Demonstration of low- and high-fidelity information display prototypes
- Final Human Subject Mockup Test Report

**Task 3.0 Advanced Integrated Systems Research and Development**

The overall goal of this task is to aid the development and wider adoption of advanced integrated systems, including hydronic-based radiant cooling and heating, UFAD, DV, and personal environmental control (PEC) systems. These systems are attractive candidates for energy-efficient cooling technologies, but work is needed to develop design and analysis tools that are fully capable of modeling these systems and the more complex and often non-uniform environmental conditions they produce.

**Task 3.1 Integrated Systems Modeling and Technology Development**

The goal of this task is to develop and/or improve EnergyPlus models for radiant, UFAD, DV, and PEC systems by validating the model predictions against laboratory experiments. A further goal is to develop optimized approaches to applying these technologies.

**The Contractor shall:**

- Perform laboratory testing of radiant system techniques to characterize key unresolved fundamental heat transfer and condensation mechanisms, primarily using the laboratories at Price Industries.
- Collect hydronic-based cooling component performance data suitable for validation and improvement of EnergyPlus modeling capabilities for radiant systems. Among the candidates to be evaluated for study are radiant slabs, radiant ceiling panels, chilled beams (passive and active), and chilled sails.
- Validate displacement ventilation modeling in EnergyPlus by testing at Price and/or Walnut laboratories.
- Make improvements to EnergyPlus Algorithms for UFAD systems which better reflect actual performance of systems based on measurements made at Walnut Laboratory and other data sources as available.
- Develop and conduct laboratory tests of advanced PEC system designs to optimize their efficiency and practical applicability.
- Develop an EnergyPlus PEC model to enable integration of PEC with building systems. Write a draft Annual PEC Framework Document #1. This document shall

be submitted to the Commission Contract Manager in accordance with the procedure for Critical Project Reviews. This document shall contain products of research relevant to PEC, including performance data and prototype PEC designs.

- Participate in the 1st Critical Project Review.
- Modify the draft Annual PEC Framework Document #1 in accordance with comments received during the Critical Project Review. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 10 working days of receipt. Key elements from this document shall be included in the Final Report for this project.
- Write a draft Annual PEC Framework Document #2 during year two of this agreement. This document shall be submitted to the Commission Contract Manager in accordance with the procedure for Critical Project Reviews. This document shall contain products of research relevant to PEC, including performance data and prototype PEC designs.
- Participate in the 2nd Critical Project Review.
- Modify the draft Annual PEC Framework Document #2 in accordance with comments received during the Critical Project Review. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 10 working days of receipt. Key elements from this document shall be included in the Final Report for this project.
- Prepare an Advanced Systems Modeling Report, including descriptions of the improved and updated algorithms for radiant, UFAD, DV, and PEC systems.
- Annually assemble products of CBE research relevant to PEC, including publications, software documentation and prototype PEC designs.

#### **Deliverables:**

- Improved UFAD and DV EnergyPlus Algorithms
- Radiant System EnergyPlus Algorithms
- PEC algorithms for EnergyPlus.
- Final Annual PEC Framework Documents (1)
- Final Annual PEC Framework Documents (2)
- CPR Report 1 and 2
- Final Advanced Systems Modeling Report

### **Task 3.2 Integrated Systems Performance and Control Analysis**

The goal of this task is to use simulation studies to investigate the energy and comfort performance of integrated architectural and engineering systems. Advanced integrated systems using radiant cooling and heating, UFAD, DV, NV, and MM, all appropriate to California's climates, will be emphasized. This task will include evaluation and development of controls sequences for advanced building systems. This will address the current tendency to use existing (canned) control sequences, which may subvert the efficient operation of these advanced systems.

**The Contractor shall:**

- Develop a selected set of EnergyPlus prototype commercial building models that integrate available simulation modules for technologies such as radiant cooling and heating, UFAD, DV, NV, and MM.
- Conduct EnergyPlus sensitivity studies with the set of prototype buildings (2 or more) to investigate energy and comfort (using the integrated UCB Thermal Comfort Model) impacts of these integrated building systems.
- Conduct simulations to study optimal performance of the advanced technologies under investigation.
- Prepare report on energy and comfort performance of advanced integrated systems.
- Write a draft Annual Advanced Systems Control Framework Document #1. This document shall be submitted to the Commission Contract Manager in accordance with the procedure for Critical Project Reviews. This document shall contain products of research relevant to this task, including sequences of operation appropriate for the building systems under active investigation.
- Participate in the 1st Critical Project Review.
- Modify the draft Annual Advanced Systems Control Framework Document #1 in accordance with comments received during the Critical Project Review. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 10 working days of receipt. Key elements from this document shall be included in the Final Report for this project.
- Write a draft Annual Advanced Systems Control Framework Document #2 during year two of this agreement. This document shall be submitted to the Commission Contract Manager in accordance with the procedure for Critical Project Reviews. This document shall contain products of research relevant to this task, including sequences of operation appropriate for the building systems under active investigation.
- Participate in the 2nd Critical Project Review.
- Modify the draft Annual Advanced Systems Control Framework Document #2 in accordance with comments received during the Critical Project Review. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 10 working days of receipt. Key elements from this document shall be included in the Final Report for this project.
- Prepare a Technology Optimization Study Report
- Evaluate and document sequences of operation appropriate for the building systems under active investigation at CBE: UFAD, DV, NV, and Radiant Cooling.
- Prepare a publication-grade Advanced Systems Control Report covering, recommended control sequences of control for advanced systems.

**Deliverables:**

- EnergyPlus prototype commercial building models
- Final report on energy and comfort performance of advanced integrated systems

- Final Annual Advanced Systems Control Framework Documents (1)
- Final Annual Advanced Systems Control Framework Documents (2)
- Final Technology Optimization Study Report
- Final Advanced Systems Control Report
- CPR Report 1 and 2

### **Task 3.3 University California, Berkeley (UCB) Thermal Comfort Research**

The goal of this task is to integrate UCB Thermal Comfort, a thermal physiology and comfort model, into newly available building energy models capable of simulating detailed interior environmental conditions, and to develop applications of the joint tool that improve designers' ability to design advanced non-uniform environments.

#### **The Contractor shall:**

- Program UCB Thermal Comfort Model to allow it to readily exchange inputs/outputs with building design models, independent of its existing interface. The target models are EnergyPlus, Integrated Environmental Solutions Virtual Environments and a CFD model.
- Improve the ability of the Berkeley Thermal Comfort Model to import body-part-specific clothing values
- Quantify the habitability (comfort, acceptability) of perimeter space affected by window glazing, shades, blinds, and NV airflow, and use this to convert acceptability metrics into rentable-floor-area-performance metrics appropriate for practical perimeter space valuation.
- Work with CBE partners and Fisher Center for Real Estate Economics at UCB Haas Business School, to enlist case studies and prepare documented case studies of buildings, to be published in architectural, real-estate, and facilities management magazines. Write a draft Annual UCB Thermal Comfort Modeling Framework Document #1. This document shall be submitted to the Commission Contract Manager in accordance with the procedure for Critical Project Reviews. This document shall contain products of research relevant to this task, including publications, software documentation, technology transfer activities such as conference presentations, workshops and model training, and contributions to codes and standards.
- Participate in the 1st Critical Project Review.
- Modify the draft Annual UCB Thermal Comfort Modeling Framework Document #1 in accordance with comments received during the Critical Project Review. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 10 working days of receipt. Key elements from this document shall be included in the Final Report for this project.
- Write a draft Annual UCB Thermal Comfort Modeling Framework Document #2 during year two if this agreement. This document shall be submitted to the Commission Contract Manager in accordance with the procedure for Critical Project Reviews. This document shall contain products of research relevant to this task,

including publications, software documentation, technology transfer activities such as conference presentations, workshops and model training, and contributions to codes and standards.

- Participate in the 2nd Critical Project Review.
- Modify the draft Annual UCB Thermal Comfort Modeling Framework Document #2 in accordance with comments received during the Critical Project Review. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 10 working days of receipt. Key elements from this document shall be included in the Final Report for this project.
- Prepare a UCB Thermal Comfort Modeling Report summarizing the work performed in this task.

**Deliverables:**

- Final Annual UCB Thermal Comfort Modeling Framework Documents (1)
- Final Annual UCB Thermal Comfort Modeling Framework Documents (2)
- CPR Report 1 and 2
- Final Thermal Comfort Modeling Report (1)
- Final UCB Thermal Comfort Modeling Report (2)
- Updated UCB Thermal Comfort Modeling
- Updated UCB Thermal Comfort Model user tutorial

**Task 4.0 Technology Transfer Activities**

The goal of this task is to make the knowledge gained, experimental results and lessons learned available to key decision-makers. This will include encouraging that revisions to American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE) standards be done in an energy-conscious manner, reflecting the full range of design and technology choices available today. In addition, modeling improvements to EnergyPlus, EnergyPro, and eQUEST in support of Title 24 will be continued. Work will also be performed to assist ASHRAE in developing Handbook chapters, the revised UFAD Design Guide, and Special Publications that adequately reflect new technologies and advanced design concepts. Finally this task will also include workshops for practitioners addressing the building technologies being developed at CBE.

**The Contractor shall:**

- Attend ASHRAE and other relevant conferences (e.g., GreenBuild) to present findings from this research and participate on technical committees.
- Continue development of advanced systems modeling support for Title 24 Alternative Calculation Method (ACM) procedures. Submit these Advanced Systems Models.
- Attend ASHRAE Standing Standards Project Committee (SSPC) committee meetings and work on managing the proposed standards revisions through the ASHRAE public review process.

- Develop an approach to predicting an accurate equivalent Predicted Mean Vote (PMV) at any combination of airspeed/temperature/humidity/mean radiant temperature (MRT), for ASHRAE Standard 55.
- Conduct a detailed analysis of the energy costs of ASHRAE Std 55 adopting the International Organization for Standardization (ISO) 3-class structure in California and other characteristic U.S. climates.
- Conduct further research with our field study and survey databases, to quantify the actual comfort/discomfort associated with the different class environments.
- Work with Standard 55 committee to make sure the class structure is fully evaluated and discussed before being adopted by ASHRAE.
- Provide technical advice for the development of a test method for ASHRAE Std. 113 (Room air distribution) for characterizing the room air distribution performance of stratified systems.
- Write a draft Annual Standards Support Framework Document #1. This document shall be submitted to the Commission Contract Manager in accordance with the procedure for Critical Project Reviews. This document shall contain products of the standard support effort: professional publications and the actual contributions to codes and standards.
- Participate in the 1st Critical Project Review.
- Modify the draft Annual Standards Support Framework Document #1 in accordance with comments received during the Critical Project Review. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 10 working days of receipt. Key elements from this document shall be included in the Final Report for this project.
- Write a draft Annual Standards Support Framework Document #2 during year two of this agreement. This document shall be submitted to the Commission Contract Manager in accordance with the procedure for Critical Project Reviews. This document shall contain products of the standard support effort: professional publications and the actual contributions to codes and standards.
- Participate in the 2nd Critical Project Review.
- Modify the draft Annual Standards Support Framework Document #2 in accordance with comments received during the Critical Project Review. Once agreement has been reached on the draft, the Contractor shall submit the final deliverable to the Commission Contract Manager. The Commission Contract Manager shall provide written approval of the final deliverable within 10 working days of receipt. Key elements from this document shall be included in the Final Report for this project.
- Prepare a Standards Support Report summarizing the work performed in this task.
- Contribute to ASHRAE Handbook chapters on mixed mode, UFAD, thermal comfort.
- Work with ASHRAE Technical Resource Group TRG7-UFAD on revising the 2003 UFAD Design Guide, originally authored by Bauman, incorporating subsequent PIER-sponsored research results obtained by CBE.
- Work with ASHRAE TRG7-UFAD to prepare a final draft of the revised UFAD Design Guide.
- Conduct no less than two training workshops on the above-mentioned topics.

- Develop and distribute training materials via the CBE website.
- Submit any Workshop Materials generated in this Task, including summaries, presentations, training materials and software tutorials.

**Deliverables:**

- T-24 Advanced Systems Models
- Final Annual Standards Support Framework Documents (1)
- Final Annual Standards Support Framework Documents (2)
- Final Standards Support Report
- Revised ASHRAE Handbook Chapters (based on ASHRAE schedule)
- Final Draft of Revised UFAD Design Guide
- Workshop Materials
- CPR Report 1 and 2

**Task 5.0 Personal Comfort Systems (PCSs)**

**The goals of this task are to utilize 80 existing PCSs in different types of buildings, both conventional and energy-efficient, to demonstrate their energy and comfort impacts; to demonstrate how existing building controls can be interoperated with PCSs to enhance whole-building energy savings; and to influence the manufacturing of future PCSs through presentations to the building industry and specifications for clients and standards organizations.**

**The Contractor shall:**

- **Select at least 3 buildings (including air-conditioned, naturally ventilated or mixed-mode, and radiant-cooled systems) in which to install PCSs for this study and do the following in each building:**
  - **Install PCSs as feasible.**
  - **Monitor the buildings' physical environment, analyze energy savings, and conduct occupancy satisfaction surveys.**
  - **Determine the extent of acceptable interior set-point ranges associated with PCS operation in these buildings.**
  - **Document control strategies for integrating PCSs with building HVAC systems.**
  - **Prepare a Case Study Report that includes but is not limited to: a description of the building, an explanation of how PCS were deployed and integrated, results of occupant surveys, and a description of energy savings achieved.**
- **Make improvements to the PCS design and prepare specifications based on occupant feedback.**
- **Provide estimated cost for the market-ready version of the PCS and determine overall cost-effectiveness.**
- **Promote more PCS products in the marketplace by visiting manufacturers of PCS furniture and office interiors and presenting the PCS performance**

results, and solutions to identified barriers to implementation. Submit presentation materials to the Commission Contract Manager.

- Incorporate PCS user behavior findings in ASHRAE Standard 55. In particular, establish whether the Std. 55 Adaptive Model applies to buildings containing PCS systems.
- Prepare a final PCS Project Report including but not limited to occupant survey results, energy savings, cost analysis, design improvements, standards-related efforts, market outreach, and barriers.

Deliverables:

- Case Study Report
- Presentation materials for manufacturers of PCS furniture and office interiors
- PCS user behavior findings included in ASHRAE Standard 55
- PCS Project Report

Task 6.0 Space Conditioning in Near Zero-Net-Energy (ZNE) Buildings

The goal of this task is to provide to the professional design community new and improved information, guidance, and tools for designing and operating near ZNE buildings using radiant heating and cooling systems. This will be accomplished by conducting two thorough case studies of existing near ZNE buildings using radiant systems. The two buildings to be studied will be selected from a list of candidate buildings provided by CBE industry partners and other sources. In addition to performance data and occupant satisfaction survey results from the case studies, improved understanding of optimized control strategies for radiant slab systems will be developed through a series of laboratory experiments at the new Facility for Low Energy eXperiments in Buildings (FLEX) test chambers at Lawrence Berkeley National Laboratory (LBNL), or an equivalent testing facility. All findings from the case studies and laboratory testing will be supplemented with whole-building energy simulations using EnergyPlus, allowing a sensitivity analysis of climate and control strategies.

The Contractor shall:

- Develop list of candidate buildings for investigation, based on existing near ZNE buildings with radiant systems in California provided by CBE Industry Partners and other sources.
- Select two buildings from the above list for the case studies, including confirmation of collaboration with building owners and system designers.
- Conduct Case Study #1.
- Prepare Case Study Report #1, which will include but not limited to: occupant survey, energy analysis, design, cost, and operational issues.
- Conduct Case Study #2.
- Prepare Case Study Report #2 which will include but not limited to: occupant survey, energy analysis, design, cost, and operational issues.
- Conduct laboratory experiments investigating optimized control strategies for radiant heating and cooling systems, including data suitable for comparison

and validation of EnergyPlus simulations. The tests will be performed in the FLEX test chambers at LBNL, or an equivalent full-scale testing facility.

- Prepare a Laboratory Testing Report, or equivalent journal publication.
- Conduct EnergyPlus simulations on radiant systems to investigate key radiant system control issues identified from case studies and laboratory tests.
- Prepare a Radiant Systems Energy Simulation Report, or equivalent journal publication.
- Prepare presentation materials for a seminar on near ZNE buildings with radiant systems, including energy performance, cost effectiveness, and other non-energy benefits.
- Prepare a Project Report on Near ZNE Building that includes but not limited to: significant results from case studies and simulation, and conclusions.

Deliverables:

- Case Study Report #1
- Case Study Report #2
- Laboratory Testing Report
- Radiant Systems Energy Simulation Report
- Presentation materials for ZNE Building Performance Seminar
- Project Report on Near-ZNE Building Space Conditioning