STATE OF CALIFORNIA

CONTRACT REQUESTS FORM (CRF)

CEC-94 (Revised 5/11) CALIFORNIA ENERGY COMMISSION

☐ New Contract _____ ☒ Amendment to Existing Contract: 500-09-046 Amendment Number: 1

Division	Contract Manager:	MS-	Phone	CM Training Date
ERDD - Buildings End-Use Energy Efficiency	Kiel Pratt	43	916-327-1412	9/29/2009

Contractor's Legal Name	Federal ID Number
Institute for Sustainable Building Performance (DBA) Institute for the Sustainable Performance of Buildings	26-1732324

Title of Project
Training Tools to Increase Building Efficiency

Term	Start Date	End Date	Amount
New/Original Contract	6/30/2010	7/15/2013	$ 1,986,715

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

Amendment #	End Date *(mm/dd/yy)*	Amount
Amendment 1	7/15/2014	$0

Business Meeting Information			
Proposed Business Meeting Date	10/10/2012	☒ Consent	☐ Discussion
Business Meeting Presenter	Kiel Pratt	Time Needed:	

Agenda Item Subject and Description

Possible approval of Amendment 1 to Contract 500-09-046-01 with the institute for Sustainable Building Performance to perform a no-cost time extension extending the term by one year to July 15, 2014, to reallocate funds in the budget, to modify the Scope of Work and use the most modern programming environments for creating the project's educational software. The terms and conditions are being modified. The total contract amount of $1,986,715 remains unchanged. (PIER electricity funding). Contact: Kiel Pratt.

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 proposed contract amendment revises the schedule, modifies the distribution of technical effort and responsibility in the scope of work consistent with contactor and minor subcontractor capabilities, and re-allocates the budget within the five major technical activities based on projected expenses to the end of the project. As directed by the Department of General Services, Office of Legal Services, the Terms and Conditions, Alternative Dispute Resolution is being amended to remove the Binding Arbitration language. In addition, other edits are being made to the remaining language.

California Environmental Quality Act (CEQA) Compliance

1. 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":
   The Contract will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because it involves development of web-based building energy efficiency educational tools.
2. 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: _____
   ☐ Common Sense Exemption. 14 CCR 15061 (b) (3)
   Explain reason why contract is exempt under the above section:
   ☐ 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.

Budgets Information								
Contract Amount Funded		Breakdown by FY			Funding Sources			
Funding Source	Amount	FY	Amount	Approved?	Funding Source	FY	Budget List No.	Amount
ARFVTF	$		$					$
ECAA	$		$					$
State- ERPA	$		$					$
Federal	$		$					$
PIER - E	$		$					$
PIER - NG	$		$					$
Reimbursement	$		$					$
Other	$		$					$
TOTAL:	$0	TOTAL:	$0				TOTAL:	$0
Reimbursement Contract #:					Federal Agreement			

Contractor's Administrator/ Officer		Contractor's Project Manager	
Name:	Joseph Deringer	Name:	Joseph Deringer
Address:	1349 Addison St	Address:	1349 Addison St
City, State, Zip:	Berkeley, CA 94702-1716	City, State, Zip:	Berkeley, CA 94702-1716
Phone/ Fax:	510-843-9300 / 510-843-9300	Phone/ Fax:	510-843-9300 / 510-843-9300
E-Mail:	jderinger@su-per-b.org	E-Mail:	jderinger@su-per-b.org

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 RFP Solicitation #: 50008503 # of Bids: 33 Low Bid? ☒ No ☐ Yes
- ☐ Non Competitive Bid *(Attach CEC 96)*
- ☐ Exempt Select Exemption

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)

Payment Method

☒ A. Reimbursement in arrears based on:
☒ Itemized Monthly ☐ Itemized Quarterly ☐ Flat Rate ☐ One-time
☐ B. Advanced Payment
☐ C. Other, explain:

Retention

1. Is contract subject to retention?	☐ No	☒ Yes
If Yes, Do you plan to release retention prior to contract termination?	☒ No	☐ Yes

Justification of Rates

This project was competitively bid as part of solicitation 500-08-503. No increase in rates will be included with this amendment.

Disabled Veteran Business Enterprise Program (DVBE)

1. ☐ Not Applicable
2. ☒ Meets DVBE Requirements DVBE Amount:$ 60,000.00 DVBE %: 3.02
   ☐ Contractor is Certified DVBE
   ☒ Contractor is Subcontracting with a DVBE: Ambire Consulting
3. ☐ Requesting DVBE Exemption (attach CEC 95)

Is Contractor a certified Small Business (SB), Micro Business (MB) or DVBE?	☐ No	☒ Yes
If yes, check appropriate box:	☒ SB ☐ MB	☐ DVBE

Is Contractor subcontracting any services?	☐ No	☒ Yes
If yes, give company name and identify if they are a Small Business (SB), Micro Business (MB) and/or DVBE:		

Lawrence Berkeley National Laboratory	☒ No	☐ SB	☐ MB	☐ DVBE
California Lighting Technology Center - UC Davis	☒ No	☐ SB	☐ MB	☐ DVBE
UC Merced	☒ No	☐ SB	☐ MB	☐ DVBE
Western Cooling Efficiency Center - UC Davis	☒ No	☐ SB	☐ MB	☐ DVBE
QuEST	☒ No	☐ SB	☐ MB	☐ DVBE
The Regents of the University of California on behalf of the Berkeley campus	☒ No	☐ SB	☐ MB	☐ DVBE
Laney College	☒ No	☐ SB	☐ MB	☐ DVBE
California Polytechnic State University	☒ No	☐ SB	☐ MB	☐ DVBE
The Weidt Group	☒ No	☐ SB	☐ MB	☐ DVBE
LOISOS + UBBELOHDE ASSOCIATES	☒ No	☐ SB	☐ MB	☐ DVBE
Advanced Technology Environmental and Energy Center	☒ No	☐ SB	☐ MB	☐ DVBE
McQuillen Interactive LLC	☒ No	☐ SB	☐ MB	☐ DVBE
Infrared5, Inc.	☒ No	☐ SB	☐ MB	☐ DVBE
DeAnza College-Energy Management Technology Program	☒ No	☐ SB	☐ MB	☐ DVBE
City College of San Francisco	☒ No	☐ SB	☐ MB	☐ DVBE
Ambire Consulting	☐ No	☒ SB	☒ MB	☒ DVBE
McClintock	☒ No	☐ SB	☐ MB	☐ DVBE

Miscellaneous Contract Information		
1. Will there be Work Authorizations?	☒ No	☐ Yes
2. Is the Contractor providing confidential information?	☒ No	☐ Yes
3. Is the contractor going to purchase equipment?	☒ No	☐ Yes
4. Check frequency of progress reports ☒ Monthly ☐ Quarterly ☐		
5. Will a final report be required?	☐ No	☒ Yes
6. Is the contract, with amendments, longer than a year? If yes, why?	☐ No	☒ 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.

The following items should be attached to this CRF		
1. Scope of Work, Attach as Exhibit A.	☐ N/A	☒ Attached
2. Budget Detail, Attach as Exhibit B.	☐ N/A	☒ Attached
3. CEC 96, NCB Request	☒ N/A	☐ Attached
4. CEC 30, Survey of Prior Work	☒ N/A	☐ Attached
5. CEC 95, DVBE Exemption Request	☒ N/A	☐ Attached
6. Draft CEQA Notice of Exemption (NOE)	☒ N/A	☐ Attached
7. Resumes	☒ N/A	☐ Attached
8. CEC 105, Questionnaire for Identifying Conflicts		☒ 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

PROJECT AND TASK LIST

Project & Task #s	CPR	Project & Task Names
Administration		**Program Administration**
Task A.1		Attend Kick-off Meeting
Task A.2		CPR Meetings
Task A.3		Final Meeting
Task A.4		Monthly Progress Reports
Task A.5		Test Plans, Technical reports and Interim Deliverables
Task A.6		Final report
Task A.7		Identify and Obtain Matching Funds
Task A.8		Identify and Obtain Required Permits
Task A.9		Electronic File Format
Task A.10		Establish the PAC
Task A.11		Conduct PAC Meetings
~~Project~~ Task 1		**Learn HVAC: Enhance for New User Types and Whole-Building Integration**
Task 1.1		Complete Field Test of Learn HVAC Beta Version & Release Final Version
Task 1.2	X	Enable Whole-Building Systems Integration
Task 1.3	X	Enhance Learn HVAC for students in 4-year college programs and other new types of users
Task 1.4		Add New Web-based User Resources and Tools
Task 1.5		Add New Troubleshooting Features
Task 1.6		Add Building Physical Science Module Capabilities for High School Students
Task 1.7		Project 1 Quality Assurance, Field Testing and Revisions
Task 1.8		Document and Publish Project 1 Alpha and Beta Releases
~~Project~~ Task 2		**Learn HVAC: Enhance Technical Capabilities**
Task 2.1	X	Identify users, pedagogical approach and required tool functionality
Task 2.2		Incorporate New Simulation Models
Task 2.3		Control Hardware-in-the-loop and Loop Tuning
Task 2.4		Universal Translator Interface
Task 2.5		Refine the Integration of EnergyPlus & Learn HVAC
Task 2.6		Quality Assurance, Field Testing and Revisions
Task 2.7		Document and Publish Alpha and Beta Releases
~~Project~~ Task 3		**Develop "Learn Green Lighting" Education Software**
Task 3.1		Define LGL Pedagogical Approaches
Task 3.2		Define LGL Software Functional Requirements
Task 3.3		Develop LGL Graphic User Interface (GUI) and Data Functionality
Task 3.4		Develop LGL Component Level Functionality
Task 3.5		Develop LGL System Level Functionality

Project & Task #s	CPR	Project & Task Names
Task 3.6		Prepare LGL Documentation
Task 3.7		Preliminary LGL Outreach / Dissemination Activities
Task 3.8		Release LGL Alpha Version
Task 3.9		Develop and Release LGL Beta Version
Task 3.10		Develop & Release LGL Final Version
~~Project~~ Task 4		**Develop "Learn Envelopes" Education Software**
Task 4.1		Define LE Pedagogical Approaches
Task 4.2		Define LE Software Functional Requirements
Task 4.3		Develop LE Graphic User Interface (GUI) and Data Functionality
Task 4.4		Develop LE Component Level Functionality
Task 4.5		Develop LE System Level Functionality
Task 4.6		Prepare LE documentation
Task 4.7		Preliminary LE Outreach / Dissemination Activities
Task 4.8		Release LE Alpha version
Task 4.9		Develop and Release LE Beta version
Task 4.10		Develop & Release LE final version
~~Project~~ Task 5		**Develop "Learn Daylighting" Education Software**
Task 5.1		Define LDL Pedagogical Approaches
Task 5.2		Define LDL Software Functional Requirements
Task 5.3		Develop LDL Graphic User Interface (GUI) and Data Functionality
Task 5.4		Develop LDL Component Level Functionality
Task 5.5		Develop LDL System Level Functionality
Task 5.6		Prepare LDL Documentation
Task 5.7		Preliminary LDL Outreach / Dissemination Activities
Task 5.8		Release LDL Alpha Version
Task 5.9		Develop and Release LDL Beta Version
Task 5.10		Develop & Release LDL Final Version

KEY NAME LIST

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
A	Joseph Deringer~~,~~ ~~Rolland Otto~~ – SuPerB	LBNL, CLTC~~, The Weidt Group~~	~~CUNY, Texas A&M, Iowa Energy Center, PG&E Pacific Energy Center (PEC)~~
1	Joseph Deringer~~,~~ ~~Rolland Otto~~ – SuPerB	~~McQuillen Interactive, Martian Interactive,~~ LBNL, ~~UC Berkeley,~~ UC Merced, ~~Ambire Consulting – DVBE~~	~~CUNY, Texas A&M, Iowa Energy Center, PG&E PEC~~
2	~~Philip Haves – LBNL~~	~~McQuillen Interactive, Martian Interactive,~~ LBNL, UC Merced~~, Ambire~~	~~IEC, TEES, CUNY, Texas A&M, PG&E PEC~~

Task #	Key Personnel	Key Subcontractor(s)	Key Partner(s)
		~~Consulting - DVBE~~	
3	~~K. Papamichael – CLTC~~	CLTC, LBNL~~, Ambire Consulting - DVBE~~	~~CUNY, Texas A&M, Iowa Energy Center, PG&E PEC~~
4	Joseph Deringer – SuPerB	LBNL~~, McQuillen Interactive, Martian Interactive, UC Berkeley, Ambire Consulting - DVBE~~	~~CUNY, Texas A&M, Iowa Energy Center,~~
5	~~Prasad Vaidya – Weidt Grp.~~ Joseph Deringer – SuPerB	~~Loisos+Ubbelohde,~~ LBNL~~, McQuillen Interactive, Martian Interactive, Ambire Consulting - DVBE~~	~~CUNY, Texas A&M, Iowa Energy Center, PG&E PEC~~

GLOSSARY

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

Acronym	Definition
AIA	American Institute of Architects
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ATEEC	Advanced Technology Environmental and Energy Center
BETEC	Building Enclosure Technology & Environment Council
BIM	Building Information Modeling
CLTC	California Lighting Technology Center, UC Davis
COMFEN	Commercial Fenestration Design Tool
CPR	Critical Project Review
CUNY	City University of New York
DGS	California Department of General Services
DVBE	Disabled Veteran Business Enterprise
ECT	Environmental Control Technology
Energy Commission	California Energy Commission
GSA	United States General Services Administration
GUI	Graphic User Interface
HVAC	Heating, Ventilation, and Air Conditioning
IALD	International Association of Lighting Designers
IEC	Iowa Energy Center
IESNA	Illuminating Engineering Society of North America
I-O	User Input – Output
IT	Information Technology
LBNL	Lawrence Berkeley National Laboratory
LDL	Learn Daylighting
LE	Learn Envelopes

Acronym	Definition
LGL	Learn Green Lighting
NIBS	National Institute of Building Sciences
NSF	National Science Foundation
O&M	Operations and Maintenance
PAC	Project Advisory Committee
PBCS	Problem-Based Case Study
PG&E	Pacific Gas & Electric
PG&E PEC	Pacific Gas & Electric Pacific Energy Center
PIER	Public Interest Energy Research Program
QA	Quality Assurance
SuPerB	The Institute for Sustainable Building Performance
TEES	Texas Engineering Experiment Station
XML	Extensible Markup Language

Problem Statement

The goal of this program is to improve the ability of the buildings industry to deliver and operate energy-efficient commercial buildings by enhancing the education and training of architects, mechanical designers, commissioning providers, service technicians and building operators. The approach is to develop and distribute open-source, free software products to provide substantial computer-based resources and tools for assisting in workforce development. The areas to be addressed are Heating, Ventilation, and Air Conditioning (HVAC) system operation, controls and troubleshooting, lighting, envelope, controls, and the whole building integrated design and operation of low-energy, sustainable buildings. The proposed program builds on previous collaborations among the Institute for Sustainable Building Performance (SuPerB), the Lawrence Berkeley National Laboratory (LBNL) and others that were funded by the National Science Foundation's Advanced Technological Education program and by the California Energy Commission (Energy Commission).

Saving energy in buildings involves more than developing new technologies. High-efficiency equipment that is not properly installed, calibrated, tested, operated or maintained will typically save far less energy than estimated. Thus, a critical need today and in the future is to train skilled people to design, construct, operate, and maintain increasingly complex buildings and systems. This discussion is applied to commercial buildings, but many aspects also extend to residential buildings.

Currently, there are very few software resources that can provide system- and building-level integrated views, and no educational tools have been developed.

Goals of the Agreement

The goal of this Agreement is to provide methods and tools for computer-based workforce development to increase skill levels as a major means of increasing the efficiency and sustainability of existing and new buildings, both as-designed and as-operated.

Objectives of the Agreement
The contractor's major objective is to transform building performance in the commercial sector by raising the problem-solving and troubleshooting skills of technicians, building operators, commissioning agents, architects, engineers, and other building industry professionals.

The contractor will develop and disseminate cyber-based education software tools and resources to California technicians, building operators, educational institutions, and organizations with in-house energy education programs. The contractor is actively involving these potential user groups in the software development process.

The tools can be used either individually or in groups learning situations. All products developed are either open source or web-based public domain delivery platforms, ensuring their widespread use and their potential extension and modification by others. All tools and resources developed are intended to be available at no cost to users. The intent is to develop a framework and resource upon which organizations worldwide will be encouraged to build upon and refine.

TASK A.0 ADMINISTRATION

MEETINGS

Task A.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 A.2)
- Match fund documentation (Task A.7)
- Permit documentation (Task A.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 A.4)
- Technical Deliverables (Task A.5)
- Final Report (Task A.6)
- Establish the PAC (Task A.10)
- PAC Meetings (Task A.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 A.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.

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 any additional costs will be borne by the Contractor.

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 satisfactory progress is not being made, this conclusion will be referred to the Energy 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)
- 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 A.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 A.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.

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:

- Monthly Progress Reports

Task A.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 A.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 A.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 5 working days of receipt.

Deliverables:
- Draft Outline of the Final Report
- Final Outline of the Final Report

Task A.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 5 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 A.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 A.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 not reimbursable under this Agreement. While the PIER budget for this task will be zero dollars, the Contractor shall show match funds for this task. Permits must be identified in writing and obtained before the Contractor can incur any costs related to the use of the permits 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 A.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 A.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 A.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.

Deliverables:
- Draft PAC Meeting Schedule
- Final PAC Meeting Schedule
- 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 A.5. Deliverables not requiring a draft version are indicated by marking "(no draft)" after the deliverable name.

~~PROJECT~~ TASK 1 LEARN HVAC: ENHANCE USER FEATURES FOR WHOLE-BUILDING INTEGRATION & NEW USER TYPES
The goal of this ~~project~~ **task** is to advance the program goal of improving the ability of the buildings industry to deliver and operate energy-efficient commercial buildings through enhanced education and training. The strategy for this ~~project~~ **task** is to improve substantially the user interaction features of the Learn HVAC cyber-based education tool that was developed originally for use in community college programs by:
- expanding the interface approach and the software data structure to include additional building energy systems, especially lighting, building envelope, and daylighting, in addition to HVAC systems, and
- expanding the interface approach and the software data structure to be able to handle dynamic 3D graphics,

- expanding the user interaction capabilities of Learn HVAC to be able to better meet the pedagogical needs of four year academic colleges, professional continuing education programs, and in-service career ladder training programs, and
- enhancing the learning experience of Learn HVAC by several user-oriented features requested by past users – more robust web-based features for instructors and administrators, better use and control of sensors by all users, improving trouble-shooting support to all users, and adding physical science module capabilities for high school students.

Task List

~~The project's~~ **This task's** work scope involves the following technical ~~tasks~~ **activities**:

~~Project & Task #s~~	CPR	~~Project & Task Names~~
~~Project~~ Task 1		**Learn HVAC: Enhance for New User Types & Whole-Building Integration**
Task 1.1		Complete Field Test of Learn HVAC Beta Version & Release Final Version
Task 1.2	X	Enable Whole-Building Systems Integration via Revised Data Structures, Graphic User Interface (GUI), and Dynamic 3D Environment
Task 1.3	X	Enhance Learn HVAC for Students in 4-year College Programs and Other New Types of Users
Task 1.4		Add New Web-based User Resources and Tools
Task 1.5		Add New Troubleshooting Features
Task 1.6		Add Building Physical Science Module Capabilities for High School Students
Task 1.7		Quality Assurance, Field Testing and Revisions
Task 1.8		Document and Publish Alpha and Beta Releases

Task 1.1 Complete Field Test of Learn HVAC 2009 Beta Version & Release Final Version

The goal of this task is to improve user's experience of Learn HVAC by completing the testing of a Beta version of Learn HVAC that will exist at the beginning of the project in order to properly address all bugs and problems identified by users of the beta version, revise the software in response to the beta feedback obtained, refine the software documentation appropriately, and publish a final release of Learn HVAC Version 1.0.

The Contractor shall:

- Complete the field testing of the existing Learn HVAC software and document the problems and requests for improvement identified during the field testing using **Mantis (http://www.mantisbt.org/) or other appropriate** ~~the~~ online ~~"Redmine"~~ tracking software ~~at http://redmine.learnHVAC.org~~.
- Prioritize and address the problems and requests identified and documented in the field testing.
- Update and maintain new versions of the Learn HVAC software on the Git open source repository.
- Release a final version of Learn HVAC downloadable client, Version 1.0, for free download from the www.learnHVAC.org website.
- Release a final version of Learn HVAC source code, Version ~~1~~**2**.0, for distribution via the Git repository as open source software under Open Source License 3.0.
- Conduct preliminary outreach via notices of software availability to
    - California community colleges with active commercial building Environmental Control Technology (ECT)/ HVAC programs.
    - Universities with engineering and architecture programs.
    - Energy centers such as Pacific Gas & Electric's (PG&E) two energy centers.
    - Other building industry groups such as:
        - American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), American Institute of Architects (AIA), unions, California Department of General Services (DGS), United States General Services Administration (GSA), large HVAC manufacturers, etc.
        - Community colleges nationwide with known commercial ECT/HVAC programs,
        - Engineering and architectural programs in universities nationwide,
        - Union-based education efforts, and
        - Organizations with active in-house energy education programs.
- Prepare the Learn HVAC 2009 Software Refinement Report, which will summarize software refinement activities such as bugs documented, improvements identified, and improvements implemented in the new software version.
- Prepare Learn HVAC 2009 Preliminary Outreach Activity Report, describing method and results of preliminary outreach efforts.

Deliverables:

- Learn HVAC 2009 Software Refinement Report (no draft)
- Learn HVAC 2009 downloadable client and website (no draft)
- Learn HVAC 2009 published source code for client and website (no draft)
- Learn HVAC 2009 Preliminary Outreach Activity Report (no draft)

Task 1.2 Enable Whole-Building Systems Integration via Revised Data Structures, Graphic User Interface (GUI), and Dynamic 3D Environment

The goal of this task is to expand the Graphic User Interface (GUI) interactions and supporting data structures from just HVAC to be able to handle a whole-building integrated systems approach addressing multiple building systems, multiple phases,

and multiple user types. The team will revisit the GUI interactions and related data structures of Learn HVAC 2009, which was developed for a limited set of conditions. The contractor will expand the GUI and data frameworks to be able to handle multiple building systems, multiple building phases, and several types of users represented by different educational settings.

The Contractor shall:

- Enhance the Graphic User Interface (GUI) and modeling environment by:
    - Refining the existing 3D modeling environment or selecting a new, dynamic 3D modeling environment (e.g., **WebGL** ~~Papervision3D, Unity3D~~, or similar).
    - Developing new modeling and animation approaches for Learn HVAC.
    - Developing a plan for transferring the existing Learn HVAC 3D models and views to the new dynamic 3D environment.
    - Developing new conceptual dynamic 3D modeling and animation approaches for the new system modules: (1) envelope, (2) lighting, and (3) daylighting.
    - Developing new data structures, Graphic User Interface (GUI), and animation approaches for whole-building systems integration.
- Enhance the software coding and data structures for Whole-Building Integration by:
    - Refining existing communications between ~~Flash/~~Modelica, the long-term simulation model, and the GUI.
    - Extending overall existing data structure to generically handle the new lighting, envelope, and daylighting modules, as well as the existing or extended HVAC data structure, within a whole-building context, and considering Building Information Modeling (BIM).
    - Considering Student and Instructor Use Cases and Scenarios that can occur within any of the building life-cycle phases and not just within operations & maintenance, as is the case with Learn HVAC, Version 1.0.
    - Considering GUI refinements in response to the above.
- Hold a task kick-off meeting followed by a series of web-meetings to enable the team to collaborate on accomplishing this task.
- Prepare an Interim 3D Whole-Building report describing proposed refinements for the GUI, data structures, and modeling of the 3D environment.
- Create an overall Alpha software version incorporating the above new software features to the enhanced GUI and supporting 3D whole-building data structures.
- Prepare a Final 3D Whole-Building report describing proposed refinements for the GUI, data structures, and modeling of the 3D environment.
- Perform CPR as per Task A.2.

Deliverables:

- Interim 3D Whole-Building Report. (no draft)
- Alpha version of enhanced GUI and 3D whole-building data structures software. (no draft)
- Final 3D Whole-Building Report. (no draft)
- CPR Report (no draft)

Task 1.3 Enhance Learn HVAC For Students In 4-Year College Programs And Other New Types Of Users

The goal of this task is to add to Learn HVAC new GUI features and supporting pedagogical approaches and technical structures tailored to the educational needs of 4-year students of engineering and architecture and other new user types. Other new user types include commissioning agents and technicians, 2-year college students, and architectural technicians. The intent is to permit users or instructors to be able to toggle between the various software versions as needed.

The Contractor shall:

- Refine pedagogical approaches by organizing and participating in meetings, web meetings and design charrettes with potential new users of Learn HVAC in four-year colleges, energy centers, and in-service training in order to define:
    - The pedagogical approaches to be adopted and
    - The tool functionality required to support those approaches.
- Refine GUI and data structure approaches by planning and developing GUI and data structure extensions to Learn HVAC to allow:
    - “Drilling down” into the simulation
    - Modeling equations and processes, and
    - Observing presentations of simulation equations and processes.
- Develop the GUI and data structure extensions to Learn HVAC.
    - Define the new use cases appropriate to the new users. This shall include defining use cases for key user groups, enhancing Instructor Use Cases and developing new online delivery mechanisms and certifications as necessary
- Implement the newly identified use cases.
- Define new Problem-Based Case Study Scenarios appropriate to the new users and the software developers will implement them. This will include but not be limited to:
    - Seeking update on key industry problems
    - Defining new Problem-Based Case Studies
    - Adapting Scenarios to Various User Types
    - Developing the new Problem-Based Case Studies and related content
    - Linking the new case studies to existing curricula / courses/ content
    - Adding concepts, content, modules and links to lab equipment as necessary to support the new case studies

- Implement the newly identified Problem-Based Case Study Scenarios.
- Prepare GUI and Structures Development Report, describing pedagogical objectives, user needs, the desired software functional requirements, and the process used.
- Perform CPR as per Task A.2.

Deliverables:
- Alpha version of a 4-year version of Learn HVAC 2012 (no draft)
- Beta version of a 4-year version of Learn HVAC 2012 (no draft)
- GUI and Structures Development Report (no draft)
- CPR Report (no draft)

Task 1.4 Add New Web-based User Resources and Tools
The goal of this task is to add new capabilities to the web-based administrative / instructor site to enhance the user's experience and to encourage the growth of an active user community. The user community can share software scenarios, share curriculum applications, and use the open source code features to collaborate toward developing the next generations of this suite of educational software resources.

The Contractor shall:
- Collaborate with subcontractors and partners to provide input on pedagogical objectives and needs.
- Gather and provide input on the enhanced features from the perspective of potential 2-year and 4-year educational users.
- Add the following resources to the web site: Wiki's, Forums, and related online user support, community-building capabilities, and social networking and social problem-solving venues, plus a "help" service, and shall incorporate the new features into an overall Alpha version of the enhanced website in Task 1.8
- Develop an interim Website Development Report, documenting the development process and describing the resulting enhancements to the website.
- Develop a final Website Development Report documenting the development process and describing the resulting enhancements to the website.

Deliverables:
- Alpha version of enhanced Learn HVAC administrative/instructor website (no draft)
- Interim Website Development Report (no draft)
- Final Website Development Report (no draft)

Task 1.5 Add New Troubleshooting Features
The goal of this task is to add two new troubleshooting capabilities to the Learn HVAC client used by the student, and to add corresponding system variables and instructor options to the administration / instructor website. The first capability is a troubleshooting methodology to train users to adopt more consistent trouble-shooting techniques and approaches. The second capability is sensor handling that can selectively choose and hide virtually all potential sensors for assessing the performance of the HVAC components and systems involved.

The Contractor shall:

- Coordinate with subcontractors and partners regarding the development process, providing input to the software conceptual approach, supervising the quality assurance (QA) activities, and providing pedagogical input to the development capabilities.
- Develop the software on the Flex-based client side and incorporate the software with the new features into an overall Alpha version of the enhanced Learn HVAC 2012 client software.
- Develop the web-based software for the administration/instructor site using ~~Ruby on Rails~~ **appropriate software**, including changes and extensions to the system variables, and shall incorporate the new features into an overall Alpha version of the enhanced Learn HVAC 2012 website.
- Coordinate input from participating 2-year and 4-year colleges on pedagogy and functional requirements from a user perspective and conduct field testing of the draft alpha and beta software as it develops.
- Develop an interim Troubleshooting and Sensor Handling Report describing the pedagogical objectives, user needs, the desired software functional requirements, the process used, and the basic software features that have been developed.
- Develop a final Troubleshooting and Sensor Handling Report describing the pedagogical objectives, user needs, the desired software functional requirements, the process used, and the basic software features that have been developed.

Deliverables:

- Alpha version of the client for troubleshooting / sensor handling modules (no draft)
- Alpha version of the website for troubleshooting / sensor handling modules (no draft)
- Interim Troubleshooting and Sensor Handling Report (no draft)
- Final Troubleshooting and Sensor Handling Report (no draft)

Task 1.6 Add Building Physical Science Module Capabilities for High School Students

The main goal of this task is to develop example Problem-Based Case Study (PBCS) scenario modules for building physical science to use with Learn HVAC to provide hands-on links from high school physics concepts and procedures to the analysis of the performance of buildings. This will include defining and constructing example PBCS scenarios modules for building physics, improved building efficiency via applied building physics, and explaining underlying physics principles.

Another goal of this task is to explore the potential for linking one or more PBCS scenarios with the new software tools developed elsewhere in this contract.

The Contractor shall:

- Develop draft PBCS scenarios.
- Embed the new PBCS scenarios in the software on the ~~FLEX-based client~~ **Scenario Player** side, and incorporate the scenarios into an overall Alpha version of the enhanced Learn HVAC 2012 ~~client~~ **Scenario Player** software.
- Embed the new PBCS scenarios in the web-based software for the administration**& Scenario Developer** ~~/instructor~~ site using ~~Ruby on Rails~~ **appropriate software**, including changes and extensions to the system variables, and ~~shall~~ incorporate the scenarios into an overall Alpha version of the enhanced Learn HVAC 2012 **Scenario Player and administrative** website in Task 1.8.
- Coordinate input from subcontractors and partners on pedagogy and functional requirements from a user perspective of community colleges that work in support of high school technical education programs and conduct field testing of the draft alpha and beta PBCS scenarios imbedded in software as it develops.
- Develop an interim Problem-Based Case Study Module **section of the** Report describing the pedagogical objectives, user needs, the process used, and the PBCS scenarios being developed.
- Develop a final Problem-Based Case Study Module **section of the** Report describing the pedagogical objectives, user needs, the process used, and the PBCS scenarios that have been developed.

Deliverables:

- ~~Alpha version of the client portion of the PBCS scenarios (no draft)~~
- ~~Alpha version of the website portion of the PBCS scenarios (no draft)~~
- ~~Interim Problem-Based Case Study Module Report (no draft)~~
- ~~Final Problem-Based Case Study Module Report (no draft)~~

- **Alpha version of enhanced Learn HVAC administrative website (no draft)**
- **Interim Report with sections on Website, Troubleshooting, Sensor Handling, and PBCS (no draft)**
- **Final Report with sections on Website, Troubleshooting, Sensor Handling, and PBCS (no draft)**
- **Alpha version of the Scenario Player and Scenario Builder features for troubleshooting / sensor handling modules and PBCS scenarios (no draft)**

Task 1.7 Quality Assurance, Field Testing and Revisions

The goal of this task is to ensure that the expanded and enhanced modeling features of Learn HVAC developed within ~~Project~~ **Task** 1 are robust and operate correctly via a combination of functional testing and stress-testing/field-testing in real-life situations with large numbers of users.

The Contractor shall:

- Facilitate field-testing by others of the enhancements to Learn HVAC and prioritize the actions to be taken in response to the results of this field-testing. Data shall be gathered on bugs, system performance, usability and achievement of learning goals.
- Design the functional testing and field-testing protocols for use for the Alpha testing. The testing protocols shall include but not be limited to:
    - New data structures, GUI, and dynamic 3D environment**, user features for 4-year college programs & others** from Task 1.2,
    - New user features for 4-year college programs & others from Task 1.3.
    - New web-based user**, troubleshooting, and building science** features from Task 1.4.
    - New troubleshooting features from Task 1.5.
    - New building physical science features from Task 1.6.
- Conduct testing of the new software features and document the results using the online ~~Redmine~~ report capabilities **of the Mantis (or similar) system** ~~at http://redmine.learnHVAC.org~~.
- Respond to questions raised in the Quality Assurance process and ensure that any deficiencies identified are remedied to the extent allowed by available resources.
- Refine Alpha software features into Beta versions in response to the field-testing results.
- Prepare an Interim QA and Testing Report, documenting functional and field-testing protocols, along with QA and testing results. The report will also explain changes to the Alpha software to refine the software into Beta version.
- Prepare a final QA and Testing Report, documenting functional and field-testing protocols, along with QA and testing results. The report will also explain changes to the Alpha software to refine the software into Beta version.

Deliverables:

- Interim QA and Testing Report (no draft)
- Final QA and Testing Report (no draft)

Task 1.8 Document and Publish Alpha and Beta Releases

The goal of this task is to document the newly expanded Learn HVAC user features and to make these new features available for use.

The Contractor shall:

- Create Interim and Final Learn HVAC 2012 Documentation For User-Oriented Features including:
    - Create interim technical documentation for system administrators, open source programmers and Information Technology (IT) staff.
    - Create interim instructor documentation for instructors customizing the tool and using it in classroom, workshop, and online education settings.
    - Create interim user documentation for students.
    - Create each type of interim documentation to include but not be limited to:

        - New GUI and data structure enhancements for whole building and 3D applications from Task 1.2,
        - New GUI and data structure enhancements for new users in particular users in 4-year academic programs from Task 1.3,
        - New troubleshooting / sensor handling modules from Task 1.5
        - New Building Physical Science PBCS module Task 1.6.
    - Create final technical documentation for system administrators, open source programmers and IT staff.
    - Create final instructor documentation for instructors customizing the tool and using it in classroom, workshop, and online education settings.
    - Create final user documentation for students.
    - Create each type of final documentation to include but not be limited to:
        - New GUI and data structure enhancements for whole building and 3D applications from Task 1.2,
        - New GUI and data structure enhancements for new users in particular users in 4-year academic programs from Task 1.3,
        - New troubleshooting / sensor handling modules from Task 1.5
        - New Building Physical Science PBCS module Task 1.6.
- Publish and release an Alpha version of Learn HVAC 2012 with expanded user oriented functional capabilities for internal project based field-testing described in Task 1.6.
- Publish and release a Beta version of Learn HVAC 2012 with expanded user oriented functional capabilities based upon the revisions to the Alpha version made in Task 1.6.

Deliverables:
- Interim Learn HVAC 2012 Technical, Instructor, and User Documentation For User-Oriented Features (no draft)
- Final Learn HVAC 2012 Technical, Instructor, and User Documentation For User-Oriented Features (no draft)
- Alpha release of Learn HVAC 2012 with new user-oriented features (no draft)
- Beta release of Learn HVAC 2012 with new user-oriented features (no draft)

~~Project~~ Task 2 Learn HVAC: Enhance Technical Capabilities
The goal of this ~~project~~ **task** is to advance the program goal of improving the ability of the buildings industry to deliver and operate energy-efficient commercial buildings through enhanced education and training. The strategy for this ~~project~~ **task** is to enhance the technical capabilities of the Learn HVAC cyber-based education software by:

- Incorporating simulation models of new HVAC components and systems into the software,
- Extending the depth and breadth of the existing simulation models,
- Adding hardware-in-the-loop and loop tuning capabilities
- Interfacing with PG&E's Universal Translator,
- Refining the integration of EnergyPlus and Learn HVAC.

Task List

~~The project's~~ **This task's** work scope involves the following technical ~~tasks~~ **activities**:

~~Project & Task #s~~	CPR	~~Project & Task Names~~
~~Project~~ Task 2		**Learn HVAC: Enhance Technical Capabilities**
Task 2.1	X	Identify users, pedagogical approach and required tool functionality
Task 2.2		Incorporate New Simulation Models
Task 2.3		Control Hardware-in-the-loop and Loop Tuning
Task 2.4		Universal Translator Interface
Task 2.5		Refine the Integration of EnergyPlus & Learn HVAC
Task 2.6		Quality Assurance, Field Testing and Revisions
Task 2.7		Document and Publish Alpha and Beta Releases

Task 2.1 Identify Users, Pedagogical Approach And Required Tool Functionality

The goal of this task is to specify the new functionality required for Learn HVAC to support new pedagogical approaches and new user types.

The Contractor shall:

- Coordinate with subcontractors, partners to organize and participate in meetings and design charrettes with potential users of Learn HVAC in two year colleges, universities and in-service training in order to define the tool functionality required to support the new pedagogical approaches identified in Project 1, focusing on but not limited to new simulation models desired, new simulation features desired, enhancing existing technical capabilities, and adding new technical capabilities.
- Prepare Interim Learn HVAC Functionality and User Types Report. This will include descriptions of the meetings, of the identified software technical function requirements, including prioritized recommendations for new tool functionality to support new pedagogical approaches.
- Provide the Interim Learn HVAC Functionality and User Types Report to the Commission Contract Manager, the PAC, and the user groups from the community colleges and universities for the purpose of soliciting feedback.
- Prepare Final Learn HVAC Functionality and User Types Report. This will include revisions to the interim report based upon feedback from the Commission Contract Manager, the PAC, and the user representatives.
- Perform CPR as per Task A.2.

Deliverables:

- Interim Learn HVAC Functionality and User Types Report (no draft)
- Final Learn HVAC Functionality and User Types Report (no draft)
- CPR Report (no draft)

Task 2.2 Incorporate New Simulation Models

The goal of this task is to expand the range of HVAC systems and components that can be addressed by Learn HVAC.

The Contractor shall:

- Develop new HVAC system simulation models and refine current HVAC component models as needed to support the new users and pedagogy. These new components and systems shall include:
    - Rooftop unit simulation models with direct expansion cooling and direct fired gas heating
    - Explicit modeling of multiple zones in HVAC systems
    - Multiple boilers, chillers and cooling towers and the associated pumps and piping
    - A steam heating coil option for the built-up air handling unit mode.
    - Variable frequency drives for fan, chillers and cooling tower pumps
    - Variable flow laboratory fume hood models, if resources permit.
- Develop Alpha versions of the new HVAC system simulation models and refined current HVAC component models in ~~either~~ Modelica ~~or Spark as appropriate~~, and provide these to **the software development team (e.g.,** ~~McQuillen Interactive and~~ Martian Interactive**)**.
- Expand the number and types of faults in systems and components including:
    - Expanding the faults in the air handling unit models from 20 to 60 **as appropriate**,
    - Identifying and adding faults with energy impacts,
    - Adding faults to EnergyPlus simulation of HVAC systems and components **as appropriate and feasible**, and
    - Adding faults to existing simulation models of chiller, boiler & cooling tower.
- Develop an Interim HVAC Simulation Model Report that documents the new and refined system models, components, and faults.
- Develop Alpha versions of the new faults and provide these to relevant subcontractors and partners.
- Develop additional functionality, including:
    - Add 3-D models of the new HVAC components and systems,
    - Refine data structures and system variables to incorporate the new components, systems, and faults, starting with the new data structures from Tasks 2.2 and 2.3,
    - Extend the user interface to allow the user to select the new components, systems, and faults and to change the values of their parameters, starting from the enhanced GUI features defined above in Tasks 2.2 and 2.3.

    - Extend the web-based instructor site to address the systems, components, faults, and variables.
    - Incorporate the new models and faults from LBNL and UC Merced.
    - Add the above new software features into an overall Alpha software version to be prepared for Alpha release in Task 2.7
- Develop a Final HVAC Simulation Model Report that documents the new and refined system models, components, and faults.

Deliverables:
- Interim HVAC Simulation Model Report (no draft)
- Final HVAC Simulation Model Report (no draft)

Task 2.3 Control Hardware-in-the-Loop and Loop Tuning
The goal of this task is to support hands-on learning of local loop controls with real control systems.

The Contractor shall:
- ~~Enhance~~ **Examine the enhancement of** the equipment models to improve simulation of dynamic response in general and control loop performance in particular in order to support realistic simulation of the tuning of feedback control loops.
- ~~Implement~~ **Examine the implementation of** an analog interface that can be used to couple Learn HVAC to real control hardware from different manufacturers
- Develop teaching and learning Problem-Based Case Study scenarios and exercises for different HVAC control loops.
- Extend the Learn HVAC GUI and data structures **as appropriate**, including refinements developed in ~~Project~~ **Task** 1, to support the use of Learn HVAC connected to real control systems and shall incorporate these features into an overall alpha software version.
- Document the capabilities and operations of this software feature.
- Design functional testing and field-testing protocols to use for the Alpha testing phase.
- Prepare HVAC Loop Controls Testing and Protocols Report, describing the functional testing and field-testing protocols developed for use in the Alpha testing phase.
- Develop an Interim HVAC Loop Controls Report that documents the features of Learn HVAC connected to real control systems and the teaching and learning Problem-Based Case Study scenarios and exercises.
- Develop a Final HVAC Loop Controls Report that documents the features of Learn HVAC connected to real control systems and the teaching and learning Problem-Based Case Study scenarios and exercises.

Deliverables:

- Alpha version of software that implements control loop capabilities (no draft)
- HVAC Loop Controls Testing and Protocols Report (no draft)
- Interim HVAC Loop Controls Report (no draft)
- Final HVAC Loop Controls Report (no draft)

Task 2.4 Universal Translator Interface

The goal of this task is to allow students and other users to understand building performance better by manipulating and visualizing measured data from real buildings.

The Contractor shall:

- Define how the Universal Translator can be interfaced with the Learn HVAC software so that measured data from a real building can be used within Learn HVAC in place of, or even in comparison with, output from the current real-time, second-by-second ~~Spark-based~~ simulation program embedded in Learn HVAC.
- Implement this interface **as appropriate** in Learn HVAC.
- Adapt and extend **as appropriate, in consultation with the Commission Project Manager,** the data visualization capabilities of Learn HVAC to support large data sets.
- Develop Problem-Based Case Study scenarios that **can** make use of measured performance of example sets of data from real buildings
- ~~Produce~~ **As appropriate, in consultation with the Commission Project Manager, produce** an alpha version of these software these features into an overall Alpha software version.
- Prepare the Visualization Capabilities Report, which will document the capabilities and operations of the Learn HVAC program with respect to the Universal Translator, extensions in data visualization capabilities, and PBCS scenarios.

Deliverables:

- Alpha software that implements Learn HVAC and Universal Translator interface and related visualizations **as appropriate** (no draft)
- Visualization Capabilities Report (no draft)

Task 2.5 Refine the Integration of EnergyPlus & Learn HVAC

The goal of this task is to maximize the synergy obtainable from integrated use of short term and long term simulation by enabling the user to move back and forth between the system simulation and EnergyPlus.

The Contractor shall:

- Enhance the interaction between EnergyPlus and Learn HVAC to:
    - Allow heating and cooling loads for the detailed system simulation to be defined either directly or by EnergyPlus at a user-selected point in the EnergyPlus run,
    - Access additional EnergyPlus Prototypes from within Learn HVAC, and
    - Add **as appropriate** a link to the OpenStudio Sketchup-EnergyPlus plug-in to Learn HVAC.

- Produce an alpha version of these software features into ~~an~~ **the** overall **Learn HVAC** Alpha software.
- Prepare the EnergyPlus Integration **section of the Task 2** Report, which will document the capabilities and operations of the Learn HVAC program and EnergyPlus simulation integration.

Deliverables:
- Alpha version of the new EnergyPlus / Learn HVAC software features (no draft)
- EnergyPlus Integration Report (no draft)

Task 2.6 Quality Assurance, Field Testing and Revisions
The goal of this task is to ensure that the expanded and enhanced modeling features of Learn HVAC developed within ~~Project~~ **Task** 2 are robust and operate correctly via a combination of functional testing and stress-testing/field-testing in real-life situations with large numbers of users.

The Contractor shall:
- Facilitate field-testing of the enhancements to Learn HVAC and prioritize the actions to be taken in response to the results of this field-testing, in consultation with the Program Manager. Data shall be gathered on bugs, system performance, usability and achievement of learning goals.
- Design the functional testing and field-testing protocols for use for the Alpha testing. The testing protocols shall include but not be limited to:
    - New systems, components, and faults from Task 2.2,
    - Control loop modeling, real control systems, and Problem-Based Case Study scenarios and exercises from Task 2.3,
    - Linkage with the Universal Translator from Task 2.4, and
    - Improved links to EnergyPlus from Task 2.5.
- Perform functional testing of the Alpha version of Learn HVAC against a defined set of criteria (as defined in Task 2.2, 2.3 and 2.4 of the project), together with usability field-testing. The function testing shall not only validate the application works as expected, but also verify that the simulation and educational data is valid and appropriate for the learning goals.
- Conduct field-testing of the new components, systems, faults, and related software features, and document the results using the online Redmine report capabilities at http://redmine.learnHVAC.org. The field-testing shall include, but not be limited to testing of **the following from Task 2**:
    - From Task 2.2:
        - New HVAC system simulation models and refined current HVAC component models,
        - New faults,
        - New 3-D models,
        - New data structures and system variables for the new components, systems, and faults,
        - Extended user interface.

        - Extend the web-based instructor site features.
    - From Task 2.3
        - Control **Appropriate control** loop modeling
        - Real control systems, and
        - Problem-Based Case Study scenarios and exercises
    - From Task 2.4, **Appropriate** links with the Universal Translator, and
    - From Task 2.5, improved links to EnergyPlus.
- Respond to questions raised in the Quality Assurance process and remedy any deficiencies identified to the extent allowed by available resources.
- Refine the Alpha versions of the various simulation models into Beta versions in response to the field-testing results, and shall provide these revised models to **the software development team (e.g.,**~~McQuillen Interactive and~~ Martian Interactive**)**.
- Refine Alpha software features into Beta versions in response to the field-testing results and develop and publish in Task 2.7 a Beta version for widespread public testing and field-testing. The refinements shall include, but not be limited to revisions to the software related to:
    - New systems, components, and faults from Task 2.2,
    - Control loop modeling, real control systems, and Problem-Based Case Study scenarios and exercises from Task 2.3,
    - Linkage with the Universal Translator from Task 2.4, and
    - Improved links to EnergyPlus from Task 2.5.
- Prepare Interim Learn HVAC QA and Testing Report, documenting functional and field-testing protocols, along with QA and testing results. The report will also explain changes to the Alpha software to refine the software into Beta version.
- Prepare Final Learn HVAC QA and Testing Report, documenting functional and field-testing protocols, along with QA and testing results. The report will also explain changes to the Alpha software to refine the software into Beta version.

Deliverables:
- Interim Learn HVAC QA and Testing Report (no draft)
- Final Learn HVAC QA and Testing Report (no draft)

Task 2.7 Document and Publish Alpha and Beta Releases
The goal of this task is to document the newly expanded Learn HVAC architecture and features and make the expanded and enhanced tool widely available. Audiences will include both technical audience, who may wish to enhance the tool, and users of the tool such as students and teachers.

The Contractor shall:
- Create Interim Learn HVAC 2012 Documentation For Expanded Modeling Capabilities for:
    - Technical documentation for system administrators, open source programmers and IT staff.
    - Instructor documentation for instructors customizing the tool and using it in classroom, workshop, and online education settings.

    - User documentation for students.
    - Create each type of interim documentation to include but not be limited to:
        - New systems, components, and faults from Task 2.2,
        - Control loop modeling, real control systems, and Problem-Based Case Study scenarios and exercises from Task 2.3,
        - Linkage with the Universal Translator from Task 2.4, and
        - Improved linkage to EnergyPlus from Task 2.5.
- Create Final Learn HVAC 2012 Documentation For Expanded Modeling Capabilities for:
    - Technical documentation for system administrators, open source programmers and IT staff.
    - Instructor documentation for instructors customizing the tool and using it in classroom, workshop, and online education settings.
    - User documentation for students.
    - Create each type of interim documentation to include but not be limited to:
        - New systems, components, and faults from Task 2.2,
        - Control loop modeling, real control systems, and Problem-Based Case Study scenarios and exercises from Task 2.3,
        - Linkage with the Universal Translator from Task 2.4, and
        - Improved linkage to EnergyPlus from Task 2.5.
- Publish and release an Alpha version of Learn HVAC 2012 with expanded modeling capabilities for internal project based field-testing described in Task 2.6.
- Publish and release a Beta version of Learn HVAC 2012 with expanded modeling capabilities based upon the revisions to the Alpha version made in Task 2.6.

Deliverables:
- Interim Learn HVAC 2012 Technical, Instructor, and User Documentation For Expanded Modeling Capabilities (no draft)
- Final Learn HVAC 2012 Technical, Instructor, and User Documentation For Expanded Modeling Capabilities (no draft)
- Alpha release of Learn HVAC 2012 **software functionality** with expanded modeling capabilities (no draft)
- Beta release of Learn HVAC 2012 **software functionality** with expanded modeling capabilities (no draft)

~~Project~~ Task 3 Develop "Learn Green Lighting" Education Software
The goal of this project is to advance the program goal of improving the ability of the buildings industry to deliver and operate energy-efficient commercial buildings through enhanced education and training.

Task List
~~The project's~~ **This task's** work scope involves the following technical tasks:

~~Project & Task #s~~	CPR	~~Project & Task Names~~
~~Project~~ Tas		**Develop "Learn Green Lighting" Education Software**

k 3		
Task 3.1		Define Pedagogical Approaches
Task 3.2		Define Software Functional Requirements
Task 3.3		Develop Graphic User Interface (GUI) and Data Functionality
Task 3.4		Develop Component Level Functionality
Task 3.5		Develop System Level Functionality
Task 3.6		Prepare Documentation
Task 3.7		Preliminary Outreach / Dissemination Activities
Task 3.8		Release Alpha version
Task 3.9		Develop and Release Beta version
Task 3.10		Develop and Release final version

Task 3.1 Define LGL Pedagogical Approaches
The goal of this task is to obtain as much clarity and detail as possible about the learning objectives, approaches, and methods to be used by Learn Green Lighting, as well as the knowledge, skills and attitudes to be acquired by the users of Learn Green Lighting.

The Contractor shall:

- Organize and participate in a project kickoff meeting plus subsequent webinar "charrette" meetings with potential users of Learn Green Lighting as well as from the building industry in order to define the pedagogical approaches to be adopted and the tool functionality required to support those approaches. The expected participants in this process shall include representative 2-year colleges, 4-year universities, energy centers and in-service training organizations.
- Develop an Interim Learn Green Lighting Pedagogical Objectives Report, prior to the kickoff meeting, a description of its understanding of the pedagogical foundation for Learn Green Lighting.
    - Send this draft to subcontractors and partners as appropriate, the pedagogy experts on the team, for review and comment.
    - Obtain review and comment from appropriate subcontractors and partners.
    - Send this revised draft pedagogical statement to all involved participants in advance of the first meeting. This document, and any resource of reference materials supplied by subcontractors and partners, shall form the basis of discussion at the first meeting.

- Coordinate the provision by participating universities of user inputs from the 4-year university curriculum perspective.
- Coordinate the elicitation of input from participating community colleges of user inputs from the 2-year community college perspective.
- Elicit user input from the Pacific Energy Center from the perspective of a center of continuing education of building industry professionals.
- Provide an overview perspective on pedagogical issues from their experience gained from many projects.
- Provide a research overview technical perspective on pedagogical issues from their years of conducting research and producing guidance documents and resources on lighting systems.
- Provide a practitioner-oriented overview technical perspective on pedagogical issues from their extensive building design experience with traditional and advanced lighting systems.
- Produce Final Learn Green Lighting Pedagogical Objectives Report by refining Interim Learn Green Lighting Pedagogical Objectives Report, throughout the task, to produce a consensus of the team's thinking and input to the pedagogical objectives.

Deliverables:
- Interim Learn Green Lighting Pedagogical Objectives Report (no draft)
- Final Learn Green Lighting Pedagogical Objectives Report (no draft)

Task 3.2 Define LGL Software Functional Requirements
The goal of this task is to define the software functional requirements for the Learn Green Lighting software with as much clarity and detail as possible, given the pedagogical information developed in the previous task.

The Contractor shall:
- Organize and participate in webinar meetings in order to define the software requirements based upon the pedagogy developed in the previous task. Participants shall include:
    - The Learn Green Lighting software development team,
    - Several potential users of Learn Green Lighting including representative 2-year colleges, 4-year universities, energy centers and in-service training organizations.
    - Selected building industry representatives on the PAC.
- Develop an Interim Learn Green Lighting Functional Requirements Report, an initial description of contractor's understanding of the software functional requirements for Learn Green Lighting in consultation with appropriate subcontractors and partners. This description shall be developed prior to the first meeting, form the basis of discussion, and include consideration of at least the following:
    - The "client" software that the student will see, including GUI, simulations, animations, 3D environment, BIM, and others.
    - The administrative website that the instructors and administrator will use.
    - The communications between the website and the client software.

    - The underlying lighting system data structures and lighting system variables to be used. This will include but not be limited to:
        - Variables for each lighting system component to be included,
        - Key values for each variable,
        - Identification of key likely faults for each major lighting component (faults could come from design, documentation, construction, etc.)
    - Simulation capabilities, tools, and I-O for various time horizons (diurnal, weekly, monthly, and annual) that are important to the education experience.
    - Animation requirements.
    - Graphic display typical requirements and variations, such as minimum & typical display sizes.
    - Speed, storage, graphic resolution, and 3D resolution requirements.
    - Refine software functional requirements document by obtaining review and comment from the software team and appropriate subcontractors and partners.
    - Gather user review and feedback from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, and the perspective of a center of continuing education of building industry professionals.
- Subcontractors and partners will be tapped to provide an overview perspective on pedagogical issues based on their experience of multiple projects, provide technical input to the functional requirements development process, provide a practitioner-oriented overview technical perspective on pedagogical issues based on their building design experience, and provide input to the functional requirements document, from the perspective and knowledge base of software developers.
- Prepare a Final Learn Green Lighting Functional Requirements Report, which describes the software functional requirements as originally developed in the Interim report and refined throughout the task.

Deliverables:
- Interim Learn Green Lighting Functional Requirements Report (no draft)
- Final Learn Green Lighting Functional Requirements Report (no draft)

Task 3.3 Develop LGL Graphic User Interface (GUI) and Data Functionality
The goal of this task is to develop working software for the GUI and data handling functions that respond to the pedagogical approaches and functional requirements defined in Tasks 3.1 and 3.2 above.

The Contractor shall:
- Refine and adapt the existing Learn HVAC client software to generate a version suitable for Learn Green Lighting, using:
    - Flex GUI capabilities from Learn HVAC to develop building-level data structures and models for the client portion.

- ~~Extensible Markup Language (XML)~~ **Data approaches**, developed ~~to be consistent with~~ **in consideration of** BIM procedures.
- A 2- or 3-story office building as the example building type and set of space types for the development, the structures to be developed to be expandable to other building types and space types.
- The existing EnergyPlus office building prototype in Learn HVAC as a starting point.
- Sets of lighting space type definitions established to provide a solid basis for learning experiences.
- User input – output (I-O) and display structures, formats and procedures based on Learn HVAC input techniques and formats as starting points, where appropriate.
- New GUI and data structure approaches identified from ~~Project~~ **Task** 1, especially:
    - Task 1.2 Enable Whole-Building Systems Integration and
    - Task 1.5 Enhance Learn HVAC for students in 4-year college programs and other new types of users
    - New input, output, and fault menus derived from the draft set of lighting system variables defined above in Task 3.2 software functional requirements.
- The GUI I-O shall include providing "hooks" to allow popup presentations of building case study examples of various traditional and advanced lighting system solutions.

- Develop a pre-alpha version of the client GUI and data structure for review by the project team.
- Develop, in response to review comments, an alpha version of the client GUI and data structure suitable for inclusion in the overall Learn Green Lighting alpha version to be assembled and released in Task 3.8 below.
- Refine and adapt the existing Learn HVAC administrative / instructor software capabilities to generate a version suitable for Learn Green Lighting:
    - Adapt existing ~~Ruby on Rails~~ **software** capabilities
    - Adapt existing GUI features and data structures from the Learn HVAC administrative site Learn HVAC input techniques and formats as starting points, where appropriate.
    - Design the Learn Green Lighting administrative site to be used by educational organizations teaching lighting and by lighting instructors.
- Develop a pre-alpha version of the administrative / instructor GUI and data structure for review by the project team.
- Develop, in response to review comments, an alpha version of the administrative / instructor GUI and data structure suitable for inclusion in the overall Learn Green Lighting alpha version to be assembled and released in Task 3.8 below.
- Organize and participate in routine webinar meetings during the software development process that will include members of the software team plus potential users and will provide opportunities to review the progress to ensure it is consistent

with the pedagogical objectives from Task 3.1 and the software functional requirements identified in Task 3.2.

- Gather user review and feedback from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, and the perspective of a center of continuing education of building industry professionals.
- Establish a Quality Assurance function that will include the independent testing, by others, of the software as it is defined and implemented. Testing shall include:
    - Functional testing against a defined set of criteria (as defined in the early stages of the project) and usability testing.
    - Validation that the application works as expected, and also that the simulation and educational data are valid and appropriate for the learning goals.
    - Ongoing QA assessment.
    -

Deliverables:

- Alpha version of GUI and data structures for Learn Green Lighting client (no draft)
- Alpha version of GUI and data structures for Learn Green Lighting administration site (no draft)

Task 3.4 Develop LGL Component Level Functionality

The goal of this task is to develop working software to address the components of the building envelope as listed below that respond to the pedagogical approaches and functional requirements defined in Tasks 3.1 and 3.2 above.

The Contractor shall:

- Develop basic component level data structures, GUI input-output, and functionality for the lighting system components listed below. Data structures and approaches shall draw upon those in such existing tools as EnergyPlus, Lithonia's Visual, etc. Factors to be considered shall include but not be limited to:
    - Ceiling mounted lighting systems
        - Fixture types (lay-in, direct-indirect)
        - Lamps types and characteristics
        - Lens types
        - Ballasts
        - Controls
        - Wiring / switching
    - Furniture-mounted & under-cabinet lighting, and moveable, desk-top task-lighting:
        - Fixture & lamp types
        - Lens types
        - Ballasts
        - Controls, manual and automatic

        - Wiring / switching
    - Wall sconces and other luminaires
    - Space and surface key attributes:
        - Room geometry
        - Surface reflectance
        - Window areas
    - Commissioning (using total building commissioning approach in National Institute of Building Service (NIBS) guideline 3-2006 and ASHRAE guideline 0-2005).
    - Education of Operations and Maintenance (O&M) staff and occupants (using total building commissioning tools and procedures from NIBS guideline 3-2006 and ASHRAE guideline 0-2005).
- Develop the above component functionality for an example office space within a 2- to 3-story office building, but using a data structure that will allow the setting to be expandable to other building types and space types. This shall include:
    - Establishing data and GUI links so that animations respond to the simulations, given techniques developed in Learn HVAC,
    - Linking **as appropriate** the components listed above:
        - To Energy~~p~~**P**lus to determine energy impacts
        - To a lumen method calculation program such as Lithonia's Visual.
        - To the dynamic 3D display capability (likely to be ~~Unity3D~~ **WebGL**, or similar).
        - Other simulation tools as appropriate.
    - Developing supporting GUI I-O capabilities to relate the animations/ simulations to the related lighting Problem-Based Case Study scenarios PBCS, using techniques developed in Learn HVAC, and inserting key related content from existing guidelines.
- Construct example Use Cases and scenarios for key phases of the lighting system development and use, using the use cases and Problem-Based Case Study scenarios identified in Task 3.2 as starting points, and the commissioning guideline annex materials as resources.
- Develop a pre-alpha version of the component-level software for review by the project team.
- Develop, in response to review comments, an alpha version of the component-level software suitable for inclusion in the overall Learn Green Lighting alpha version to be assembled and released in Task 3.8 below.
- Develop and populate a new set of lighting system variables to handle the range of variables for the lighting systems, components and faults being addressed. User-interactions for the Learn Green Lighting administrative site may need to be refined to address the enhanced combination of lighting system variables.
- Develop a pre-alpha version of the administrative / instructor component level software for review by the project team.

- Develop, in response to review comments, an alpha version of the administrative / instructor component level software suitable for inclusion in the overall Learn Green Lighting alpha version to be assembled and released in Task 3.8 below.
- Organize and participate in routine webinar meetings during the software development process that will include members of the software team plus potential users and will provide opportunities to review the progress to ensure it is consistent with the pedagogical objectives from Task 3.2 and the software functional requirements identified in Task 3.3.
- Gather user review and feedback from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, and the perspective of a center of continuing education of building industry professionals.
- Establish a Quality Assurance function that will include the independent testing, by others, of the software as it is defined and implemented. Testing shall include:
    - Functional testing against a defined set of criteria (as defined in the early stages of the project) and usability testing.
    - Validation that the application works as expected, and also that the simulation and educational data are valid and appropriate for the learning goals.
    - Ongoing QA assessment.

Deliverables:
- Alpha version of the component software for Learn Green Lighting client (no draft)
- Alpha version of the component software for Learn Green Lighting administration site (no draft)

Task 3.5 Develop LGL System Level Functionality
The goal of this task is to develop working software to address the overall educational software for the building's lighting system that responds to the pedagogical approaches and functional requirements defined in Tasks 3.1 and 3.2 above.

The Contractor shall:
- Integrate into a functional whole and test the combined functionality of all aspects of the Learn Green Lighting educational software, including but not limited to:
    - Component models,
    - GUI functions,
    - Simulation tools,
    - 3D displays,
    - Simulation-driven animations
    - Example problem-based case study scenarios (PBCS) scenarios.
    - Coordinating the development of a new wrapper for the various software components or the refinement of an existing wrapper.
- Develop a pre-alpha version of the system-level software for review by the project team.

- Develop, in response to review comments, an alpha version of the system-level software suitable for inclusion in the overall Learn Green Lighting alpha version to be assembled and released in Task 3.8 below.
- Develop an integrated functioning administrative / instructor site including:
    - A fully populated set of system variables with default values useful for establishing initial conditions for PBCS Scenarios.
    - GUI functions, including the ability for:
        - Institutions to set up, manage, and maintain educational sites using Learn Green Lighting.
        - Instructors to manage students in course
        - Instructors to edit existing lighting PBCS scenarios and to create new scenarios.
- Develop a pre-alpha version of the administrative / instructor system level software for review by the project team.
- Develop, in response to review comments, an alpha version of the administrative / instructor GUI and data structure suitable for inclusion in the overall Learn Green Lighting alpha version to be assembled and released in Task 3.8 below.
- Organize and participate in routine webinar meetings during the software development process that will include members of the software team plus potential users and will provide opportunities to review the progress to ensure it is consistent with the pedagogical objectives from Task 3.2 and the software functional requirements identified in Task 3.3.
- Gather user review and feedback from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, and the perspective of a center of continuing education of building industry professionals.
- Establish a Quality Assurance function that will include the independent testing of the software as it is defined and implemented. Testing shall include:
    - Functional testing against a defined set of criteria (as defined in the early stages of the project) and usability testing.
    - Validation that the application works as expected, and also that the simulation and educational data are valid and appropriate for the learning goals.
    - Ongoing QA assessment.

Deliverables:

- Alpha version of the system level software for Learn Green Lighting client (no draft)
- Alpha version of the system level software for Learn Green Lighting administration site (no draft)

Task 3.6 Prepare LGL Documentation

The goal of this task is to document the new Learn Green Lighting educational software so that it is easy to understand and to use. As with documentation of Learn HVAC, the audiences for this lighting documentation will include both technical audiences who may wish to enhance the tool, as well as users of the tool such as students and teachers.

The Contractor shall:

- Create Interim Learn Green Lighting Documentation, including:
    - Technical documentation for system administrators, open source programmers and IT staff.
    - Instructor documentation for instructors customizing the tool and using it in classroom, workshop, and online education settings.
    - User documentation for students.
- Create Final Learn Green Lighting Documentation, including:
    - Technical documentation for system administrators, open source programmers and IT staff.
    - Instructor documentation for instructors customizing the tool and using it in classroom, workshop, and online education settings.
    - User documentation for students.

Deliverables:

- Interim Learn Green Lighting Technical, Instructor, and User Documentation (no draft)
- Final Learn Green Lighting Technical, Instructor, and User Documentation (no draft)

Task 3.7 Preliminary LGL Outreach / Dissemination Activities

The goal of this task is to conduct outreach and publicity activities to alert potential users that the software is under development to allow them to plan for its use in the near future. These preliminary outreach activities will be done as introductory to a larger outreach, dissemination, and training effort to be done in a future phase of software development.

The Contractor shall:

- Work with the community colleges in California with active lighting and/or architecture programs to facilitate its use. This shall be done during and after field-testing
- Notify other possible building industry groups such as:
    - Illuminating Engineering Society of North America (IESNA), International Association of Lighting Designers (IALD), ASHRAE, AIA, unions, DGS, GSA, large lighting equipment manufacturers, etc.
    - The community colleges in the US with lighting and/or architectural programs,
    - Engineering and architectural programs in universities nationwide,
    - Union-based education efforts, and
    - Organizations with active in-house energy education programs.
- Develop an Interim Learn Green Lighting Outreach Report documenting outreach and dissemination activities both underway and planned.
- Develop a Final Learn Green Lighting Outreach Report documenting the outreach and dissemination activities accomplished in this task and project.

Deliverables:

- Interim Learn Green Lighting Outreach Report (no draft)
- Final Learn Green Lighting Outreach Report (no draft)

Task 3.8 Release LGL Alpha Version
The goal of this task is to release the alpha versions of the software for both the client and the web-based administration website in order to obtain feedback from functional and field-testing activities. This task involves the final assembly of the alpha version release and testing and providing feedback on the alpha release.

The Contractor shall:
- Package the alpha version prepared in Task 3.5 and distribute to the project team the full alpha release of the client portion of the Learn Green Lighting educational software, including but not limited to:
    - Component models,
    - GUI functions,
    - Simulation tools,
    - 3D displays,
    - Simulation-driven animations
    - Example Problem-Based Case Study Scenarios (PBCS) Scenarios.
- Coordinate the development of a new wrapper for the various software components or the refinement of an existing wrapper.
- Package the alpha version prepared in Task 3.5 and distribute to the project team the full alpha release of the administrative / instructor website portion of the Learn Green Lighting educational software including but not limited to:
    - A fully populated set of system variables with default values useful for establishing initial conditions for Problem-Based Case Study (PBCS) Scenarios.
    - GUI functions, including the ability for:
        - Institutions to set up, manage, and maintain educational sites using Learn Green Lighting.
        - Instructors to manage students in course
        - Instructors to edit existing lighting PBCS scenarios and to create new scenarios.

- Create testing protocols, procedures and instructions for use by the testing groups. All testing groups shall provide feedback via an online reporting system at http://redmine.learnHVAC.org/.
- Conduct functional and field-testing and provide feedback from the 4-year university curriculum perspective.
- Coordinate functional and field-testing by the participating community colleges in order to provide feedback from the 2-year community college perspective.
- Solicit functional and field-testing from the Pacific Energy Center, from the perspective of a center of continuing education of building industry professionals.
- Conduct functional and field-testing and provide feedback from the perspective of a lay person, such as a high school student or teacher, or a member of the building industry with little or no technical knowledge of lighting systems.
- Produce an Interim Learn Green Lighting Alpha Feedback Report that documents the feedback obtained.
- Produce a Final Learn Green Lighting Alpha Feedback Report that documents the feedback obtained.

Deliverables:
- Alpha release of Learn Green Lighting client (no draft)
- Alpha release of Learn Green Lighting administrative / instructor website (no draft)
- Interim Learn Green Lighting Alpha Feedback Report (no draft)
- Final Learn Green Lighting Alpha Feedback Report (no draft)

Task 3.9 Develop and Release LGL Beta Version

The goal of this task is to prepare and release Beta versions of the software for both the client and the web-based administration site, based upon the feedback from the alpha testing and the revisions and improvements made to the software in response.

The Contractor shall:
- Revise the client software in response to the alpha feedback and package a beta version and distribute this version to the public for widespread testing and use.
- Revise the administrative / instructor website software in response to the alpha feedback and package a beta version and distribute this version to the public for widespread testing and use.
- Create beta version testing protocols, procedures and instructions for use by the testing groups. All testing groups shall provide feedback on the beta version via an online reporting system at http://redmine.learnHVAC.org/.
- Conduct functional and field-testing and provide feedback from the 4-year university curriculum perspective.
- Coordinate functional and field-testing by the participating community colleges in order to provide feedback from the 2-year community college perspective.
- Solicit functional and field-testing from the Pacific Energy Center, from the perspective of a center of continuing education of building industry professionals.

- Conduct functional and field-testing and provide feedback from the perspective of a lay person, such as a high school student or teacher, or a member of the building industry with little or no technical knowledge of lighting systems.
- Produce an Interim Learn Green Lighting Beta Feedback Report that documents the feedback obtained.
- Produce a Final Learn Green Lighting Beta Feedback Report that documents the feedback obtained.

Deliverables:

- Beta release of Learn Green Lighting client (no draft)
- Beta release of Learn Green Lighting administrative / instructor website (no draft)
- Interim Learn Green Lighting Beta Feedback Report (no draft)
- Final Learn Green Lighting Beta Feedback Report (no draft)

Task 3.10 Develop and Release LGL Final Version

The goal of this task is to do final revisions to the software and release the final of the Learn Green Lighting software to the general public, for both the client and the web-based administration site, based upon the feedback from the beta testing and the revisions and improvements made to the software in response.

The Contractor shall:

- Revise the client software in response to the beta feedback and shall package a final version and distribute this version to the public.
- Revise the administrative / instructor website software in response to the beta feedback and package a final version and distribute this version to the public.
- Produce an Interim Learn Green Lighting Final Feedback Report that documents the revisions made to the software.
- Produce a Final Learn Green Lighting Final Feedback Report that documents the final revisions made to the software.

Deliverables:

- Final release of Learn Green Lighting client (no draft)
- Final release of Learn Green Lighting administrative / instructor website (no draft)
- Interim Learn Green Lighting Final Feedback Report (no draft)
- Final Learn Green Lighting Final Feedback Report (no draft)

~~Project~~ Task 4 Develop "Learn Envelopes" (LE) Education Software

The goal of this ~~project~~ **task** is to advance the program goal of improving the ability of the buildings industry to deliver and operate low energy, high performance commercial buildings through enhanced education and training by developing a new learning tool for building envelope systems in commercial buildings that:

- facilitates learning about the energy saving potentials of reducing external loads in buildings via proper envelope system design, installation, operations, renovation, and system level troubleshooting;
- provides a conceptual framework that balances energy efficiency, cost, visual quality and productivity considerations; and
- provides a learning structure for exploring very low energy, advanced envelope systems.

Task List

~~The project's~~ **This task's** work scope involves the following technical tasks:

~~Project & Task #s~~	CPR	~~Project & Task Names~~
~~Project~~ Task 4		**Develop "Learn Envelopes" Education Software**
Task 4.1		Define Pedagogical Approaches
Task 4.2		Define Software Functional Requirements
Task 4.3		Develop Graphic User Interface (GUI) and Data Functionality
Task 4.4		Develop Component Level Functionality
Task 4.5		Develop System Level Functionality
Task 4.6		Prepare Documentation
Task 4.7		Preliminary Outreach / Dissemination Activities
Task 4.8		Release Alpha version
Task 4.9		Develop and Release Beta version
Task 4.10		Develop and Release final version

4.1 Define LE Pedagogical Approaches

The goal of this task is to obtain as much clarity and detail as possible about the learning objectives, approaches, and methods to be used by Learn Envelopes, as well as the knowledge, skills and attitudes to be acquired by the users of Learn Envelopes.

The Contractor shall:

- Organize and participate in a project kickoff meeting plus subsequent webinar "charrette" meetings with potential users of Learn Envelopes as well as from the building industry in order to define the pedagogical approaches to be adopted and the tool functionality required to support those approaches. The expected participants in this process shall include representative 2-year colleges, 4-year universities, energy centers and in-service training organizations.
- Develop an Interim Learn Envelopes Pedagogical Objectives Report, prior to the kickoff meeting, a description of its understanding of the pedagogical foundation for Learn Envelopes.
    - Send this draft to subcontractors and partners as appropriate, the pedagogy experts on the team, for review and comment.
    - Obtain review and comment from appropriate subcontractors and partners.

    - Send this revised draft pedagogical statement to all involved participants in advance of the first meeting. This document, and any resource of reference materials supplied by subcontractors and partners, shall form the basis of discussion at the first meeting.
- Organize and participate in subsequent webinar "charrette" meetings with potential users of Learn Envelopes.
- Gather user input from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, and the perspective of a center of continuing education of building industry professionals, and subcontractors and partners as appropriate.
- Refine the pedagogical objectives document, throughout the task, to produce a consensus of the team's thinking and input to the pedagogical objectives.
- Prepare Final Learn Envelopes Pedagogical Objectives Report describing the pedagogical objectives, based on Interim report and refinements made throughout the task.

Deliverables:
- Interim Learn Envelopes Pedagogical Objectives Report (no draft)
- Final Learn Envelopes Pedagogical Objectives Report (no draft)

Task 4.2 Define LE Software Functional Requirements
The goal of this task is to define the software functional requirements for the Learn Envelopes software with as much clarity and detail as possible, given the pedagogical information developed in the previous task.

The Contractor shall:
- Organize and participate in webinar meetings in order to define the software requirements based upon the pedagogy developed in the previous task. Participants will include:
    - The Learn Envelopes software development team,
    - Several potential users of Learn Envelopes including representative 2-year colleges, 4-year universities, energy centers and in-service training organizations.
    - Selected building industry representatives on the PAC.
- Develop an Interim Learn Envelopes Functional Requirements Report, an initial description of contractor's understanding of the software functional requirements for Learn Envelopes in consultation with appropriate subcontractors and partners. This description shall be developed prior to the first meeting to form the basis of discussion, and include consideration of at least the following:
    - The ~~"client"~~ **Scenario Player** software that the student will see, including GUI, simulations, animations, 3D environment, BIM, and others.
    - The administrative website that the instructors and administrator will use.
    - The communications between the website and the client software.
    - The underlying envelope system data structures and lighting system variables to be used.

    - Simulation capabilities, tools, and I-O for various time horizons (diurnal, weekly, monthly, and annual) that are important to the education experience.
    - Animation requirements.
    - Graphic display typical requirements and variations, such as minimum & typical display sizes.
    - Speed, storage, graphic resolution, and 3D resolution requirements.
- Gather user input from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, and the perspective of a center of continuing education of building industry professionals, and subcontractors and partners as appropriate.
- Prepare a Final Learn Envelopes Functional Requirements Report, based on Interim report and further user input as gathered in this task.

Deliverables:
- Interim Learn Envelopes Functional Requirements Report (no draft)
- Final Learn Envelopes Functional Requirements Report (no draft)

Task 4.3 Develop LE Graphic User Interface (GUI) and Data Functionality
The goal of this task is to develop working software for the GUI and data handling functions that respond to the pedagogical approaches and functional requirements defined in Tasks 4.1 and 4.2 above.

The Contractor shall:
- Refine and adapt the existing Learn HVAC **Scenario Player** ~~client~~ software to generate a version suitable for Learn Envelopes, using:
    - Flex GUI capabilities from Learn HVAC to develop building-level data structures and models for the client portion.
    - ~~XML,~~ **Data structures**, developed to be consistent with BIM procedures.
    - A 2- or 3-story office building as the example building type and set of space types for the development, the structures to be developed to be expandable to other building types and space types.
    - The existing EnergyPlus office building prototype in Learn HVAC as a starting point.
    - Sets of envelope space type definitions established to provide a solid basis for learning experiences.
    - User input – output (I-O) and display structures, formats and procedures based on Learn HVAC input techniques and formats as starting points, where appropriate.
    - New GUI and data structure approaches identified from Project **Task** 1, especially:
        - Task 1.2 Enable Whole-Building Systems Integration and
        - Task 1.5 Enhance Learn HVAC for students in 4-year college programs and other new types of users

        - New input, output, and fault menus derived from the draft set of envelope system variables defined above in Task 4.2 software functional requirements.
    - The GUI I-O shall include providing “hooks” to allow popup presentations of building case study examples of various traditional and advanced envelope system solutions.
- Develop a pre-alpha version of the **Scenario Player** ~~client~~ GUI and data structure for review by the project team.
- Develop, in response to review comments, an alpha version of the **Scenario Player** ~~client~~ GUI and data structure suitable for inclusion in the overall Learn Envelopes alpha version to be assembled and released in Task 4.8 below.
- Refine and adapt the existing Learn HVAC administrative / instructor software capabilities to generate a version suitable for Learn Envelopes:
    - Adapt existing ~~Ruby on Rails~~ **software** capabilities
    - Adapt existing GUI features and data structures from the Learn HVAC administrative site Learn HVAC input techniques and formats as starting points, where appropriate.
    - Design the Learn Envelopes administrative site to be used by educational organizations and instructors teaching envelopes.
    - Develop a pre-alpha version of the administrative / instructor GUI and data structure for review by the project team.
    - Develop, in response to review comments, an alpha version of the administrative / instructor GUI and data structure suitable for inclusion in the overall Learn Envelopes alpha version to be assembled and released in Task 4.8 below.
    - Organize and participate in routine webinar meetings during the software development process that will include members of the software team plus potential users and will provide opportunities to review the progress to ensure it is consistent with the pedagogical objectives from Task 4.1 and the software functional requirements identified in Task 4.2.
    - Gather user input from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, and the perspective of a center of continuing education of building industry professionals, and subcontractors and partners as appropriate. Establish a Quality Assurance function that will include the independent testing, by others, of the software as it is defined and implemented. Testing shall include:
    - Functional testing against a defined set of criteria (as defined in the early stages of the project) and usability testing.
    - Validation that the application works as expected, and also that the simulation and educational data are valid and appropriate for the learning goals.
    - Ongoing QA assessment

Deliverables:

- Alpha version of GUI and data structures for Learn Envelopes client (no draft)
- Alpha version of GUI and data structures for Learn Envelopes administration site (no draft)

Task 4.4 Develop LE Component Level Functionality

The goal of this task is to develop working software to address the components of the building envelope as listed below that respond to the pedagogical approaches and functional requirements defined in Tasks 4.1 and 4.2 above.

The Contractor shall:

- Develop basic component level data structures, GUI input-output, and functionality for the building envelope components listed below. Data structures and approaches will draw upon those in such existing tools as EnergyPlus, UC Berkeley thermal comfort model, Commercial Fenestration Design Tool (COMFEN), etc.:
    - Opaque envelope elements, including such elements as:
        - Construction and assembly type.
        - Insulation levels, placement, and location.
        - Thermal mass.
        - Surface reflectance and emittance (e.g., cool roofs, etc.)
        - Thermal breaks
    - Fenestration elements such as:
        - Glazing characteristics
        - Frame type and construction.
        - Thermal characteristics
        - Visual characteristics
        - Fenestration amounts and locations
    - Interior thermal comfort considerations, for both exterior zones and interior zones, using the UC Berkeley Thermal Comfort model.
    - Intersections of envelope elements
    - Air leakage, considering leakage through materials and via intersections
    - Commissioning (using Total Building Commissioning approach in NIBS Guideline 3-2006 and ASHRAE Guideline 0-2005).
    - Education of O&M staff & Occupants (using Total Building Commissioning tools and procedures from NIBS Guideline 3-2006 and form ASHRAE Guideline 0-2005).
- Develop the above component functionality for an example office space within a 2- to 3-story office building, the data structure to allow the setting to be expandable to other building types and space types. This will include:
    - Establishing data and GUI links so that the animations respond to the simulations, given techniques developed in Learn HVAC, including links **as appropriate** to components 1-5 above to:
        - EnergyPlus to determine energy impacts
        - COMFEN

        - The UC Berkeley Thermal comfort model.
        - The dynamic 3D display capability (likely to be ~~Unity3D~~ **WebGL**, or similar).
        - Other simulation tools as appropriate.
    - Developing supporting GUI I-O capabilities to relate the animations/ simulations to the related building envelope Problem-Based Case Study scenarios PBCS, using techniques developed in Learn HVAC, and inserting key related content from existing guidelines.
    - Construct example Use Cases and scenarios for key phases of the envelope system development and use, using the use cases and Problem-Based Case Study scenarios identified in Task 4.2 as starting points, and the commissioning guideline annex materials as resources.
    - Develop a pre-alpha version of the component-level software for review by the project team.
    - Develop, in response to review comments, an alpha version of the component-level software suitable for inclusion in the overall Learn Envelopes alpha version to be assembled and released in Task 4.8 below.
    - Develop and populate a new set of lighting system variables to handle the range of variables for the envelope systems, components and faults being addressed. User-interactions for the Learn Envelopes administrative site may need to be refined to address the enhanced combination of lighting system variables.
- Develop a pre-alpha version of the administrative / instructor component level software for review by the project team.
- Develop, in response to review comments, an alpha version of the administrative / instructor component level software suitable for inclusion in the overall Learn Envelopes alpha version to be assembled and released in Task 4.8 below.
- Organize and participate in routine webinar meetings during the software development process that will include members of the software team plus potential users and will provide opportunities to review the progress to ensure it is consistent with the pedagogical objectives from Task 4.1 and the software functional requirements identified in Task 4.2.
- Gather user input from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, and the perspective of a center of continuing education of building industry professionals, and subcontractors and partners as appropriate.
- Establish a Quality Assurance function that will include the independent testing, by others, of the software as it is defined and implemented. Testing shall include:
    - Functional testing against a defined set of criteria (as defined in the early stages of the project) and usability testing.
    - Validation that the application works as expected, and also that the simulation and educational data are valid and appropriate for the learning goals.
    - Ongoing QA assessment.

Deliverables:
- Alpha version of the component level software for Learn Envelopes client (no draft)
- Alpha version of the component level software for Learn Envelopes administration site (no draft)

Task 4.5 Develop LE System Level Functionality
The goal of this task is to develop working software to address the overall educational software for the building envelope system that responds to the pedagogical approaches and functional requirements defined in Tasks 4.1 and 4.2 above.

The Contractor shall:
- Integrate into a functional whole and test the combined functionality of all aspects of the Learn Envelopes educational software, including but not limited to:
    - Component models,
    - GUI functions,
    - Simulation tools,
    - 3D displays,
    - Simulation-driven animations
    - Example problem-based case study scenarios (PBCS) scenarios.
    - Coordinating the development of a new wrapper for the various software components or the refinement of an existing wrapper.
- Develop a pre-alpha version of the system-level software for review by the project team.
- Develop, in response to review comments, an alpha version of the system-level software suitable for inclusion in the overall Learn Green Lighting alpha version to be assembled and released in Task 4.8 below.
- Develop an integrated functioning administrative / instructor site including:
    - A fully populated set of system variables with default values useful for establishing initial conditions for Problem-Based Case Study (PBCS) Scenarios.
    - GUI functions, including the ability for:
        - Institutions to set up, manage, and maintain educational sites using Learn Envelopes.
        - Instructors to manage students in course
        - Instructors to edit existing envelope PBCS scenarios and to create new scenarios.
- Develop a pre-alpha version of the administrative / instructor system level software for review by the project team.
- Develop, in response to review comments, an alpha version of the administrative / instructor GUI and data structure suitable for inclusion in the overall Learn Envelopes alpha version to be assembled and released in Task 4.8 below.
- Organize and participate in routine webinar meetings during the software development process that will include members of the software team plus potential users and will provide opportunities to review the progress to ensure it is consistent

with the pedagogical objectives from Task 4.1 and the software functional requirements identified in Task 4.2.

- Gather user input from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, and the perspective of a center of continuing education of building industry professionals, and subcontractors and partners as appropriate.
- Establish a Quality Assurance function that will include the independent testing, by others, of the software as it is defined and implemented. Testing shall include:
    - Functional testing against a defined set of criteria (as defined in the early stages of the project) and usability testing.
    - Validation that the application works as expected, and also that the simulation and educational data are valid and appropriate for the learning goals.
    - Ongoing QA assessment.

Deliverables:

- Alpha version of the system level software for Learn Envelopes client (no draft)
- Alpha version of the system level software for Learn Envelopes administration site (no draft)

Task 4.6 Prepare LE Documentation

The goal of this task is to document the new Learn Envelope educational software so that it is easy to understand and to use. As with documentation of Learn HVAC, the audiences for this building envelope documentation will include both technical audiences who may wish to enhance the tool, as well as users of the tool such as students and teachers.

The Contractor shall:

- Create Interim Learn Envelopes Documentation, including:
    - Technical documentation for system administrators, open source programmers and IT staff.
    - Instructor documentation for instructors customizing the tool and using it in classroom, workshop, and online education settings.
    - User documentation for students.
- Create Final Learn Envelopes Documentation, including:
    - Technical documentation for system administrators, open source programmers and IT staff.
    - Instructor documentation for instructors customizing the tool and using it in classroom, workshop, and online education settings.
    - User documentation for students.

Deliverables:

- Interim Learn Envelopes Technical, Instructor, and User Documentation (no draft)
- Final Learn Envelopes Technical, Instructor, and User Documentation (no draft)

Task 4.7 Preliminary LE Outreach / Dissemination Activities
The goal of this task is to conduct outreach and publicity activities to alert potential users that the software is under development to allow them to plan for its use in the near future.

The Contractor shall:
- Work with the community colleges in California with active architecture programs to facilitate its use. This will be done during and after field-testing
- Notify other possible building industry groups such as:
    - Building Enclosure Technology & Environment Council (BETEC), ASHRAE, AIA, unions, DGS, GSA, large manufacturers of envelope and fenestration materials and equipment, etc.
    - The community colleges in the US with architectural programs,
    - Engineering and architectural programs in universities nationwide,
    - Union-based education efforts, and
    - Organizations with active in-house energy education programs.
- Develop an Interim **section on Outreach within the** Learn Envelopes ~~Outreach~~ Report documenting outreach and dissemination activities both underway and planned.
- Develop a Final **section on Outreach within the** Learn Envelopes ~~Outreach~~ Report documenting the outreach and dissemination activities accomplished in this task and project.

Deliverables:
- Interim **section on Outreach within the** Learn Envelopes ~~Outreach~~ Report (no draft)
- Final **section on Outreach within the** Learn Green Lighting ~~Outreach~~ Report (no draft)

Task 4.8 Release LE Alpha Version
The goal of this task is to the alpha versions of the software for both the client and the web-based administration website in order to obtain feedback from functional and field-testing activities. This task involves the final assembly of the alpha version release and testing and providing feedback on the alpha release.

The Contractor shall:
- Package the alpha version prepared in Task 4.5 and distribute to the project team the full alpha release of the client portion of the Learn Envelopes educational software, including but not limited to:
    - Component models,
    - GUI functions,
    - Simulation tools,
    - 3D displays,
    - Simulation-driven animations
    - Example problem-based case study scenarios (PBCS) scenarios.

- Coordinate the development of a new wrapper for the various software components or the refinement of an existing wrapper.
- Package the alpha version prepared in Task 4.5 and distribute to the project team the full alpha release of the administrative / instructor website portion of the Learn Green Lighting educational software including but not limited to:
    - A fully populated set of system variables with default values useful for establishing initial conditions for PBCS scenarios.
    - GUI functions, including the ability for:
        - Institutions to set up, manage, and maintain educational sites using Learn Envelopes.
        - Instructors to manage students in course
        - Instructors to edit existing lighting PBCS scenarios and to create new scenarios.
- Gather user input from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, the lay-person perspective, and the perspective of a center of continuing education of building industry professionals, and subcontractors and partners as appropriate.
- Produce an Interim Learn Envelopes Alpha Feedback Report that documents the feedback obtained.
- Produce a Final Learn Envelopes Alpha Feedback Report that documents the feedback obtained.

Deliverables:
- Alpha release of Learn Envelopes client (no draft)
- Alpha release of Learn Envelopes administrative / instructor website (no draft)
- Interim Learn Envelopes Alpha Feedback Report (no draft)
- Final Learn Envelopes Alpha Feedback Report (no draft)

Task 4.9 Develop and Release LE Beta Version
The goal of this task is to prepare and release Beta versions of the software for both the client and the web-based administration site, based upon the feedback from the alpha testing and the revisions and improvements made to the software in response.

The Contractor shall:
- Revise the **Scenario Player** ~~client~~ software in response to the alpha feedback and package a beta version and distribute this version to the public for widespread testing and use.
- Revise the **Scenario Builder and** administrative ~~/ instructor website~~ software in response to the alpha feedback and package a beta version and distribute this version to the public for widespread testing and use.
- Package the alpha version prepared in Task 4.5 and distribute to the project team the full alpha release of the **Scenario Builder and** administrative ~~/ instructor website portion of the Learn Envelopes educational~~ software including but not limited to:

    - A fully populated set of system variables with default values useful for establishing initial conditions for PBCS scenarios.
    - GUI functions, including the ability for:
        - Institutions to set up, manage, and maintain educational sites using Learn Envelopes.
        - Instructors to manage students in course
        - Instructors to edit existing lighting PBCS scenarios and to create new scenarios.
- Create beta version testing protocols, procedures and instructions for use by the testing groups. All testing groups shall provide feedback on the beta version via an online reporting system **using Mantis or a similar package** ~~at http://redmine.learnHVAC.org/.~~
- Gather user input from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, the lay-person perspective, and the perspective of a center of continuing education of building industry professionals, and subcontractors and partners as appropriate.
- Produce an Interim **Beta Feedback section of the** Learn Envelopes ~~Beta Feedback~~ Report that documents the feedback obtained.
- Produce a Final **Beta Feedback section of the** Learn Envelopes ~~Beta Feedback~~ Report that documents the feedback obtained.

Deliverables:
- Beta release Learn Envelopes client (no draft)
- Beta release of Learn Envelopes administrative / instructor website (no draft)
- Interim **Beta Feedback section of the** Learn Envelopes ~~Beta Feedback~~ Report (no draft)
- Final **Beta Feedback section of the** Learn Envelopes ~~Beta Feedback~~ Report (no draft)

Task 4.10 Develop and Release LE Final Version
The goal of this task is to do final revisions to the software and release the final of the Learn Envelopes software to the general public, for both the client and the web-based administration site, based upon the feedback from the beta testing and the revisions and improvements made to the software in response.

The Contractor shall:
- Revise the client software in response to the beta feedback and shall package a final version and distribute this version to the public.
- Revise the **Scenario Builder and** administrative ~~/ instructor website~~ software in response to the beta feedback and package a final version and distribute this version to the public.
- Produce an Interim **Final Feedback section of the** Learn Envelopes ~~Final Feedback~~ Report that documents the feedback obtained.
- Produce a Final **Feedback section of the** Learn Envelopes ~~Final Feedback~~ Report that documents the feedback obtained.

Deliverables:

- Final release Learn Envelopes client (no draft)
- Final release of Learn Envelopes administrative / instructor website (no draft)
- Interim Learn Envelopes Final Feedback Report (no draft)
- Final Learn Envelopes Final Feedback Report (no draft)

~~Project~~ Task 5 Develop "Learn Daylighting" Education Software

The goal of this project is to advance the program goal of improving the ability of the buildings industry to deliver and operate energy-efficient commercial buildings through enhanced education and training by developing a new learning tool for daylighting systems in commercial buildings that:

- Facilitates the learning of designing for daylighting in a space.
- Provides a software platform to evaluate and learn about the daylighting controls components available from manufacturers to convert the daylighting in to energy savings.
- Provides a conceptual structure for adding future capabilities to the daylighting educational software tool that will facilitate learning about total building commissioning and troubleshooting of daylighting systems during several phases of building delivery and use including :
    - Pre-design and design
    - Construction documents
    - Construction
    - Occupancy, operations & maintenance
    - Retrofit

Task List

~~The project's~~ **This task's** work scope involves the following technical tasks:

~~Project & Task #s~~	CPR	~~Project & Task Names~~
~~Project~~ Task 5		**Develop "Learn Daylighting" Education Software**
Task 5.1		Define Pedagogical Approaches
Task 5.2		Define Software Functional Requirements
Task 5.3		Develop Graphic User Interface (GUI) and Data Functionality
Task 5.4		Develop Component Level Functionality
Task 5.5		Develop System Level Functionality
Task 5.6		Prepare Documentation
Task 5.7		Preliminary Outreach / Dissemination Activities
Task 5.8		Release Alpha version
Task 5.9		Develop and Release Beta version
Task 5.10		Develop and Release final version

Task 5.1 Define LDL Pedagogical Approaches
The goal of this task is to obtain as much clarity and detail as possible about the learning objectives, approaches, and methods to be used by Learn Daylighting, as well as the knowledge, skills and attitudes to be acquired by the users of Learn Daylighting.

The Contractor shall:

- Organize and participate in a project kickoff meeting plus subsequent webinar "charrette" meetings with potential users of Learn Daylighting as well as from the building industry in order to define the pedagogical approaches to be adopted and the tool functionality required to support those approaches. The expected participants in this process shall include representative 2-year colleges, 4-year universities, energy centers and in-service training organizations.
- Develop an Interim Learn Envelopes Pedagogical Objectives Report **section**, prior to the kickoff meeting, a description of its understanding of the pedagogical foundation for Learn Envelopes.
    - Send this draft to subcontractors and partners as appropriate, the pedagogy experts on the team, for review and comment.
    - Obtain review and comment from appropriate subcontractors and partners.
    - Send this revised draft pedagogical statement to all involved participants in advance of the first meeting. This document, and any resource of reference materials supplied by subcontractors and partners, shall form the basis of discussion at the first meeting.
- The Interim Learn Envelopes Pedagogical Objectives Report **section** should result in a clear identification for each user group of:
    - The Use Cases and types of interactivity expected from the daylighting tool, by life-cycle phases.
    - Any constraints or opportunities special to each user group. This will include consideration of:
        - Technical objectives, issues, opportunities, and requirements including energy, cost, comfort and productivity.
        - Business, communications, team-building, and collaboration objectives such as speaking in public, etc.
        - Key Example Problem-Based Case Study (PBCS) scenarios.
- Organize and participate in subsequent webinar "charrette" meetings with potential users of Learn Daylighting.
- Gather user input from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, and the perspective of a center of continuing education of building industry professionals, and subcontractors and partners as appropriate.
- Refine the pedagogical objectives document, throughout the task, to produce a consensus of the team's thinking and input to the pedagogical objectives.
- Prepare Final Learn Envelopes Pedagogical Objectives Report **section** describing the pedagogical objectives, based on Interim report and refinements made throughout the task.

Deliverables:
- Interim Learn Daylighting Pedagogical Objectives Report **section** (no draft)
- Final Learn Envelopes Pedagogical Objectives Report **section** (no draft)

Task 5.2 Define LDL Software Functional Requirements
The goal of this task is to define the software functional requirements for the Learn Daylighting software with as much clarity and detail as possible, given the pedagogical information developed in the previous task.

The Contractor shall:
- Organize and participate in webinar meetings in order to define the software requirements based upon the pedagogy developed in the previous task. Participants shall include:
    - The Learn Daylighting software development team,
    - Several potential users of Learn Daylighting including representative 2-year colleges, 4-year universities, energy centers and in-service training organizations.
    - Selected building industry representatives on the PAC.
- Develop an Interim Learn Daylighting Functional Requirements Report, an initial description of contractor's understanding of the software functional requirements for Learn Envelopes in consultation with appropriate subcontractors and partners. This description shall be developed prior to the first meeting, form the basis of discussion, and include consideration of at least the following:
    - The "client" software that the student will see, including GUI, simulations, animations, 3D environment, BIM, and other.
    - The administrative website that the instructors and administrator will use.
    - The communications between the website and the client software.
    - The underlying daylighting data structures and daylighting variables to be used. This will include but not be limited to:
        - Variables for each daylighting component to be included,
        - Key values for each variable,
        - Identification of key likely faults for each major daylighting component (faults could come from design, documentation, construction, O&M, etc.)
    - Simulation capabilities, tools, and I-O for various time horizons (diurnal, weekly, monthly, and annual) that are important to the education experience.
    - Animation requirements.
    - Graphic display typical requirements and variations, such as minimum & typical display sizes.
    - Speed, storage, graphic resolution, and 3D resolution requirements.
- Gather user input from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, and the perspective of a center of continuing education of building industry professionals, and subcontractors and partners as appropriate.

- Prepare a Final Learn Daylighting Functional Requirements Report, based on Interim report and further user input as gathered in this task.

Deliverables:
- Interim Learn Daylighting Functional Requirements Report (no draft)
- Final Learn Daylighting Functional Requirements Report (no draft)

Task 5.3 Develop LDL Graphic User Interface (GUI) and Data Functionality
The goal of this task is to develop working software for the GUI and data handling functions that respond to the pedagogical approaches and functional requirements defined in Tasks 5.1 and 5.2 above.

The Contractor shall:
- Refine and adapt the existing Learn HVAC client software to generate a version suitable for Learn Daylighting, using:
    - FLEX GUI capabilities from Learn HVAC to develop building-level data structures and models for the **Scenario Player** ~~client~~ portion.
    - ~~XML,~~ **Data structures and presentations** developed to be consistent with BIM procedures.
    - A 2- or 3-story office building as the example building type and set of space types for the development, the structures to be developed to be expandable to other building types and space types.
    - The existing EnergyPlus office building prototype in Learn HVAC as a starting point.
    - Sets of daylighting space type definitions established to provide a solid basis for learning experiences.
    - User input – output (I-O) and display structures, formats and procedures based on Learn HVAC input techniques and formats as starting points, where appropriate.
    - New GUI and data structure approaches identified from Project 1, especially:
        - Task 1.2 Enable Whole-Building Systems Integration and
        - Task 1.5 Enhance Learn HVAC for students in 4-year college programs and other new types of users
        - New input, output, and fault menus derived from the draft set of lighting system variables defined above in Task 5.2 software functional requirements.
    - The GUI I-O shall include providing “hooks” to allow popup presentations of building case study examples of various traditional and advanced lighting system solutions.

- Develop a pre-alpha version of the client GUI and data structure for review by the project team.
- Develop, in response to review comments, an alpha version of the client GUI and data structure suitable for inclusion in the overall Learn Daylighting alpha version to be assembled and released in Task 5.8 below.
- Refine and adapt the existing Learn HVAC administrative / instructor software capabilities to generate a version suitable for Learn Daylighting:
    - Adapt existing ~~Ruby on Rails~~ **software** capabilities
    - Adapt existing GUI features and data structures from the Learn HVAC administrative site Learn HVAC input techniques and formats as starting points, where appropriate.
    - Design the Learn Daylighting administrative **web-based functions** ~~site~~ to be used by educational organizations teaching daylighting and by daylighting instructors.
- Develop a pre-alpha version of the **Scenario Builder** administrative ~~/ instructor~~ GUI and data structure for review by the project team.
- Develop, in response to review comments, an alpha version of the **Scenario Builder** administrative ~~/ instructor~~ GUI and data structure suitable for inclusion in the overall Learn Daylighting alpha version to be assembled and released in Task 5.8 below.
- Organize and participate in routine webinar meetings during the software development process that will include members of the software team plus potential users and will provide opportunities to review the progress to ensure it is consistent with the pedagogical objectives from Task 5.1 and the software functional requirements identified in Task 5.2.
- Gather user input from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, and the perspective of a center of continuing education of building industry professionals, and subcontractors and partners as appropriate.
- Establish a Quality Assurance function that will include the independent testing, by others, of the software as it is defined and implemented. Testing shall include:
    - Functional testing against a defined set of criteria (as defined in the early stages of the project) and usability testing.
    - Validation that the application works as expected, and also that the simulation and educational data are valid and appropriate for the learning goals.
    - Ongoing QA assessment.

Deliverables:

- Alpha version of GUI and data structures for Learn Daylighting client (no draft)
- Alpha version of GUI and data structures for Learn Daylighting administration site (no draft)

Task 5.4 Develop LDL Component Level Functionality

The goal of this task is to develop working software to address the components of the building envelope as listed below that respond to the pedagogical approaches and functional requirements defined in Tasks 5.1 and 5.2 above.

The Contractor shall:

- Develop basic component level data structures, GUI input-output, and functionality for the daylighting system components listed below:
    - Building form and envelope (using techniques from the EcoAdvisor/Daylighting website and its supporting data structures).
    - Envelope & Glazing, using techniques and supporting data structures from Project 4 Learn Envelopes (including COMFEN) of this contract.
    - Interiors (using techniques, variables and approaches for interior surfaces, furniture arrangements, and partition heights and transparency options developed for the EcoAdvisor/Daylighting website).
    - Lighting (using techniques and supporting data structures from Project 3
    - Controls (using inputs from CLTC, LBNL, **and others as appropriate** ~~the Weidt Group~~.)
    - Educating O&M staff & Occupants (using Total Building Commissioning tools and procedures from the ASHRAE/NIBS collaboration).
- Develop the above component functionality for an example office space within a 2- to 3-story office building, but using a data structure will allow the setting to be expandable to other building types and space types. This shall include:
    - Establishing data and GUI links to enable the animations respond to the simulations, given techniques developed in Learn HVAC,
    - Linking **the six** components ~~1-6~~ listed **immediately** above to:
        - EnergyPlus to determine energy impacts
        - The dynamic 3D display capability (likely to be **WebGL** ~~Unity3D~~).
        - Other simulation tools as appropriate.
    - Developing supporting GUI I-O capabilities to relate the animations/ simulations to the related daylighting Problem-Based Case Study scenarios PBCS, using techniques developed in Learn HVAC, and inserting key related content from existing guidelines.
- Construct example Use Cases and scenarios for key phases of daylighting system development and use, using the use cases and Problem-Based Case Study scenarios identified in Task 5.2 as starting points, and the commissioning guideline annex materials as resources.
- Develop a pre-alpha version of the component-level software for review by the project team.
- Develop, in response to review comments, an alpha version of the component-level software suitable for inclusion in the overall Learn Daylighting alpha version to be assembled and released in Task 5.8 below.
- Develop and populate a new set of daylighting system variables to handle the range of variables for the daylighting systems, components and faults being addressed. User-interactions for the Learn Daylighting administrative site may need to be refined to address the enhanced combination of lighting system variables.
- Develop a pre-alpha version of the administrative / instructor component level software for review by the project team.

- Develop, in response to review comments, an alpha version of the administrative / instructor component level software suitable for inclusion in the overall Learn Daylighting alpha version to be assembled and released in Task 5.8 below.
- Organize and participate in routine webinar meetings during the software development process that will include members of the software team plus potential users and will provide opportunities to review the progress to ensure it is consistent with the pedagogical objectives from Task 5.1 and the software functional requirements identified in Task 5.2.
- Gather user input from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, and the perspective of a center of continuing education of building industry professionals, and subcontractors and partners as appropriate.
- Establish a Quality Assurance function that will include the independent testing, by others, of the software as it is defined and implemented. Testing shall include:
    - Functional testing against a defined set of criteria (as defined in the early stages of the project) and usability testing.
    - Validation that the application works as expected, and also that the simulation and educational data are valid and appropriate for the learning goals.
    - Ongoing QA assessment.

Deliverables:

- Alpha version of the component level software for Learn Daylighting client (no draft)
- Alpha version of the component level software for Learn Daylighting administration site (no draft)

Task 5.5 Develop LDL System Level Functionality

The goal of this task is to develop working software to address the overall educational software for the building's daylighting system that responds to the pedagogical approaches and functional requirements defined in Tasks 5.1 and 5.2.

The Contractor shall:

- Integrate into a functional whole and test the combined functionality of all aspects of the Learn Daylighting educational software, including but not limited to:
    - Component models,
    - GUI functions,
    - Simulation tools,
    - 3D displays,
    - Simulation-driven animations
    - Example problem-based case study scenarios (PBCS) scenarios.
    - Coordinating the development of a new wrapper for the various software components or the refinement of an existing wrapper.

- Develop a pre-alpha version of the system-level software for review by the project team.
- Develop, in response to review comments, an alpha version of the system-level software suitable for inclusion in the overall Learn Daylighting alpha version to be assembled and released in Task 5.8 below.
- Develop an integrated functioning administrative / instructor site including:
    - a fully populated set of system variables with default values useful for establishing initial conditions for Problem-Based Case Study (PBCS) Scenarios.
    - GUI functions, including the ability for:
        - Institutions to set up, manage, and maintain educational sites using Learn Daylighting.
        - Instructors to manage students in course
        - Instructors to edit existing lighting PBCS scenarios and to create new scenarios.
- Develop a pre-alpha version of the administrative / instructor system level software for review by the project team.
- Develop, in response to review comments, an alpha version of the administrative / instructor GUI and data structure suitable for inclusion in the overall Learn Daylighting alpha version to be assembled and released in Task 5.8 below.
- Organize and participate in routine webinar meetings during the software development process that will include members of the software team plus potential users and will provide opportunities to review the progress to ensure it is consistent with the pedagogical objectives from Task 5.1 and the software functional requirements identified in Task 5.2.
- Gather user input from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, and the perspective of a center of continuing education of building industry professionals, and subcontractors and partners as appropriate.
- Establish a Quality Assurance function that will include the independent testing, by others, of the software as it is defined and implemented. Testing shall include:
    - Functional testing against a defined set of criteria (as defined in the early stages of the project) and usability testing.
    - Validation that the application works as expected, and also that the simulation and educational data are valid and appropriate for the learning goals.
    - Ongoing QA assessment.

Deliverables:

- Alpha version of the system level software for Learn Daylighting client (no draft)
- Alpha version of the system level software for Learn Daylighting administration site (no draft)

Task 5.6 Prepare LDL Documentation
The goal of this task is to document the new Learn Daylighting educational software so that it is easy to understand and to use. As with documentation of Learn HVAC, the audiences for this lighting documentation will include both technical audiences who may wish to enhance the tool, as well as users of the tool such as students and teachers.

The Contractor shall:
- Create Interim Learn Daylighting Documentation, including:
    - Technical documentation for system administrators, open source programmers and IT staff.
    - Instructor documentation for instructors customizing the tool and using it in classroom, workshop, and online education settings.
    - User documentation for students.
- Create Final Learn Daylighting Documentation, including:
    - Technical documentation for system administrators, open source programmers and IT staff.
    - Instructor documentation for instructors customizing the tool and using it in classroom, workshop, and online education settings.
    - User documentation for students.

Deliverables:
- Interim Learn Daylighting Technical, Instructor, and User Documentation (no draft)
- Final Learn Daylighting Technical, Instructor, and User Documentation (no draft)

Task 5.7 Preliminary LDL Outreach / Dissemination Activities
The goal of this task is to conduct outreach and publicity activities to alert potential users that the software is under development to allow them to plan for its use in the near future.

The Contractor shall:
- Work with the community colleges in California with active lighting and/or architecture programs to facilitate its use. This shall be done during and after field-testing.
- Notify other possible building industry groups such as:
    - IESNA, IALD, ASHRAE, AIA, unions, DGS, GSA, large lighting equipment manufacturers, etc.
    - The community colleges in the US with lighting and/or architectural programs,
    - Engineering and architectural programs in universities nationwide,
    - Union-based education efforts, and
    - Organizations with active in-house energy education programs.

- Develop an Interim Learn Daylighting Outreach Report **section** documenting outreach and dissemination activities both underway and planned.
- Develop a Final Learn Daylighting Outreach Report **section** documenting the outreach and dissemination activities accomplished in this task and project.

Deliverables:
- Interim Learn Daylighting Outreach Report **section** (no draft)
- Final Learn Daylighting Outreach Report **section** (no draft)

Task 5.8 Release LDL Alpha Version
The goal of this task is to assemble and release the alpha versions of the software for both the client and the web-based administration website in order to obtain feedback from functional and field-testing activities. This task involves the final assembly of the alpha version release and testing and providing feedback on the alpha release.

The Contractor shall:
- Package the alpha version prepared in Task 5.5 and distribute to the project team the full alpha release of the client portion of the Learn Daylighting educational software, including but not limited to:
    - Component models,
    - GUI functions,
    - Simulation tools,
    - 3D displays,
    - Simulation-driven animations
    - Example problem-based case study scenarios (PBCS) scenarios.
- Coordinate the development of a new wrapper for the various software components or the refinement of an existing wrapper.
- Package the alpha version prepared in Task 5.5 and distribute to the project team the full alpha release of the administrative / instructor website portion of the learn daylighting educational software including but not limited to:
    - A fully populated set of system variables with default values useful for establishing initial conditions for problem-based case study (PBCS) scenarios.
    - GUI functions, including the ability for:
        - Institutions to set up, manage, and maintain educational sites using learn daylighting.
        - Instructors to manage students in course
        - Instructors to edit existing lighting PBCS scenarios and to create new scenarios.
- Create testing protocols, procedures and instructions for use by the testing groups. All testing groups shall provide feedback via an online reporting system at http://redmine.learnHVAC.org/.
- Gather user input from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, the lay-

person perspective, and the perspective of a center of continuing education of building industry professionals, and subcontractors and partners as appropriate.
- Produce an Interim Learn Daylighting Alpha Feedback Report **section** that documents the feedback obtained.
- Produce a Final Learn Daylighting Alpha Feedback Report **section** that documents the feedback obtained.

Deliverables:
- Alpha release of Learn Daylighting client (no draft)
- Alpha release of Learn Daylighting administrative / instructor website (no draft)
- Interim Learn Daylighting Alpha Feedback Report **section** (no draft)
- Final Learn Daylighting Alpha Feedback Report **section** (no draft)

Task 5.9 Develop and Release LDL Beta Version
The goal of this task is to prepare and release Beta versions of the software for both the client and the web-based administration site, based upon the feedback from the alpha testing and the revisions and improvements made to the software in response.

The Contractor shall:
- Revise the client software in response to the alpha feedback and package a beta version and distribute this version to the public for widespread testing and use.
- Revise the administrative / instructor website software in response to the alpha feedback and package a beta version and distribute this version to the public for widespread testing and use.
- Create beta version testing protocols, procedures and instructions for use by the testing groups. All testing groups shall provide feedback on the beta version via an online reporting system at http://redmine.learnhvac.org/.
- Gather user input from the 4-year university curriculum perspective, the 2-year community college perspective, the Pacific Energy Center perspective, the lay-person perspective, and the perspective of a center of continuing education of building industry professionals, and subcontractors and partners as appropriate.
- Produce an Interim Learn Daylighting Beta Feedback Report **section** that documents the feedback obtained.
- Produce a Final Learn Daylighting Beta Feedback Report **section** that documents the feedback obtained.

Deliverables:
- Beta release of Learn Daylighting client (no draft)
- Beta release of Learn Daylighting administrative / instructor website (no draft)
- Interim Learn Daylighting Beta Feedback Report **section** (no draft)
- Final Learn Daylighting Beta Feedback Report **section** (no draft)

Task 5.10 Develop and Release LDL Final Version
The goal of this task is to make final revisions to the software and release the final of the Learn Daylighting software to the general public, for both the client and the web-

based administration site, based upon the feedback from the beta testing and the revisions and improvements made to the software in response.

The Contractor shall:

- Revise the client software in response to the beta feedback and shall package a final version and distribute this version to the public.
- Revise the administrative / instructor website software in response to the beta feedback and package a final version and distribute this version to the public.
- Produce an Interim Learn Daylighting Final Feedback Report **section** that documents the feedback obtained.
- Produce a Final Learn Daylighting Final Feedback Report **section** that documents the feedback obtained.

Deliverables:

- Final release of Learn Daylighting client (no draft)
- Final release of Learn Daylighting administrative / instructor website (no draft)
- Interim Learn Daylighting Final Feedback Report **section** (no draft)
- Final Learn Daylighting Final Feedback Report **section** (no draft)