

GRANT REQUEST FORM (GRF)

CEC-270 (Revised 02/13)

CALIFORNIA ENERGY COMMISSION

New Agreement EPC-15-004 (To be completed by CGL Office)

Division	Agreement Manager:	MS-	Phone
ERDD	Bradley Meister	51	916-327-1722

Recipient's Legal Name	Federal ID Number
Electric Power Research Institute, Inc.	23-7175375

Title of Project
Climate appropriate HVAC Systems for Commercial Buildings to Reduce Energy Use and Demand

Term and Amount	Start Date	End Date	Amount
	7/1/2015	12/30/2018	\$ 2,834,721

Business Meeting Information
 ARFVTP agreements under \$75K delegated to Executive Director.

Proposed Business Meeting Date	7/8/2015	<input type="checkbox"/> Consent	<input checked="" type="checkbox"/> Discussion
Business Meeting Presenter	Bradley Meister	Time Needed: 5 minutes	

Please select one list serve. Select

Agenda Item Subject and Description

Proposed resolution approving Agreement EPC-15-004 with the Electric Power Research Institute (EPRI) for a \$2,834,721 grant to develop and demonstrate a climate appropriate HVAC system for commercial buildings that integrates variable refrigerant flow technology with indirect evaporative cooling and operationally optimizes use of the building control system. This combined system is expected to reduce energy use and peak demand. (EPIC funding)
Contact: Bradley Meister

California Environmental Quality Act (CEQA) Compliance

1. Is Agreement considered a "Project" under CEQA?
 Yes (skip to question 2) No (complete the following (PRC 21065 and 14 CCR 15378)):
 Explain why Agreement is not considered a "Project":
 Agreement will not cause direct physical change in the environment or a reasonably foreseeable indirect physical change in the environment because

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

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

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

 Categorical Exemption. List CCR section number: 14 CCR 15306 and 14 CCR 15301
 Common Sense Exemption. 14 CCR 15061 (b) (3)

Explain reason why Agreement is exempt under the above section:

The Class 6 exemption for basic data collection, research, experimental management, and resource evaluation activities that do not result in major disturbances to an environmental resource applies to this project because it includes collecting data from variable refrigerant flow and indirect evaporative cooling systems. This data will help inform the best way to use the building control system to optimize energy use.

The Class 1 exemption for operation, repair, maintenance, permitting, leasing, or licensing, or minor alteration of existing structures or facilities, involving no expansion of existing uses applies to this project because it may include removal of HVAC units and installation of IEC and VRF units with minor associated construction work, as described above, that may include the following: duct work; installation of a 100 square foot concrete pad; adding additional wiring; installing small IEC and VRF controls, sensors, and thermostats; running refrigerant, water supply, and drain lines; possible structural strengthening to support IEC and VRF weight; painting; and minor landscaping. The removal of HVAC units and installation of IEC and VRF units, and associated construction, are minor alterations to the existing structure that will not expand its use.

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

Check all that apply

 Initial Study

 Environmental Impact Report

 Negative Declaration

 Statement of Overriding Considerations

 Mitigated Negative Declaration

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List all subcontractors (major and minor) and equipment vendors: (attach additional sheets as necessary)	
Legal Company Name:	Budget
Pacific Gas and Electric Company	\$ 559,834
The Regents of the University of California, Davis-Western Cooling	\$ 765,000
Morton H. Blatt	\$ 15,000
TBD multiple consultants for demonstration plant operations	\$ 100,000
	\$
	\$
	\$
	\$
	\$

List all key partners: (attach additional sheets as necessary)
Legal Company Name:

Budget Information			
Funding Source	Funding Year of Appropriation	Budget List No.	Amount
EPIC	13-14	301.001A	\$2,834,721
			\$
			\$
			\$
			\$
			\$
R&D Program Area:	EERO: Buildings	TOTAL:	\$2,834,721
Explanation for "Other" selection			
Reimbursement Contract #:		Federal Agreement #:	

Recipient's Administrator/ Officer				Recipient's Project Manager			
Name:	Ramachandran Narayanamurthy			Name:	Ramachandran Narayanamurthy		
Address:	3420 Hillview Ave			Address:	3420 Hillview Ave		
City, State, Zip:	Palo Alto, CA 94304-1355			City, State, Zip:	Palo Alto, CA 94304-1355		
Phone:	650-855-2419 /	Fax:	650-855-1097	Phone:	650-855-2419 /	Fax:	650-855-1097
E-Mail:	rnarayanamurthy@epri.com			E-Mail:	rnarayanamurthy@epri.com		

Selection Process Used	
<input checked="" type="checkbox"/> Competitive Solicitation	Solicitation #: PON-13-301
<input type="checkbox"/> First Come First Served Solicitation	

The following items should be attached to this GRF			
1. Exhibit A, Scope of Work		<input type="checkbox"/>	Attached
2. Exhibit B, Budget Detail		<input type="checkbox"/>	Attached
3. CEC 105, Questionnaire for Identifying Conflicts		<input type="checkbox"/>	Attached
4. Recipient Resolution	<input type="checkbox"/> N/A	<input type="checkbox"/>	Attached
5. CEQA Documentation	<input type="checkbox"/> N/A	<input type="checkbox"/>	Attached

Agreement Manager _____

Date _____

Office Manager _____

Date _____

Deputy Director _____

Date _____

EXHIBIT A Scope of Work

A. Task List

Task #	CPR ¹	Task Name
1		General Project Tasks
2	X	Baseline Development, Modeling, and Requirements
3	X	Product Development and Evaluation
4		Pilot Site Evaluation and Reporting
5		Evaluation of Project Benefits
6		Technology/Knowledge Transfer Activities
7		Production Readiness Plan

B. Acronym/Term List

Acronym/Term	Meaning
AHRI	Air-conditioning, Heating and Refrigeration Institute
BACnet	Building Automation and Control networks
CAM	Commission Agreement Manager
CAO	Commission Agreement Officer
CPR	Critical Project Review
DOAS	Dedicated Outdoor Air System
DOE	Department of Energy
DR	Demand Response
EER	Energy Efficiency Ratio
EPRI	Electric Power Research Institute
ERV	Energy-Recovery Ventilation
GWP	Global Warming Potential
HVAC	Heating, Ventilating, and Air Conditioning
HRV	Heat-Recovery Ventilation
IDEC	Indirect/Direct Evaporative Cooler
IEC	Indirect Evaporative Cooler
ODP	Ozone Depleting Potential
OpenADR	Open Automated Demand Response
PG&E	Pacific Gas and Electric
RTU	Roof Top Unit
SCE	Southern California Edison
TAC	Technical Advisory Committee
VEN	Virtual End Node
VRF	Variable Refrigerant Flow

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

EXHIBIT A

Scope of Work

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

A. Purpose of Agreement

The purpose of this agreement is to develop and demonstrate an integrated Heating, Ventilating, and Air Conditioning (HVAC) system for commercial buildings that optimizes occupant comfort and can reduce energy use and peak demand. Cooling and heating buildings to achieve comfortable indoor conditions accounts for a large portion of the electricity bills of California commercial ratepayers. This project will apply a combination of Variable Refrigerant Flow (VRF) technology with Indirect Evaporative Cooling (IEC) integrated and operationally optimized through the building control system. The VRF technology eliminates inefficient ducting by circulating refrigerant to individual “cassettes” that can either cool or heat an office or zone. The IEC technology reduces outdoor air loads and provides “free night cooling” by pre-conditioning the fresh air required by the building. Control algorithms that monitor and optimize the operation of these two systems together will enable substantial reduction in annual energy use and peak demand.

B. Problem/ Solution Statement

Problem

Commercial buildings in California are typically conditioned with packaged rooftop units. However, these systems are not optimal for California climates which tend to have hotter and dryer summers and milder winters than other parts of the United States. In addition, rooftop units serving small and medium commercial buildings suffer from inefficiency on several fronts including duct and cabinet leaks, significant thermal losses, poor distribution efficacy, and low peak performance. This raises the need for a more climate appropriate cooling solution for commercial buildings. There are two technologies – VRF and IEC that are market ready and can address some of these concerns, but also have their own barriers to implementation.

VRF systems potentially eliminate duct losses and improve zoning operation while IEC can provide more “climate appropriate” (i.e. more aligned to the appropriate climate for California’s 16 different climate zones) cooling for many of the hours of operation in California. It can accommodate higher sensible heat ratios and provide heat recovery with a 3 pipe system. However, VRF falls short in providing efficient ventilation and in many cases the controls are not tuned correctly, resulting in either direct intake of unconditioned outside air or very energy intensive reheat operation. The current schema also maximizes peak demand with the VRF operating at the highest capacity during the peak hours of the year. Many VRF system configurations do not easily allow for economizer cooling during the hours when outdoor air temperatures are cooler than indoor temperature. In comparison, IEC operation in California climate conditions has been shown to have a full load Energy Efficiency Ratio (EER)=40+ at peak, and part load EER=80+. However, IEC has limited cooling capacity at high ambient conditions and usually requires vapor compression cooling as an auxiliary cooling system.

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These two products have not been combined to create an integrated solution, though they are very complimentary. This is true because they have been applied as holistic solutions, while they have high potential as parts of an integrated solution. The integration has to be accomplished both with design and controls. This project will develop both design guidelines using EnergyPlus modeling as well as develop and demonstrate control systems and algorithms which can provide these integrated solutions. The project will also evaluate cost effectiveness of the integrated solution for new and retrofit buildings including the cost of control system integration.

Solution

This project will develop and test a more Climate Appropriate HVAC system that integrates a VRF system in conjunction with an IEC. The IEC will be set up as a Dedicated Outdoor Air System (DOAS) and incorporate a variable speed blower and Heat Recovery Ventilation (HRV). These subsystems will be integrated using a control schema (hardware and operating algorithms) that can be deployed as a stand-alone controller or as part of a Building Management System. The controller will be cloud connected and utilize external inputs such as weather and grid status information to manage operation of the subsystems in an optimal combination to minimize energy and water use, as well as system electrical demand. The results will be incorporated into modeling programs for building design (e.g., EnergyPlus) and also presented to Title 24 compliance staff for consideration to overcome current shortfalls in system performance prediction capability. The project will also address improving efficiency and environmental stewardship goals by investigating alternative non- Ozone Depleting Potential (ODP) refrigerants and HVAC system designs that could enable their usage in commercial buildings.

The Climate Appropriate HVAC system is expected to reduce energy use and peak demand through the following strategies:

- Optimize cooling capacity and outside air requirement in line with occupancy.
- Use adaptive controls to distribute cooling and heating load between the Indirect/Direct Evaporative Cooler (IDEC) and VRF systems and also optimize water use.
- Implement cloud based advanced algorithms that utilize learned patterns of building behavior and weather to both optimize energy use and predict and detect faults in system operation.
- Use on-board OpenADR Virtual End Node (VEN) to obtain grid condition signals (peak, renewable balancing) and optimize system operation (e.g., precooling of spaces using historic occupancy patterns).

C. Goals and Objectives of the Agreement

Agreement Goals

The goals of this Agreement are to:

- Develop a more Climate Appropriate HVAC system for commercial buildings to ensure that its energy performance is optimal for California's 16 climate zones.
- Reduce annual energy use by up to 40% for HVAC systems in commercial buildings compared to current code baseline operation.
- Reduce peak demand by up to 40% and provide enhanced demand response capabilities for HVAC systems in commercial buildings.
- Advance application of alternate refrigerants that have zero ODP and reduced Global Warming Potential (GWP) to meet the goals of AB32.

EXHIBIT A Scope of Work

- Align energy models for design and code compliance (Title 24) of commercial buildings with measured operational data.

Ratepayer Benefits:²

These types of systems would apply to many building types in the commercial segment, including medium and large retail stores, schools, small and medium offices, and food-service buildings. Using data from the California Commercial End-use Survey (CEUS³), the estimated electricity use for HVAC in these segments is 7000 GWh and contributes 5 GW of peak demand. If this research project is successful, assuming a 40% reduction in energy use and peak energy demand, it will result in approximately 2800 GWh of energy savings or about 5% reduction of electricity use in the commercial building sector, and 2 GW load reduction or about 4% of total California peak demand.

Technological Advancement and Breakthroughs:⁴ If successful, this research project could lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by reducing overall energy use by HVAC systems, reducing peak energy demand requirements, and advancing alternative refrigerants with low GWP. A key expected technology advancement is a novel controls based schema to synchronize operation of VRF and IEC to reduce energy use for both interior and outside air loads and to reduce peak energy demand while keeping a high level of occupant comfort.

The technology breakthroughs expected through this project include:

- an innovative control system that utilizes cloud based optimization using weather, grid conditions and occupancy (CO₂) as inputs to optimally operate a VRF and the IEC system. The controls can switch between operating either the IEC or VRF as a primary system and reduce both energy and water use.
- HVAC systems that use alternative refrigerants that have zero ODP or low GWP, and enhance occupant safety by reducing refrigerant levels below American Society of Heating, Refrigerating and Air Conditioning Engineers limits and isolating any marginally flammable or toxic refrigerants outside the building boundaries.

Agreement Objectives

The objectives of this Agreement are to:

- Develop and test an advanced "Climate Appropriate" HVAC system for commercial buildings in California that can reduce energy use and peak energy demand by 40%. Conduct cost effectiveness calculation for the resulting solutions.
- Develop new building models that incorporate control strategies and enable market adoption of the system.

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

³ *California Commercial End-Use Survey*, California Energy Commission, Report CEC-400-2006-005, March 2006.

⁴ California Public Resources Code, Section 25711.5(a) also requires EPIC-funded projects to lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory and energy goals.

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- Present HVAC system designs that use alternative refrigerants to help meet both California's efficiency and environmental goals (AB32).
- Integrate new technology capabilities for predictive analytics and cloud based controls to enable better occupant comfort, energy performance and peak demand management.
- Develop a grid integrated commercial HVAC system that incorporates native OpenADR capability along with system optimization algorithms for demand response.

II. TASK 1 GENERAL PROJECT TASKS

PRODUCTS

Subtask 1.1 Products

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

The Recipient shall:

For products that require a draft version

- Submit all draft products to the CAM for review and comment in accordance with the Project Schedule (Part V). The CAM will provide written comments to the Recipient on the draft product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- Submit the final product to the CAM once agreement has been reached on the draft. The CAM will provide written approval of the final product within 15 days of receipt, unless otherwise specified in the task/subtask for which the product is required.
- If the CAM determines that the final product does not sufficiently incorporate his/her comments, submit the revised product to the CAM within 10 days of notice by the CAM, unless the CAM specifies a longer time period.

For products that require a final version only

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

For all products

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

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- **Electronic File Format**

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

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

- Data sets will be in MS Access or MS Excel file format (Version 2007 or later), or any other format approved by the CAM.
- Text documents will be in MS Word file format, version 2007 or later.
- Documents intended for public distribution will be in PDF file format. The Recipient must also provide the native Microsoft file format.
- Project management documents will be in Microsoft Project file format, version 2007 or later.

- **Software Application Development**

Use the following standard Application Architecture components in compatible versions for any software application development required by this Agreement (e.g., databases, models, modeling tools), unless the CAM approves other software applications such as open source programs:

- Microsoft ASP.NET framework (version 3.5 and up). Recommend 4.0.
- Microsoft Internet Information Services (IIS), (version 6 and up) Recommend 7.5.
- Visual Studio.NET (version 2008 and up). Recommend 2010.
- C# Programming Language with Presentation (UI), Business Object and Data Layers.
- SQL (Structured Query Language).
- Microsoft SQL Server 2008, Stored Procedures. Recommend 2008 R2.
- Microsoft SQL Reporting Services. Recommend 2008 R2.
- XML (external interfaces).

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

MEETINGS

Subtask 1.2 Kick-off Meeting

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

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The Recipient shall:

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

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

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

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

- The CAM's expectations for accomplishing tasks described in the Scope of Work;
 - An updated Project Schedule;
 - Technical products (subtask 1.1);
 - Progress reports and invoices (subtask 1.5);
 - Final Report (subtask 1.6);
 - Technical Advisory Committee meetings (subtasks 1.10 and 1.11); and
 - Any other relevant topics.
- Provide an *Updated Project Schedule*, *List of Match Funds*, and *List of Permits*, as needed to reflect any changes in the documents.

The CAM shall:

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

Recipient Products:

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

CAM Product:

- Kick-off Meeting Agenda

Subtask 1.3 Critical Project Review (CPR) Meetings

The goal of this subtask is to determine if the project should continue to receive Energy Commission funding, and if so whether any modifications must be made to the tasks, products, schedule, or budget. CPR meetings provide the opportunity for frank discussions between the Energy Commission and the Recipient. As determined by the CAM, discussions may include project status, challenges, successes, advisory group findings and recommendations, final

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report preparation, and progress on technical transfer and production readiness activities (if applicable). Participants will include the CAM and the Recipient, and may include the CAO and any other individuals selected by the CAM to provide support to the Energy Commission.

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

The Recipient shall:

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

The CAM shall:

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

Recipient Products:

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

CAM Products:

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

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Subtask 1.4 Final Meeting

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

The Recipient shall:

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

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

- The technical portion of the meeting will involve the presentation of findings, conclusions, and recommended next steps (if any) for the Agreement. The CAM will determine the appropriate meeting participants.
- The administrative portion of the meeting will involve a discussion with the CAM and the CAO of the following Agreement closeout items:
 - Disposition of any state-owned equipment.
 - Need to file a Uniform Commercial Code Financing Statement (Form UCC-1) regarding the Energy Commission's interest in patented technology.
 - The Energy Commission's request for specific "generated" data (not already provided in Agreement products).
 - Need to document the Recipient's disclosure of "subject inventions" developed under the Agreement.
 - "Surviving" Agreement provisions such as repayment provisions and confidential products.
 - Final invoicing and release of retention.
- Prepare a *Final Meeting Agreement Summary* that documents any agreement made between the Recipient and Commission staff during the meeting.
- Prepare a *Schedule for Completing Agreement Closeout Activities*.
- Provide *All Draft and Final Written Products* on a CD-ROM or USB memory stick, organized by the tasks in the Agreement.

Products:

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

REPORTS AND INVOICES

Subtask 1.5 Progress Reports and Invoices

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

The Recipient shall:

- Submit a monthly *Progress Report* to the CAM. Each progress report must:
 - Summarize all Agreement activities conducted by the Recipient for the preceding

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month, including an assessment of the ability to complete the Agreement within the current budget and any anticipated cost overruns. See the Progress Report Format Attachment for the recommended specifications.

- Provide a synopsis of the project progress, including accomplishments, problems, milestones, products, schedule, fiscal status, and any evidence of progress such as photographs.
- Submit a monthly or quarterly *Invoice* that follows the instructions in the “Payment of Funds” section of the terms and conditions. In addition, each invoice must document and verify:
 - Energy Commission funds received by California-based entities;
 - Energy Commission funds spent in California (*if applicable*); and
 - Match fund expenditures.

Products:

- Progress Reports
- Invoices

Subtask 1.6 Final Report

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

Subtask 1.6.1 Final Report Outline

The Recipient shall:

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

Recipient Products:

- Final Report Outline (draft and final)

CAM Product:

- Style Manual

Subtask 1.6.2 Final Report

The Recipient shall:

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

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Products:

- Final Report (draft and final)

MATCH FUNDS, PERMITS, AND SUBCONTRACTS

Subtask 1.7 Match Funds

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

While the costs to obtain and document match funds are not reimbursable under this Agreement, the Recipient may spend match funds for this task. The Recipient may only spend match funds during the Agreement term, either concurrently or prior to the use of Energy Commission funds. Match funds must be identified in writing, and the Recipient must obtain any associated commitments before incurring any costs for which the Recipient will request reimbursement.

The Recipient shall:

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

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

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

Products:

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

EXHIBIT A Scope of Work

Subtask 1.8 Permits

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

The Recipient shall:

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

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

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

Products:

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

Subtask 1.9 Subcontracts

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

The Recipient shall:

- Manage and coordinate subcontractor activities in accordance with the requirements of this Agreement.
- Incorporate this Agreement by reference into each subcontract.
- Include any required Energy Commission flow-down provisions in each subcontract, in addition to a statement that the terms of this Agreement will prevail if they conflict with the subcontract terms.
- If required by the CAM, submit a draft of each *Subcontract* required to conduct the work under this Agreement.
- Submit a final copy of the executed subcontract.

EXHIBIT A

Scope of Work

- Notify and receive written approval from the CAM prior to adding any new subcontractors (see the discussion of subcontractor additions in the terms and conditions).

Products:

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

TECHNICAL ADVISORY COMMITTEE

Subtask 1.10 Technical Advisory Committee (TAC)

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

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

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

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

The Recipient shall:

- Prepare a *List of Potential TAC Members* that includes the names, companies, physical and electronic addresses, and phone numbers of potential members. The list will be discussed at the Kick-off meeting, and a schedule for recruiting members and holding the first TAC meeting will be developed.
- Recruit TAC members. Ensure that each individual understands member obligations and the TAC meeting schedule developed in subtask 1.11.

EXHIBIT A

Scope of Work

- Prepare a *List of TAC Members* once all TAC members have committed to serving on the TAC.
- Submit *Documentation of TAC Member Commitment* (such as Letters of Acceptance) from each TAC member.

Products:

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

Subtask 1.11 TAC Meetings

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

The Recipient shall:

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

Products:

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

III. TECHNICAL TASKS

TASK 2 BASELINE DEVELOPMENT, MODELING, AND REQUIREMENTS

The goal of this task is to calibrate current models of VRF and IEC systems with measured field performance to update and reflect any performance gaps. The project will identify key measures that can improve product field performance such as better management of ventilation requirements and controls integration. It will utilize these measures to inform an outline of controls strategies, both hardware and software, that can be implemented to improve occupant comfort, energy use and peak demand.

Subtask 2.1 Analyze Baseline Performance and Identify Gaps

The goal of this subtask is to conduct research into existing field data on VRF and IEC systems, determine expected or predicted performance for these systems, and determine root causes for any deviation in performance from the projected performance.

EXHIBIT A

Scope of Work

The Recipient shall:

- Collect field data on California buildings with VRF and/or IEC systems for both existing and new buildings in various climates.
- Map market segments that are a good fit for VRF and IEC systems (e.g., small and medium office buildings, medium and small hotels, medium stand-alone food service, medium retail).
- Identify impact of operator settings and occupant preference on energy use associated with VRF and IEC systems.
- Conduct survey of manufacturer contacts, design engineers, contractors, utility program managers, and customers to characterize ventilation design for currently deployed VRF systems. Determine performance gaps and the root causes for performance gaps.
- Prepare and provide a *Summary of Field Evaluations* that includes a discussion of the field data collected in various climates, the market segments that are a good fit for VRF and IEC systems and the impact of operator settings and occupant preference on energy use, and the results of the survey of manufacturers, design engineers and others to characterize ventilation capabilities associated with VRF systems.

Products:

- Summary of Field Evaluations (draft and final)

Subtask 2.2 Design Concepts for Integrated Systems

This subtask will develop overall system design options.

The Recipient shall:

- Develop system design documents that lay out the integrated VRF and IEC system.
- Develop design concept for a light commercial office building, medium food service facility, and a hotel with about 100 rooms.
- Prepare and provide a *Summary of Design Concepts and Options* that includes including modeling results that informed the design, operating schedules, engineering plans, and HVAC system control schemas.

Products:

- Summary of Design Concepts and Options (draft and final)

Subtask 2.3 Simulate Energy Performance

This subtask is focused on base lining current VRF models in Title 24 and EnergyPlus with actual field performance.

The Recipient shall:

- Develop an integrated model representative of actual field performance for VRF and IEC
- Develop EnergyPlus models to simulate energy performance for baseline and for alternative design options for the integrated VRF + IEC as DOAS system.
 - Baseline simulations will model standard efficiency rooftop units, no zoning, average duct losses, ducts in unconditioned space and code compliant ventilation (minimum of 6 climate zones - 2, 4, 8, 9, 10, 12).
 - Using VRF systems with assumed occupancy rates of 30% during the day for office buildings, and 20% and 60% daytime and nighttime occupancy for hotels, with separate constant speed outdoor air unit.

EXHIBIT A

Scope of Work

- Using VRF scenarios defined previously, but using indirect evaporative cooling for all outdoor air requirements and using demand controlled ventilation.
- Determine the number of operating hours that can be served only with indirect evaporative cooling systems with 50% or greater savings compared to rooftop units.
- Determine annual energy use with IEC as primary and VRF as secondary and using VRF as primary and IEC as secondary and estimate energy savings for various climate zones using models calibrated with field data.
- Prepare and provide a *Simulation Energy Performance Summary Report* that includes simulation results, description of new modules added to EnergyPlus and significant problems addressed with the model

Products:

- Simulation Energy Performance Summary Report (draft and final)

Subtask 2.4 Develop Product Requirements

This subtask will focus on requirements for the product (control system hardware and strategies) to resolve the outstanding performance gaps between actual system field performance and optimal performance with the right system configuration and operation.

The Recipient shall:

- Develop overall HVAC system architecture (for example, VRF, IEC, and Energy-Recovery Ventilation (ERV)) schema for the market segments identified in Subtask 2.3.
- Identify and describe product design elements and operating strategies that overcome installation and operational shortfalls that impact energy use.
- Identify and describe occupant preferences and its influence on operator settings.
- Prepare and provide a *Summary of Performance Gaps of Current HVAC Systems* that includes operational problems with fresh air controls, causes for shortfall in building performance with VRF systems and control schemes to address these problems.
- Participate in CPR #1 as per task 1.3 and prepare a *CPR Report #1*

Products:

- Summary of Performance Gaps of Current HVAC Systems (draft and final)
- CPR Report #1

TASK 3 PRODUCT DEVELOPMENT AND EVALUATION

The goal of this task is to develop and test the overall control system strategies that manage the VRF and IEC system to reduce energy use, water use and provide demand response factoring occupancy, weather patterns and grid requirements. A second goal of the task is to evaluate how alternative ultra-low GWP, zero ODP refrigerants could be utilized in commercial HVAC systems to possibly provide an increase in system efficiency. The testing of both product components will be conducted in the laboratory environment using environmentally controlled chambers and accurate instrumentation.

Subtask 3.1 Develop Controls Hardware Architecture

The purpose of this subtask is to use an open standard preferably BACNet to integrate operation of the various components

EXHIBIT A

Scope of Work

The Recipient shall:

- Design controller hardware architecture.
- Develop modular controls architecture schema.
- Map inputs, outputs, and algorithms and investigate how the control system will communicate with subcomponents, possibly using open standards such as BACNet.
- Design integration of Demand Response and grid services using open standards such as OpenADR.
 - Prepare and provide a *Hardware Architecture Report* that will include but not be limited to control system hardware architecture and information flow between system components.
- Prepare and provide an *Open Standards Report* to include implementation of OpenADR to control HVAC systems in commercial buildings, and operating strategies to optimize performance for various types of Demand Response events (for example, Fast DR and peak load shedding).

Products:

- Hardware Architecture Report (draft and final)
- Open Standards Report (draft and final)

Subtask 3.2 Develop Controls Software for Optimized System Management

Using the control system hardware scheme that is developed in Task 3.1, implement various strategies to optimize operation of the overall HVAC system.

The Recipient shall:

- Build control algorithms to adjust equipment operations to optimize performance for California climates. This includes adjusting fan speeds and compressor capacity management, through variable speed, staging and/or compressor cycling.
- Develop integrated controls to optimize operation of VRF in cooperation with indirect evaporative ventilation systems and economizers.
- Integrate ventilation system controls with VRF controls to use occupancy sensing, CO2 concentration measurements, and measures of occupant comfort.
- Set up cloud architecture to incorporate predictive algorithms, forecast climate conditions, and learned building thermal characteristics to optimize operating decisions.
- Incorporate open standards for grid communication, including at a minimum OpenADR.
- Prepare and provide a *Control System Logic Flow Report* that includes control software implementation including open standards integration, logic flow drawings, and algorithms implemented for the building control.
- Prepare and provide an *Integrated Fault Detection and Diagnostics Capabilities Report* that includes the fault and diagnostics capabilities of the controls software.

Products:

- Control System Logic Flow Report (draft and final)
- Integrated Fault Detection and Diagnostics Capabilities Report (draft and final)

Subtask 3.3 Evaluate Alternate Refrigerants and HVAC Architecture

In this subtask, the team will evaluate the low GWP and zero ODP refrigerant options which may be viable alternatives for HVAC applications.

EXHIBIT A Scope of Work

The Recipient shall:

- Identify viable low GWP, zero ODP refrigerants. Leading candidates include propane, carbon dioxide, R-1234yf, and R-32 refrigerants. Gather data on lab evaluations and modeled performance.
- Model thermodynamic cycle impact and overall energy savings.
- Laboratory test alternate refrigerants for VRF to identify potential refrigerant for good performance in California's climates.
- Test secondary loop concept to provide refrigerant flexibility, improve safety with refrigerants such as propane and possibly reduce total refrigerant content compared to rooftop units.
- Develop savings estimate for HRV/ERV for both IEC primary and VRF primary for the different market segments.
- Prepare and provide an *Alternate Refrigerants and HVAC Architecture Report* that includes refrigerant management system theory, components and performance, as well as schematic design drawings and construction of secondary loop concepts.
- Prepare and provide a *report on the performance of secondary-loop testing* that includes but is not limited to test results, including temperatures, pressures, and flow rates.

Products:

- Alternate Refrigerants and HVAC Architecture Report (draft and final)
- Report on Performance of Secondary-loop Testing (draft and final)

Subtask 3.4 Conduct Laboratory Testing

The purpose of this subtask is to conduct laboratory testing of the VRF and IEC system and analysis of the GWP improvements.

The Recipient shall:

- Set up load based lab testing for VRF and IEC systems that accounts for occupancy patterns and controls system integration.
- Test standalone elements for baseline performance. Baseline testing will be primarily steady-state and follow American National Standards Institute / Air-conditioning, Heating and Refrigeration Institute (AHRI) Standard 1230.
- Test integrated system controls using load based evaluation.
- Assess performance of VRF systems and their sensitivity to zone occupancy patterns. Conduct laboratory tests: one per the AHRI standard for VRF to determine Integrated Energy Efficiency Ratio, and a second based on simulated loads and zonal occupancy patterns.
- Evaluate alternate refrigerant if prototyping proves viability and they can be productized.
- Evaluate combined system operation using a software emulator (provided by manufacturer or developed) to simulate control signals, outdoor weather conditions and occupancy patterns.
- Measure energy and water use with various operating strategies.
- Measure heating performance of optimized VRF system.
- Prepare and provide *Lab Testing Report* that includes instrumentation plan and data analysis plan, test setup, data acquisition system details, test plan and performance results of advanced HVAC system
- Participate in CPR #2 as per task 1.3 and prepare a *CPR Report #2*
- Prepare a *Report on the System Performance and Controls Integration Testing* to include Integrated Energy Efficiency Ratio

EXHIBIT A

Scope of Work

Products:

- Lab Testing Report (draft and final)
- CPR Report #2
- Report on System Performance and Controls Integration Testing (draft and final)

TASK 4 PILOT SITE EVALUATION AND REPORTING

The purpose of this task is to evaluate how the proposed advances in integrated operations of commercial buildings can reduce energy use in the selected pilot site locations.

Subtask 4.1 Identify a Pilot Site and Conduct Performance Baseline Testing

The goal of this subtask is to identify pilot test sites and evaluate the integrated systems to determine the baseline performance and performance after the proposed system installation. Baseline data, consisting of electrical and thermal measurements, of HVAC systems will be monitored for at least one year. After baseline monitoring is complete, the proposed system and controls will be installed. Data collected will enable investigators to compare energy efficiency improvements between baseline and new system. Data will be collected for one year and will be available for viewing online by using data-viewing tool based on Tableau platform. EPRI will perform ongoing analysis of the data gathered and upload findings and observations through the data –viewing tool. Another alternative to baseline monitoring is to select pilot sites that have monitored data that can be obtained from earlier exercises / projects. The testing is planned to be conducted at two sites with existing VRF systems – one in SCE territory at the Miyako Hotel in Torrance, CA and one in PG&E territory. The PG&E site has not been determined yet. Once that site is identified, EPRI must request and receive written approval from the CAM to use that site. All site changes require written approval from the CAM.

The Recipient shall:

- Identify at least 2 pilot sites - one with IEC as primary cooling system and one with VRF with primary cooling system or with RTUs ready for retrofit.
- Obtain one year of baseline building operation data.
- Obtain baseline HVAC system energy use data that is measured or disaggregated using analytics with at least 6 months of pre-installation data.
- Prepare and provide *Site Selection Report* to include list of possible sites, site selection criteria, current cooling system architecture and energy use of the site.
- Prepare and provide a *Report on Instrumentation and Analytics Plan for Gathering Baseline Data*. The report shall include instruments, electrical and thermal measurements of HVAC systems

Products:

- Site Selection Report (draft and final)
- Report on Instrumentation and Analytics Plan for Gathering Baseline Data (draft and final)

Subtask 4.2 Install the System

The purpose of this subtask is to install the system at selected sites, including instrumentation and data monitoring equipment at the site.

EXHIBIT A

Scope of Work

The Recipient shall:

- Develop HVAC installation plan and drawing package with manufacturer guidance.
- Obtain permits, install and commission equipment, and install data acquisition systems.
- Prepare and provide an *Installation Report* that includes construction contractor selection process including scope of work, selection criteria, site selection process, owner/operator concerns, installation and commissioning
- Prepare and provide a *Summary Report on Installation* that includes pictures of the installations with the different construction phases and the final finished system install.

Products:

- Installation Report (Draft and Final)
- Summary report on installation (Draft and Final)

Subtask 4.3 Monitor the System, Acquire Data, and Evaluate Performance

The goal of this subtask is to measure and monitor an array of variables in order to characterize the performance of the HVAC systems developed and installed for this research program.

The Recipient shall:

- Develop monitoring plan that includes weather factors, power, refrigeration parameters, air flow parameters and indoor air quality.
- Conduct thorough system diagnostics on site at various points in time
- Set up data acquisition infrastructure.
- Analyze data and performance and determine correlations between various variables.
- Prepare and provide a *Data Analysis and Performance Evaluation Report* that includes data acquisition infrastructure, data analysis plan, data analysis and test results including both pre- and post- data from the sites.

Products:

- Data Analysis and Performance Evaluation Report (Draft and Final).

Subtask 4.4 Refine Model

This subtask will improve the current building energy models to effectively model the combined whole building energy use. It will include the complexity of the various operating sequences that can optimize energy use.

The Recipient shall:

- Utilize field data and operational results to refine models developed in subtask 2.2 and refine them to predict energy savings in multiple CA climate zones.
- Conduct final technology gap analysis.
- Prepare and provide a *Model Refinement Report* that includes changes adopted in EnergyPlus from Task 2.2 and results of the modeled performance against existing field system performance, gaps in models based on representation of actual performance and how these are addressed by updated functions and modeling techniques
- Prepare and provide a *Report on Persistent Technology Gaps* that includes at a minimum the top 10 technology gaps.

Products:

- Model Refinement Report (Draft and Final).
- Report on persistent technology gaps (Draft and Final).

EXHIBIT A

Scope of Work

Subtask 4.5 Compile Results and Present Data

The goal of this task is to compile and analyze data after the field installation through the end of the project.

The Recipient shall:

- Acquire and analyze the data obtained from the field sites.
- Review the data acquired and address correction and comments provided by the project manager and reviewers.
- Prepare and provide a power point *Summary of the Project and Findings* to date.
- Prepare and provide a *Report on Data Acquisition and Field Site Performance* with 6 months of pre-installation data and up to 12 months of post-installation data, along with operational problems with the field sites during the course of the study.

Products:

- Report on Data Acquisition and Field Site Performance
- Summary of the Project and Findings

TASK 5 EVALUATION OF PROJECT BENEFITS

The new systems developed and tested in this project shall be compared to both commonly used existing systems and best-available existing systems. The comparisons will identify the combinations of attributes that provide the most benefits compared to the baselines. Comparisons shall include operating cost (energy use, peak demand and maintenance/water treatment), first cost, assessments of comfort and fresh air delivery, reliability, and cost/benefit or life cycle costs. The comparisons shall be made by building type and size, climate and if the application is new construction, retrofit or a major remodel.

The Recipient shall:

- Complete three Project Benefits Questionnaires that correspond to three main intervals in the Agreement: (1) *Kick-off Meeting Benefits Questionnaire*; (2) *Mid-term Benefits Questionnaire*; and (3) *Final Meeting Benefits Questionnaire*.
- Provide all key assumptions used to estimate projected benefits, including targeted market sector (e.g., population and geographic location), projected market penetration, baseline and projected energy use and cost, operating conditions, and emission reduction calculations. Examples of information that may be requested in the questionnaires include:
 - For Product Development Projects and Project Demonstrations:
 - Published documents, including date, title, and periodical name.
 - Estimated or actual energy and cost savings, and estimated statewide energy savings once market potential has been realized. Identify all assumptions used in the estimates.
 - Greenhouse gas and criteria emissions reductions.
 - Other non-energy benefits such as reliability, public safety, lower operational cost, environmental improvement, indoor environmental quality, and societal benefits.
 - Data on potential job creation, market potential, economic development, and increased state revenue as a result of the project.

EXHIBIT A

Scope of Work

- A discussion of project product downloads from websites, and publications in technical journals.
- A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Additional Information for Product Development Projects:
 - Outcome of product development efforts, such copyrights and license agreements.
 - Units sold or projected to be sold in California and outside of California.
 - Total annual sales or projected annual sales (in dollars) of products developed under the Agreement.
 - Investment dollars/follow-on private funding as a result of Energy Commission funding.
 - Patent numbers and applications, along with dates and brief descriptions.
- Additional Information for Product Demonstrations:
 - Outcome of demonstrations and status of technology.
 - Number of similar installations.
 - Jobs created/retained as a result of the Agreement.
- For Information/Tools and Other Research Studies:
 - Outcome of project.
 - Published documents, including date, title, and periodical name.
 - A discussion of policy development. State if the project has been cited in government policy publications or technical journals, or has been used to inform regulatory bodies.
 - The number of website downloads.
 - An estimate of how the project information has affected energy use and cost, or has resulted in other non-energy benefits.
 - An estimate of energy and non-energy benefits.
 - Data on potential job creation, market potential, economic development, and increased state revenue as a result of project.
 - A discussion of project product downloads from websites, and publications in technical journals.
 - A comparison of project expectations and performance. Discuss whether the goals and objectives of the Agreement have been met and what improvements are needed, if any.
- Respond to CAM questions regarding responses to the questionnaires.

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

Products:

- Detailed responses to Kick-off Meeting Benefits Questionnaire
- Detailed responses to Mid-term Benefits Questionnaire
- Detailed responses to Final Meeting Benefits Questionnaire
- Report on key assumption used in estimating project benefits

EXHIBIT A

Scope of Work

TASK 6 TECHNOLOGY/KNOWLEDGE TRANSFER ACTIVITIES

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

The Recipient shall:

- Prepare an *Initial Fact Sheet* at start of the project that describes the project. Use the format provided by the CAM.
- Prepare a *Final Project Fact Sheet* at the project's conclusion that discusses results. Use the format provided by the CAM.
- Prepare a *Technology/Knowledge Transfer Plan* that includes:
 - An explanation of how the knowledge gained from the project will be made available to the public, including the targeted market sector and potential outreach to end users, utilities, regulatory agencies, and others.
 - A description of the intended use(s) for and users of the project results.
 - Published documents, including date, title, and periodical name.
 - Copies of documents, fact sheets, journal articles, press releases, and other documents prepared for public dissemination. These documents must include the Legal Notice required in the terms and conditions. Indicate where and when the documents were disseminated.
 - A discussion of policy development. State if project has been or will be cited in government policy publications, or used to inform regulatory bodies.
 - The number of website downloads or public requests for project results.
 - Additional areas as determined by the CAM.
- Conduct technology transfer activities in accordance with the Technology/Knowledge Transfer Plan. These activities will be reported in the Progress Reports.
- When directed by the CAM, develop *Presentation Materials* for an Energy Commission-sponsored conference/workshop on the results of the project.
- Prepare a *Technology/Knowledge Transfer Report* on technology transfer activities conducted during the project.
- Provide presentations of summary of results to the Title 24 CASE process for incorporation in Title 24 Non-Residential process

Products:

- Initial Fact Sheet (draft and final)
- Final Project Fact Sheet (draft and final)
- Presentation Materials (draft and final)
- Presentation to Title 24 CASE process manager
- Technology/Knowledge Transfer Plan (draft and final)
- Report to DOE on updated EnergyPlus modeling components for VRF and IEC systems
- Report and presentations provided to Title 24 CASE process managers for commercial buildings

TASK 7 PRODUCTION READINESS PLAN

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

EXHIBIT A

Scope of Work

The Recipient shall:

- Prepare a *Production Readiness Plan*. The degree of detail in the plan should be proportional to the complexity of producing or commercializing the proposed product, and to its state of development. As appropriate, the plan will discuss the following:
 - Critical production processes, equipment, facilities, personnel resources, and support systems needed to produce a commercially viable product.
 - Internal manufacturing facilities, supplier technologies, capacity constraints imposed by the design under consideration, design-critical elements, and the use of hazardous or non-recyclable materials. The product manufacturing effort may include “proof of production processes.”
 - The estimated cost of production.
 - The expected investment threshold needed to launch the commercial product.
 - An implementation plan to ramp up to full production.
 - The outcome of product development efforts, such as copyrights and license agreements.
 - Patent numbers and applications, along with dates and brief descriptions.
 - Other areas as determined by the CAM.

Products:

- Production Readiness Plan (draft and final)

IV. PROJECT SCHEDULE

Please see the attached Excel spreadsheet.

STATE OF CALIFORNIA

STATE ENERGY RESOURCES
CONSERVATION AND DEVELOPMENT COMMISSION

RESOLUTION - RE: ELECTRIC POWER RESEARCH INSTITUTE, INC.

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

RESOLVED, that the Energy Commission approves Agreement EPC-15-004 with the **Electric Power Research Institute, Inc.** for a **\$2,834,721** grant to develop and demonstrate a climate-appropriate heating, ventilating and air conditioning system for commercial buildings that integrates variable refrigerant flow technology, indirect evaporative cooling and the building control system to reduce energy use and peak demand; and

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

CERTIFICATION

The undersigned Secretariat to the Commission does hereby certify that the foregoing is a full, true, and correct copy of a Resolution duly and regularly adopted at a meeting of the California Energy Commission held on July 8, 2015.

AYE: [List of Commissioners]

NAY: [List of Commissioners]

ABSENT: [List of Commissioners]

ABSTAIN: [List of Commissioners]

Harriet Kallemeyn,
Secretariat