Attachment A: Technical Requirements

Home Battery Pilot
November 3, 2009

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1. Purpose

This document provides technical requirement information in regard to Southern California Edison's Home Battery Pilot Project. This document is intended to provide adequate information to allow for vendors to make accurate bids. SCE intends to develop a collaborative relationship with the selected vendor(s) during all phases of the project.

2. List of Acronyms

AMI – Advanced Metering Infrastructure
ANSI – American National Standards Institute
CBEMA – Computer and Business Equipment Manufacturers Association
CBKE – Certificate Based Key Establishment
CPUC – California Public Utilities Commission
DR – Demand Response
DRLC – Demand Response and Load Control
ECC – Elliptical Curve Cryptography
EVTC – Electric Vehicle Technical Center
GUI – Graphic User Interface
HAN – Home Area Network
HMI – Human-Machine Interface
IEEE – Institute of Electrical and Electronics Engineers
NEC – National Electrical Code
NEMA – National Electrical Manufacturers' Association
PEV – Plug-in Electric Vehicle
PV - Photovoltaic
RESU – Residential Energy Storage Unit
SCE – Southern California Edison
SE v1.0 – Smart Energy Profile version 1.0
UL – Underwriter's Laboratory
USABC – United States Advanced Battery Consortium
ZSE – Zigbee Smart Energy

3. Introduction

SCE proposes to develop a pilot program to assess the potential use of lithium ion battery cells of the type and size used in Plug-in Electric Vehicles (PEV) for energy storage in residential and small commercial applications. SCE proposes to test the concept by integrating home energy storage with Demand Response (DR) strategies[1], renewable energy generation (wind and solar) and SCE's advanced metering infrastructure.

The Scope of Work (SOW) will consist of developing system design requirements, testing and evaluation of trial installations at SCE's Electric Vehicle Technical Center (EVTC), an ISO-9001 registered facility located in Pomona, California, to include integration of batteries, controls, advanced interval metering, and solar photovoltaic generation in a specially prepared on-site facility. Field deployment will follow starting in Q4 2010, and will include the installation of up to 50 sites by the end of 2012. Demonstration sites will be selected for their availability of existing or planned renewable generation facilities, and the customer's willingness to participate.

The program assumes that peak power demand can be reduced by up to 4 kW per home for up to two hours per day. SCE will ask selected customers to participate in a residential time-of-use tariff with Edison SmartConnect™ meters[2]. A concerted attempt will be made to engage customers outfitted with early advanced meter installations however, that may not be possible in every case.
The pilot program has six objectives:

1. Assess currently available battery and control technologies by designing, testing and evaluating prototypical units at SCE's Pomona EVTC.
2. Facilitate the development of Edison SmartConnect™ compatible end-use technologies for future statewide implementation by assessing both infrastructure requirements for battery system deployment and compatibility with proposed advanced metering and control technologies.
3. Measure customer response to dynamic pricing as an indication of their willingness to engage in interactive load management approaches.
4. Evaluate and establish the requirements for safe installation and unobtrusive operation in a residential environment.
5. Partner with wind and solar contractors to assess and evaluate the benefits of using battery storage to augment renewable energy generation and compensate for fluctuating and intermittent power production.
6. Assess the longer term impacts of using automotive type lithium ion batteries in stationary applications for residential and small commercial customers as a means to expand the advanced battery market with the purpose of driving down prices to benefit both motorists and utility customers.

[1] Southern California Edison's Demand Response Programs: http://www.sce.com/b-rs/demand-response-programs/

[2] Edison SmartConnect™: http://www.sce.com/PowerandEnvironment/smartconnect/

Funding for the Home Battery Pilot was requested in Volume I of SCE's Amended Application for Approval of Demand Response Programs, Goals, and Budgets for 2009-2011 (A.08-06-001) and approved by California Public Utilities Commission (CPUC) Decision 09-08-027 on August 20, 2009.

4. Background and Scope

Batteries have proven to be a reliable way to store electricity for over 150 years. Advanced lithium ion batteries, capable of deep cycling, long life and high energy densities, are being developed for the emerging plug-in electric vehicle (PEV) industry. If deployed within an enclosure designed for residential or small commercial applications, the battery packs would be appropriately sized to allow the customer to store low cost and abundantly available night time (off-peak) energy or provide the utility with excess locally produced renewable energy for use during the next day's on-peak (high demand) periods. Widespread adoption of residential energy storage installations of this size may help mitigate power shortages and enhance distribution system reliability. Residential and small commercial systems could be used both by the utility for demand response purposes, as well as for the benefit of customers with favorable economics for load shifting.

Advanced lithium ion batteries are currently being tested in SCE's Electric Vehicle Technical Center (EVTC) laboratory and results have exceeded expectations. These lithium ion batteries also have potential synergies with renewable energy generation such as wind and solar. With battery systems, the capacity available from residential and small commercial installations would not be dependent on wind or solar conditions and should complement these intermittent or fluctuating renewable energy supplies by allowing energy to be stored and made available during high demand periods each day. Customer energy usage patterns could additionally be managed with the advent of Edison's SmartConnect™ advanced metering system. Edison SmartConnect™ will enable the mechanisms to integrate residential and small commercial battery systems with dynamic pricing signals for customer load shifting or utility dispatch for demand response.

It should be stressed that advanced automotive batteries are very robust, designed for daily use with a 10-15 year life expectancy, and should be extremely durable in residential and small commercial applications. Currently, low volume lithium-ion battery production costs can exceed $2,000 per kWh. However, a key element in bringing down the price of lithium ion batteries for PEVs is to explore mass market expansion strategies that will increase cell production volumes for Original Equipment Manufacturers (OEMs), with the goal being less than $500/kWh cost (USABC Target Cost).

The objective of this pilot program will be to test and evaluate the suitability of lithium-ion battery cells of the type and size proposed for PEV production for use in residential energy storage applications. Some of the pilot program installations will be placed at residences or businesses with existing wind and solar energy sources. The program assumes that "typical" peak power usage can be reduced up to 4kW. SCE will target customers with Edison SmartConnect™ meters, to participate in a residential time-of-use tariff, although that may not be possible in every case.

The battery assemblies will be constructed within an enclosure and connected to the home electrical system in such a way that they can be charged either with excess renewable energy from on-site generation (where available), or from the grid (at off-peak time) for utilization during the day as needed. Particular attention will be paid to integration with renewable power generation, the Edison grid, and the Edison SmartConnect™ Advanced Metering Infrastructure (AMI) and Home Area Network (HAN).

For demand response applications, a portion of a home's or small business's energy demand could be shifted by the utility to the battery system almost instantly and in a manner most suitable to the needs of each DR event. Discharge levels could be maximized for shorter duration events, scaled back for longer durations, or adjusted based on system needs. Battery discharges to serve in-home usage requirements could also be used for both economic and reliability load reductions to the grid.

SCE's EVTC is currently and actively involved in testing and evaluating this type of technology. Work underway includes the following activities:

- Test and evaluation of PEV advanced batteries to be used in residential applications
- Integration of new battery systems in home energy storage applications
- Validation of proper operation and performance baseline
- Integration into SCE's "garage of the future" lab
- Evaluation of system performance and reliability by simulating various residential power usage scenarios
- Development of customer and utility benefits analysis

SCE estimates the potential market for this type of device to be significant. According to the CPUC's January 2009 Staff Progress Report on the California Solar Initiative[1], homeowners, businesses, and local governments in California's Investor-Owned Utility (IOU) territories installed 158 MW of distributed solar photovoltaics (PV) in 2008, doubling the 78 MW installed in IOU territories in 2007. California boasts a cumulative total of 441 MW of distributed solar PV systems, the highest level of solar installations in the country. Customers of Southern California Edison have installed 13 MW of residential and 49 MW of non-residential projects and have an additional 7 MW of residential and 35 MW of non-residential projects pending installation. SCE is also working with regulators and governmental agencies to develop enabling tariffs and incentive legislation supportive of peak load shifting, intermittent load following and demand response.

[1] California Solar Initiative: http://www.gosolarcalifornia.ca.gov/csi/index.html

5. Communication with the Home Area Network (HAN)

For SCE's Home Battery Pilot, most of the RESUs will be installed in residential premises and controlled via the HAN. The HAN controller is an IEEE 802.15.4 radio installed under glass in every Edison SmartConnect™ meter. It is a ZigBee Smart Energy-certified Energy Services Portal and functions as the source for utility signals to the RESU. HAN commands will be sent to the RESU using the ZigBee Smart Energy profile (Ref. 13).

It should be noted that the RESU is not an existing class of HAN Device included in the Smart Energy profile. This pilot effort seeks to demonstrate the ability of both RESUs and Smart Energy profile to enable plug and play communications. SCE has done similar development work on Plug-in Electric Vehicles and believes RESU applications are very similar. Future revisions of the ZigBee Smart Energy profile will include devices of this type and better address their communication needs.

RESUs could provide bi-directional energy flow at different times of day and/or energy price periods, depending on the signals received from the user or the utility. They could also track the energy consumed and delivered and may, for the purposes of this trial, be able to report their energy storage and delivery to SCE and the consumer (e.g., via an In-Premise Display).

6. System Requirements

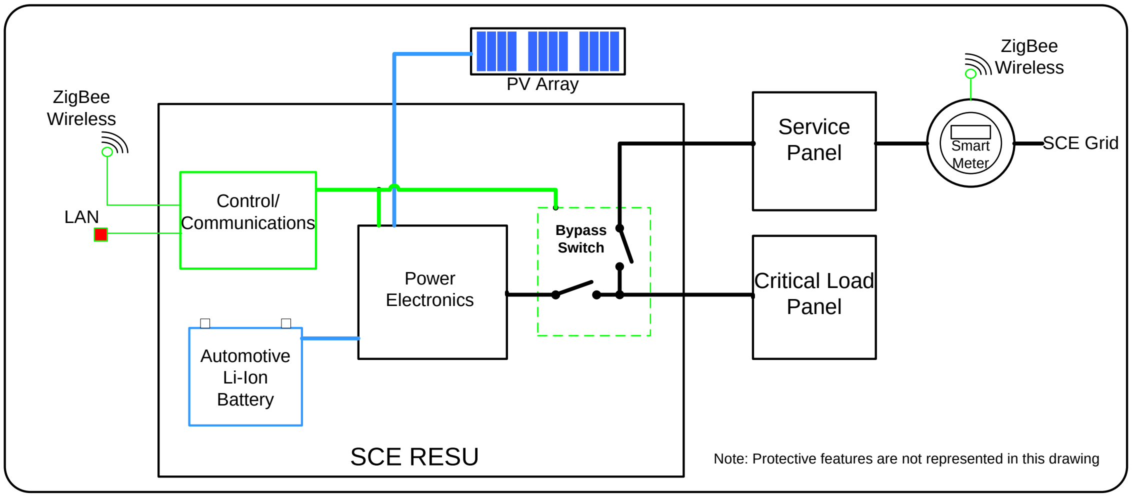

Figure 6 – 1 SCE RESU Functional Diagram

6.1 Hardware

6.1.1 The RESU and subsystems shall be designed, manufactured, and tested according to the latest applicable standards including but not limited to IEEE, ANSI, NEC, NFPA, UL and NEMA.

6.1.2 When operated in a "grid-tie" mode, the RESU shall comply with the provisions of UL 1741 and SCE's "Tariff Rule 21". The exception to this requirement is when the RESU is under utility control and Reactive Power Assist is enabled (req. 6.7.3).

6.1.3 When operating in "backup" mode (req. 6.4.2), the RESU shall comply with provisions of UL 1778.

6.1.4 The selected vendor shall obtain a listing for the RESU to UL 1778 and UL 1741 through the Underwriters Laboratory. As an alternative, testing may be conducted through an independent laboratory such as Intertek Testing Services (ETL listing).

6.1.5 The RESU shall be designed to facilitate installation according to National Electrical Code (NEC) and California Electrical Code.

6.1.6 The RESU physical dimensions shall be minimized to limit the required footprint for installation.

6.1.7 The RESU battery and any other components with exposed conductors or sensitive electronics should be contained in a locked portion of the enclosure accessible only to authorized service personnel.

6.1.8 The unit should be fully contained in NEMA type 2 or equivalent enclosure.

6.1.9 The unit shall be maintenance free or low maintenance to limit the required trips to deployment sites.

6.1.10 The RESU EMI shall not exceed levels established in the FCC Code of Federal Regulations in Sections 15.109 and 15.209. In addition, the RESU shall have the capability to withstand EMI in accordance with IEEE Std. C37.90.2-1995.

6.1.11 RESU noise level shall not exceed 68 dBA at a distance of 3 meters from the system.

6.1.12 Operating Environment:
Ambient Temperature: 0°C to +50°C
Humidity: 10% to 90% non-condensing

6.2 Electrical

6.2.1 The RESU output shall be single phase alternating current, rated at a nominal voltage of 120V or 240V/120V (split phase).

6.2.2 The nominal continuous output power rating of the RESU shall be at least 4kVA.

6.2.3 The unit shall be capable of providing reactive power to the grid with a minimum rating of 1.8kVAR.

6.2.4 The usable RESU stored energy shall be rated at a minimum of 10kWh (DC) at beginning of battery life (BOL). The energy storage system shall be comprised of automotive grade Li-Ion battery cells.

6.2.5 Based on a 2-hour discharge, the roundtrip AC energy efficiency of the unit shall be at least 80% (with PV disconnected).

6.2.6 In addition to the energy storage capabilities of the RESU, the unit shall be able to integrate the output of a photovoltaic array with a rated capacity of up to 4 kW (DC), and with an output voltage of up to 300V (DC). The unit shall be configurable for either positive or negative grounded PV arrays.

6.2.7 In addition to connection provisions that normally apply to any device that receives and supplies energy to a customer's electrical loads through the customer's service panel, the unit shall also provide a separately dedicated output circuit to isolate and supply up to 4kVA of critical household loads during an outage of the utility's grid. This separate "critical output circuit" shall be designed and switched such that only the connected critical loads are energized during utility grid outages but are reconnected and served by grid power when available.

6.2.8 A separate manual bypass switch shall allow the critical household loads to be energized in the event of a unit failure.

6.3 Power Quality

6.3.1 All requirements for current and voltage harmonics of the RESU are to be measured at the utility service panel or critical load panel.

6.3.2 Grid-Tie Operation

6.3.2.1 Total Current Demand Distortion (TDD) at 50%-100% of rated power should be less than 5%.

6.3.2.2 Individual harmonic currents should comply with the following standards:
During discharge (as a source): IEEE Std. 1547-2003
During charge & standby (as a load): IEEE Std. 519-1992

6.3.3 Back-up Mode

6.3.3.1 Output AC voltage and frequency shall meet ANSI C84.1

6.3.3.2 Voltage distortion limits shall comply with IEEE Std. 519-1992

6.4 Protection and Backup

6.4.1 General

6.4.1.1 The RESU shall be self protecting for AC or DC component failures. The RESU shall isolate itself from the grid during any internal fault.

6.4.1.2 The RESU shall include protective features to disconnect itself from the grid when voltage, current, or frequency input or output levels exceed the unit's limits.

6.4.2 Backup Mode

6.4.2.1 The RESU shall provide switching capabilities to separate its critical load circuit from the customer's electric service when a loss of grid power occurs.

6.4.2.2 The RESU shall safely reconnect with the customer's electric service when grid power is restored.

6.4.2.3 Load connected to the critical load output circuit of the RESU shall be transferred to and from the grid supply automatically based on grid availability. The load transfer in both directions shall meet the CBEMA curve requirements such that electronic appliances, like computers, will not detect the interruption and continue to work through the load transfers.

6.4.2.4 During an extended outage:

- The RESU shall continue to supply the critical load until the stored energy reaches a pre-defined level, at which point the unit reconnects the critical load to the grid and isolates itself. This will allow the RESU to retain sufficient energy for maintaining control and communication functions.
- The RESU shuts down all loads on the battery when stored energy reaches a critical minimum level.
- The RESU shall be capable of restarting itself upon restoration of the grid.

6.4.2.5 While the unit is in backup mode it shall provide indication to the customer to alert the loss of grid power (display, indicator light, etc.)

6.4.2.6 When operating in backup mode, the RESU shall also have surge capability at 1.5 times rated power (kVA) for 5 seconds to allow it to serve motor-start demands of residential loads.

6.5 RESU Energy Transfer

6.5.1 Charging

The unit shall be programmable to initiate a charge period:

6.5.1.1 During specified time periods at the unit's rated charge capability.

6.5.1.2 Whenever a signal is received from the utility to charge.

6.5.1.3 Charging shall stop when the battery is fully charged, when a specified charge period has ended, or when a specified charge level is reached.

6.5.1.4 The RESU shall normally use any renewable energy provided by a connected photovoltaic array to charge the battery when the renewable power exceeds the local demand. If the battery is fully charged, the renewable energy shall be supplied to the service panel to be used by the utility grid.

6.5.2 Discharging/Dispatching (sending energy back to the grid)

The unit shall be programmable to initiate a discharge period:

6.5.2.1 Per a defined schedule starting at specified times of day. Discharged energy shall be supplied at a defined power output level not exceeding the unit's output power rating until the battery state of charge reaches a defined minimum level.

6.5.2.2 Whenever a signal is received to discharge. Discharged energy shall be supplied at a defined power level, up to the RESU power limits, until the battery usable energy reaches a defined minimum level. This mode shall have priority over preprogrammed discharging modes as long as the request is within the unit's limits.

6.6 Modes of Operation

General

It is anticipated that the some RESUs might be operated in locations without a HAN. In this case utility commands will be received utilizing a broadband connection. The two primary users of the system will be the residential or small business customer, and the utility. SCE intends to test scenarios that allow the residential or small business user to setup and operate the device. In other scenarios, the residential user will assign control to the utility, allowing the utility to operate the device remotely. Users will interact with the system through a secure web page, allowing access from any computer with a web browser and internet connection.

<u>The unit shall support the following three control modes. The modes shall be user configurable and mutually exclusive.</u>

6.6.1 Utility Control

6.6.1.1 **Description:** Charge and dispatch schedules are programmed by the utility.

6.6.1.2 **Scenario:**

- <u>With a Smart Meter installed at the customer's site:</u> Utility sends signals (using DR cluster of SE v1.0) via Smart Meter.
  - **Charging** shall be signaled using a positive value (i.e., +1 to +100) for the Average Load Adjustment Percentage attribute of the Demand Response Load Control (DRLC) cluster message.
  - **Neutral** (i.e., not charging nor discharging) shall be signaled by the absence of a DRLC cluster message. If there is no active DRLC event message, the RESU will not charge (using grid energy) or discharge.
  - **Dispatching** shall be signaled using a negative value (i.e., -1 to -100) for the Average Load Adjustment Percentage attribute of the Demand Response Load Control (DRLC) cluster message.
- <u>Without Smart Meter:</u> Utility programs the schedule via the secure web interface.

- RESU operates as scheduled.[1]

6.6.2 Time Based Control

6.6.2.1 **Description:** Charge and dispatch schedule programmed by the residential customer.

6.6.2.2 **Scenario:**

- Residential user programs schedule locally or remotely via the secure web interface.
- RESU charges and dispatches as scheduled.1

6.6.3 Price Based Control (only available with Smart Meter)

6.6.3.1 **Description:** Charge and dispatch are optimized to provide the lowest energy cost to the user.

6.6.3.2 **Scenario:**

- RESU acquires price schedule from the Smart Meter (using the Price cluster of SE v1.0).
- RESU optimizes charge and dispatch schedule based upon price tables.
- The unit charges and dispatches as determined by the schedule.1

6.7 Additional Operating Options

The unit shall support the following listed options. The options are in addition to the modes listed in sections 6.6.2 and 6.6.3 only. These options are not available with the Utility Control mode 6.6.1.

6.7.1 Accept DR Request

6.7.1.1 **Description:** When a DR event is received, the unit dispatches power according to the event information until a minimum energy reserve level is reached, regardless of initial battery energy level. A DR event can be sent via the smart meter using the DR cluster of SE v1.0, or when a smart meter is not available the event can be programmed through the secure web interface.

Using the smart meter, the RESU discharges when it receives a DRLC event message with a negative value (i.e., -1 to -100) for the Average Load Adjustment Percentage attribute of the Demand Response Load Control (DRLC) cluster message.

6.7.1.2 **Scenario:**

- The user enables accepting DR requests through the secure web interface.
- User specifies a minimum energy reserve that will not be exceeded during the event.
- With Smart Meter capability: DR event is received via the smart meter.
- Without Smart Meter Capability: DR event is programmed by the utility via the secure web interface.

[1] Unless interrupted by a DR event when DR is enabled. Charge start time may be altered if Net Power Optimized is enabled.

- When the start time of the DR event is reached the RESU interrupts any current activity and dispatches stored energy until the minimum reserve energy level is met.

6.7.2 Net Power Optimized

6.7.2.1 **Description:** The charge schedule is optimized to store excess photovoltaic power throughout the day. Excess photovoltaic energy that would be sent back to the grid is used to charge the battery. Based on the inputs provided (during unit setup or available through the HAN), the RESU is charged to an optimal energy state during off-peak hours. The remaining charge is supplied by the amount of PV power that exceeds the house load during the day. The accuracy of the calculation is increased if solar forecast and measured house load data is available. This feature will be discussed further with the selected vendor(s).

6.7.2.2 **Scenario:**

- The user selects Net Power Optimized option through the secure web interface.
- The user enters any data required by the algorithm to optimize the charging schedule such as PV array size, location, and average daily house load. Solar forecast and measured house load data can be used if available.
- The system then determines the optimal schedule for charging
- The system then charges per the schedule.[1]

6.7.3 Reactive Power Assist

6.7.3.1 **Description:** When the sensed voltage at the unit electrical connection point falls below a predetermined value, the RESU provides maximum reactive power to the grid. When sensed voltage at the service panel rises above a predetermined value, the RESU absorbs maximum reactive power from the grid.

6.7.3.2 **Scenario:**

- The user or utility selects the Reactive power assist option and sets the maximum and minimum voltage thresholds through the secure web interface.
- The RESU then responds accordingly when voltage exceeds the set bounds.

6.8 Communication

6.8.1 General

6.8.1.1 The RESU shall have a Human-Machine-Interface (HMI) for setting up the operating parameters as well as monitoring its performance.

6.8.1.2 The HMI shall be accessible locally and remotely. A compatible control application shall be provided to permit remote or local monitoring and control (req. 6.8.2).

[1] Unless the charge is interrupted by a DR event when DR is enabled.

6.8.1.3 The RESU shall provide data acquisition capabilities (req. 6.9).

6.8.1.4 The unit should leverage any customer broadband connection for remote access. If none exists, the unit should have the option to use a cellular based communication system for connection.

6.8.1.5 The RESU shall be designed in such a way that it can communicate through a diagnostic port to a locally connected device such as a laptop computer. This diagnostic port can be used to configure, control, troubleshoot and upgrade the RESU.

6.8.1.6 The vendor shall provide back office support (server) to facilitate control and data logging functions of the RESU.

6.8.2 Control Interface - Web Enabled GUI

6.8.2.1 The RESU shall be controllable through a Graphic User Interface (GUI) locally or remotely utilizing secure HTTP.

6.8.2.2 The GUI shall offer different levels of access (e.g. to the customer, utility, manufacturer). Certain parameters, settings and control features should only be accessible to specified users.

6.8.2.3 The secure web interface shall reside on a back-office server in a remote location.

6.8.2.4 The GUI shall allow the utility to control grouping or ungrouping of multiple RESU devices when operated in the Utility Control Mode.

6.8.2.5 The GUI shall allow the utility to schedule charges and discharges (dispatching) for the units individually or as a group.

6.8.2.6 For individual RESUs the GUI shall display as a minimum:

- Available battery energy for dispatch (kWh and state of charge %)
- Power levels for:
    - Battery DC (signed +/- kW)
    - PV input (when available)
    - RESU system (AC kW in/out)
    - Site demand (with Smart Meter using Simple Metering cluster of SE v1.0)
    - Critical Load
- Any RESU system malfunctions, alarms or warnings
- Grid status (available/unavailable)
- Critical load status (grid connected/ back-up)
- Mode of operation (including selected options)
- Current and future schedules, DR event (if available), energy pricing (if available) and any other pertinent information

6.8.2.7 Aggregated available energy and power for any group shall be displayed.

6.8.2.8 The GUI shall provide a link to data logs and error logs.

6.8.2.9 The GUI may be in beta format during the prototype evaluation phase but it must be functional.

6.8.3 Home Area Network Integration

6.8.3.1 The RESU shall sit on the secured Utility communications channel (Refer to reference 11 Figure 3 – Scenario Three in the OpenSG HAN SRS v1.04, Section 2.2.10 – Architectural Scenarios, pg 29).
6.8.3.2 The RESU shall be using a ZigBee certified platform conforming to the ZSE profile specification revision 15 (i.e., SE v1.0)
6.8.3.3 The RESU shall use the ZigBee Pro stack
6.8.3.4 The RESU shall use the ZigBee 2007 stack profile
6.8.3.5 The RESU shall have HAN communications solution capable of +20dBm total transmit output power
6.8.3.6 The RESU shall enable the Demand Response and Load Control (DRLC) cluster
6.8.3.7 The RESU shall respond to requests to reduce charging rate using the Average Load Adjustment Percentage attribute (i.e., value of -1 to -100) of the DRLC message
6.8.3.8 The RESU shall respond to requests to discharge energy using the Average Load Adjustment Percentage attribute (i.e., value of +1 to +100) of the DRLC message
6.8.3.9 The RESU shall enable the Simple Metering cluster
6.8.3.10 The RESU shall provide energy consumed and delivered to the SCE meter
6.8.3.11 The RESU shall provide energy consumed and delivered to the In-Premise Display (may use the Mirroring capability of SE v1.0)
6.8.3.12 The RESU shall enable the Price cluster
6.8.3.13 The RESU shall enable the CBKE cluster
6.8.3.14 The RESU shall have the ability to use pre-configured network and link keys or Elliptical Curve Cryptography (ECC) Test Certificates from Certicom for the purposes of lab and field demonstration (if ECC, shall use an Install Code)

6.9 Data Logging

6.9.1 Data shall be time-stamped and shall be logged at least every 5 minutes locally.
6.9.2 The following data shall be logged at a minimum:

- Date and time (any common format)
- Battery energy available (kWh) and state of charge (%)
- Total energy out (cumulative kWh dispatched) since the last charge.
- Battery voltage, current and power
- PV input power
- Critical load voltage, current, frequency and power
- Grid presence
- Enclosure temperature
- PV energy delivered
- AC voltage and current
- System AC active power (+/- kW), reactive power (+/- kVAR)
- System power factor

- Minimum, maximum, and average battery cell voltages and battery cell temperatures
- Operating mode (req. 6.6)
- Any available data broadcasted by the smart meter including:

— Demand (Simple Metering cluster of SE v1.0)
— Total energy (calculated from Demand)
— Energy pricing (Price cluster of SE v1.0)
— Any DR event information (DRLC cluster of SE v1.0)

6.9.3 Logged data shall be uploaded to the server every 15 to 30 minutes.

6.9.4 Errors and malfunctions shall be logged as they occur into a separate log file.

6.9.5 The RESU shall be capable of retaining 168 hours of data in the case of a loss of connection to the server.

6.9.6 In the case of a loss of connection to the server, logged data shall be accessible at the RESU by any of the following means:

- Connecting with a laptop directly
- Removing and reading a flash memory module
- Inserting a USB flash memory device and uploading to it

6.10 Factory Acceptance Testing

6.10.1 The system supplier shall conduct system operation tests according to applicable standards and agreed upon between SCE and the system supplier.

6.10.2 The system shall be tested by the system supplier in all modes of operation at rated power levels as specified in this document. Results shall be documented in an acceptance testing report.

6.10.3 Representatives from SCE and the supplier shall be allowed to participate in factory acceptance tests covering the functionality of all system components.

6.11 Limited Warranty

6.11.1 Refer to General Terms and Conditions section 12

6.12 Project Support

6.12.1 The selected vendor shall provide back office support until December 31, 2012 to include:

- Data storage for all RESUs supplied (logged data)
- Hosting for the secure web interface

6.12.2 The vendor shall provide technical support during the lab and field testing of the first two units to include:

- Email or phone consultation regarding any technical questions from SCE engineers
- Any training or on-site support required to install and begin testing of the prototype RESUs during initial testing at the EVTC
- On-site support to repair any malfunction which disables any of the required functions of the RESU within a reasonable period of time

6.12.3 SCE staff may make hardware repairs or upgrades with the approval and support of the vendor during the prototype evaluation phase

6.12.4 During the deployment phases of the project, technical support shall be provided to any contractor hired by SCE for installation and maintenance of the RESUs.

6.13 Technical Documentation

6.13.1 Vendor shall provide detailed technical documentation to SCE upon delivery of the first unit. Initial documents provided may be in draft format.

6.13.2 Finalized technical documentation shall be provided at receipt of subsequent units.

6.13.3 Technical documents must provide but are not limited to:

- Technical specifications of the unit including operating limits
- Overview of system operation with functional diagrams
- A troubleshooting and repair section
- A detailed parts list of repairable components within the system with manufacturer part numbers listed
- Detailed configuration and diagnostic actions to be taken upon a system hard reset or commissioning
- Procedure(s) for upgrading firmware in the RESU

7. References

Ref#	Code	Agency	Applicability	Link (if available)
1	UL 1741	Underwriters Laboratory	Distributed Generation Device Safety	
2	UL 1778		UPS Device Safety	
3	Tariff Rule 21	Southern California Edison (SCE)	Distributed Generation connected to SCE's system	SCE Tariff Rules
4	47 CFR 15.109, 15.209	Federal Communications Commission (FCC)	EMI Emissions	CFR 15.109 CFR 15.209
5	Std. C37.90.2-1995	IEEE	EMI withstand capability	
6	Std. 1547-2003	IEEE	AC harmonic currents on Discharge	
7	Std. 519-1992	IEEE	AC harmonic currents on Charge and Standby	
8	CBEMA Curve	Information Technology Industry Council (ITIC)	Acceptable voltage sag when switching sources	CBEMA Curve
9	Std 802.15.4	IEEE	Wireless Communication Standard (ZigBee)	
10	Std. 802.3	IEEE	Ethernet Standard (control/communication)	
11	250-2008	National Electrical manufacturers Association (NEMA)	Enclosure Type	
12		UCA International Users Group	RESU HAN communications	UtilityAMI 2008 Home Area Network System Requirements Specification
13	Smart Energy Profile Rev. 15	ZigBee Alliance	HAN Communication	ZigBee Smart Energy Profile revision 15
14	C84.1	ANSI	Output voltage and freq. in Back-up mode.	