SmartConnect Use Case:
C8 – Load Researchers Perform Analyses Using SmartConnect Data

January 20, 2009

Document History

Revision History

Revision Number	Revision Date	Revision / Reviewed By	Summary of Changes	Changes marked
(#)	(yymmdd)	(Name)	(Describe change)	(N)
0.1	081021	Grant Gilchrist	Initial draft from workshop on August 20, 2008	N
0.2	081111	Grant Gilchrist	Revisions based on review on October 30, 2008	N
0.3	081120	Grant Gilchrist	Revisions from additional comments.	N
1.0	090107	Deborah Catanese	Edits to drafts previously reviewed by SMEs	Y

Approvals

This document requires following approvals.

Name	Title
Bryan Lambird	Project Manager, Edison SmartConnect
Cyrus Sorooshian	Manager, Load Research

Contents

1. Use Case Description

1.1 Use Case Title

Load Researchers Perform Analyses Using SmartConnect Data

1.2 Use Case Summary

Load Research, an organizational part of Southern California Edison's (SCE) Regulatory Policy and Affairs division, performs studies and produces reports for a variety of clients both inside and outside the utility. This use case describes how information gathered, stored and analyzed by the SmartConnect system can help make studies faster, more accurate, and less costly. The primary benefit of using SmartConnect data in this manner is that Load Research no longer needs to deploy a separate monitoring system to acquire the data necessary to perform studies.

1.3 Use Case Detailed Narrative

This use case is organized around the different types of studies Load Research is asked to perform. Each type of study is discussed in one of the following scenarios:

1. Load Research analyzes electric load statistics and usage patterns for any or all of SCE's rate groups and/or customer classes (market segments) with data collected from a designated subset of meter samples. This information is used for pricing, rate design, revenue allocation, and to support regulatory proceedings.

2. Load Research studies large customers individually or as a group.

3. Load Research performs end-use studies by customer segments (regions, building types, etc.).

4. Load Research studies distributed generation.

5. Load Research studies the effectiveness of demand response programs.

6. Load Research uses customer information for appliance saturation and demographic studies.

7. Load Research studies load on individual circuits.

8. Load Research provides dynamic load profiles for selected customer classes to the Web site and database tables. It also compiles annual static load profiles exclusively for the remainder of the customer classes and the Web site.

Using SmartConnect data in this way benefits the utility by:

- Eliminating the need for specialized meters and communications systems that serve Load Research exclusively

- Improving the accuracy of the studies

- Allowing greater flexibility in adjusting the samples used for the studies

- More direct marketing of those customers who can use particular programs and services (see Use Case C7)

A qualitative discussion of each scenario and the associated business value are provided individually in the sections that follow.

1.3.1 Usage Studies

The most common type of study performed by Load Researcher is an energy usage study presented to regulators to justify changes in rates and provide parameters for designing rates. Load Research performs analyses of electric load statistics and usage patterns for any or all of SCE's rate groups and/or customer classes (market segments) using data from a designated subset of meter samples. This information is provided for the purpose of pricing, rate design, revenue allocation, and support of regulatory proceedings.

This type of study is often used to explain to regulators how a rate change impacts different types of customers. The studies are performed by building load profiles for each type of customer based on random samplings. Regulations require that the raw data used to build these profiles be provided in kWh measured in 15-minute intervals.

The sample set of customers used for these studies varies depending on the size of the customer.

- For customers using less than 200 kW, approximately 4.5 million customers, 20,000 to 100,000 premises are sampled.

- For customers using more than 200 kW, no sampling is needed because there so few customers; therefore every customer is measured, approximately 15,000.

Customers are never informed that they are being studied. The same sample set is used repeatedly for this type of study and the membership of the sample set typically changes only slightly over a period of many years. Measured data must be retained indefinitely for Load Researchers to perform historical comparisons as part of their studies.

Usage studies cover the utility as a whole and must be internally consistent for regulatory purposes. For each time period in the load profile, the Load Researcher multiplies the usage for each type of customer by the number of customers of that type, and then adjusts the total usage for line losses and errors. In each case the total must equal both the measured overall energy usage for the utility and the recorded amount of energy sold to customers. Once the profiles are consistent for historical data, they are used to predict the effect of the rate change.

External clients such as the Solar Alliance or the Farm Bureau may ask for similar studies, but more often they require 1-hour interval data rather than 15-minute interval data.

The primary advantages of using SmartConnect data for these types of studies are:

- **Flexibility in choosing samples.** Without the SmartConnect system, special research meters capable of producing 15-minute interval data must be installed at the customer's premises and cannot easily be moved. Once SmartConnect deployment is complete, every meter for customers using less than 200 kW becomes a potential research meter and can be designated as such without a site visit.

- **Consistency of the process.** Load Research requirements can be met using the same physical and logical infrastructure as normal billing processes, reducing costs. All SmartConnect usage data is interval data, collected automatically by the SmartConnect Network Management System (NMS), validated by the Meter Data Management System (MDMS), and stored in the Meter Data Warehouse.

- **Scalability.** If the size of the customer sample set ever needs to be increased, it can be done without deploying additional infrastructure.

1.3.2 Individual Large Customer Studies

Load Research is often asked to perform studies on the detailed load history of individual large customers or groups of customers. These studies are often performed at the request of the customers themselves, for the purpose of improving energy efficiency. As of 2008, SmartConnect meters are only provided for customers using less than 200 kW. Customers using more than 200 kW require larger meters to interface with the SmartConnect communications system and presently studies must be performed using specialized meters – Real Time Energy Meters (RTEM) or Customer Data Acquisition System (CDAS).

To properly analyze energy efficiency at a customer site, it is important to compare energy usage to weather data for each interval in the profile; therefore, the SmartConnect system must be able to communicate with and store the interval based data it receives from the temperature and humidity sensors. Use Cases C5 and C6 can be used as a reference for establishing the requirements for registering these types of Home Area Network (HAN) devices and enabling them to communicate with the SmartConnect HAN.

A profile of the energy exchange between the utility and the cities it serves as retail customers is created as part of this study. Metering at these large-volume connection points must also be integrated into the SmartConnect system.

1.3.3 End-Use Studies

Occasionally, Load Research is asked to study the various end-uses customers make of electricity. A typical study of this type looks at approximately 2000 customers and analyzes those appliances (air conditioning, lighting, pool pumps, electrical vehicles, etc.) used by the customer. The study determines in what relative proportions, and at what time of day the customers perform these different uses, and breaks down the results by customer segments (region, building type, etc.). Customers must be randomly selected from the entire population. Some of these studies require 1-hour interval load information, while others, such as heavy use or electric vehicles require 15-minute interval load profiles.

SmartConnect makes improving this type of study possible by providing:

- **Single point of access** where the SmartConnect meter acts as a gateway for HAN devices that monitor customers' energy usage. Initially, These devices will be plug-in modules located between the wall socket and end-use; in the future they could be *smart appliances* with ZigBee communications built in. The SmartConnect communications system retrieves information automatically rather than creating another monitoring system just for end-use studies.

- **Accuracy.** Devices that monitor end-use can provide more accurate information than surveys or questionnaires that often result in the customer incorrectly estimating their energy usage.

- **Logistics.** The same mechanism used to register customer devices with the SmartConnect system for demand response (DR) programs or in-home displays (IHD) can be used to register their end-use monitoring devices.

1.3.4 Distributed Generation Studies

Requests for studies of distributed generation and the use of distributed renewable energy resources are becoming more common due to the recent political and economic climate. The key factor in such studies is the ability to measure not only the net energy use of the customer, but the gross generation and load as well. This information may be required at 15-minute or hourly intervals depending on study's goals.

Presently, some larger customers and those on standby rates are only asked to provide distributed generation information voluntarily and not all do so. Some types of generation, such as solar, require the customer to monitor their energy flow to qualify for incentive programs. Although mandatory, this information is not always available to the utility and although it is usually measured by the customer, it can be passed to an aggregator, operator or regulatory body via separate channels.

To successfully monitor distributed generation, the SmartConnect system must be able to permit multiple measurement channels and multiple meters at each customer's premises. In addition, SmartConnect meters must be available in sizes suitable for larger customers. Smaller customers have an advantage – upgrading their premises to become distributed generation sites is relatively easily being existing SmartConnect meters already perform net metering and provide multiple channels. Distributed generation requirements on the SmartConnect system are covered in more detail in other use cases, particularly D3.

1.3.5 Demand Response Studies

The deployment of automated DR through the SmartConnect system requires measuring the performance of the DR program. Requests for this type of report are expected to increase dramatically and the Load Research organization may be asked to study the effectiveness of a particular DR programs as well as events within these programs. Performance of these programs is addressed in Use Case C7's discussion of Customer Service Business Unit (CSBU) and Customer Experience Management (CEM) evaluation of the effectiveness of demand response and other customer programs.

The key technical hurdle to be addressed in a DR study is how to distinguish the customer and interval usage data associated with a particular DR event from all the other usage data being measured by the system. The problem is similar to identifying the intervals at which particular customers experience an outage where the SmartConnect system provides a tagging mechanism for each customer and interval to facilitate analysis. These status codes can be sent directly to the MDMS, and the Meter Data Warehouse, by implementing information technology (IT) such as the Load Control System (LCS) responsible for calling and managing the event, or using meters to provide the information as part of a periodic request for interval usage data. This tagging or quality stamping requirement is not new to metering systems, the tags are known as interval status codes, but the capability must be maintained as the new system is deployed.

More information on the marketing and evaluation of DR performance is available in Use Case C7.

1.3.6 Appliance Saturation and Demographic Studies

The Load Research organization is sometimes asked to perform studies on customer attributes other than basic energy use or demand. Typically a study is conducted to determine what appliances are used by customers and whether all customers in a specific area own a particular appliance. Additionally, the characteristics of a population may be studied with respect to:

- Type of customer or business, e.g. restaurant, residential, commercial, industrial, agricultural

---

- The premise's attributes, e.g. square footage, location, urban versus rural, available services

- Program participation

- Heavy use equipment, e.g. air conditioners, pool pumps

- Number and type of devices installed

- Distributed generation

Answering these types of questions helps the utility to plan and deploy a Customer Relationship Management (CRM) system. This CRM includes a database of customer characteristics populated with data collected from customer surveys, Web site responses, program choices, demand response participation, and feedback to Customer Service Representatives (CSR). Although the utility intends to link the CRM to the Meter Data Warehouse using meter identifiers, it is likely to be a separate system. The information stored in the CRM will be made available to the Load Research organization for the purpose of facilitating this type of study.

1.3.7 Circuit Loading Studies

Load Research requires SmartConnect data to perform studies on the loading of particular circuits in the electrical network. This is similar to the planning department requirements for determining when circuits are overloaded, but must be performed in response to regulatory questions and completed in greater detail. Regulators are often interested in this information for the purpose of evaluating DR or determining population growth.

Although the Supervisory Control and Data Acquisition (SCADA) system is primarily for loading data at the circuit level, the use of metering data for this type of study has other capabilities such as using individual customer data to predict the behavior of individual circuits and simulate how a typical circuit behaves.

The challenges of performing a circuit loading study are discussed in detail in other use cases, primarily D7 (asset utilization) and D8 (planner analytics). These use cases propose expanding the Transformer Load Monitoring (TLM) database and using a Planning Data Warehouse that contains a complete mapping of customers to transformers, segments and circuits. The SmartConnect communications system itself can be used to update and maintain this topology information. Once in place Load Research can calculate aggregate load on any particular circuit or segment using the sum of the loads of all customers on the circuit or segment.

The primary difference between this type of study and that conducted by Transmission and Distribution (T&D) planners is, Load Research studies are performed for regulators and require 15-minute data rather than hourly data.

Another study of this type is theft analysis in which the total load measured by all customer meters on a feeder is compared to the value measured by a separate feeder meter. This type of analysis is discussed in greater detail in Use Case B3.

1.3.8 Dynamic Load Profiles

The Load Research organization gathers Dynamic Load Profile (DLP) data for selected groups of customers. These profiles provide an hourly average usage for a given class or subset of customers, typically for the benefit of Energy Service Providers. The information must be provided within 62 hours of measurement. Presently, Load Research presents the data in semi-validated form, for approximately 12,000 customers out of

4.5 million with usages less than 200 kW. This data is published on the Utility Web Site using the same process for developing and publishing the Web site's annual static load profiles for other customer classes.

The primary difference between this scenario and the normal usage studies described in Scenario 1 is, a DLP provides significantly less information and does so in a much shorter timeframe.

The most significant benefit of using the SmartConnect system for developing DPL is the process can be fully automated. The deployment of the SmartConnect system provides an opportunity for every customer to access hourly load profile information for their own account. Compared to the logistics of acquiring and storing so much information, it is a relatively easy task aggregating and averaging customer usage to produce DLP profiles for each customer class or voltage level. This means DLP can be produced more reliably and promptly than the present system, which requires human intervention.

In addition, using the SmartConnect system permits the same level of accuracy used for billing the customer. The SmartConnect data acquisition mechanism includes a daily Validating, Editing and Estimating (VEE) cycle, which allows DLP to be based on a more complete set of validated data.

1.4 Business Rules and Assumptions

This use case assumes:

- The current sample set of load research meters are maintained throughout the SmartConnect deployment period. During that time, data from existing RTEM and CDAS meters is stored in the Meter Data Warehouse and Load Researchers are able to query this warehouse. Following the creation and deployment of the Meter Data Warehouse the old load research meters and related analytical systems are retired.

- There is as much demand for these studies after SmartConnect deployment as before. There may be even greater demand, once different parts of the organization and external stakeholders (e.g. regulators and customers) realize how much information is available.

- The SmartConnect system covers 100 percent of the customer population. If this assumption is not met, it may be necessary to continue using Load Research meters to reach customers in the missing areas.

- CSBU continues to enlist Load Research to provide relevant data before considering any new customer rate and program options.

2. Actors

Describe the primary and secondary actors involved in the use case. This might include all the people (their job), systems, databases, organizations, and devices involved in or affected by the Function (e.g. operators, system administrators, customer, end users, service personnel, executives, meter, real-time database, ISO, power system). Actors listed for this use case should be copied from the global actors list to ensure consistency across all use cases.

Actor Name	Actor Type (person, device, system etc.)	Actor Description
Customer	Person	A residential or small business energy user that has contracted with the utility to receive electrical service from the utility and has a SmartConnect meter installed. May or may not participate in programs provided by the utility including pricing events, load control or distributed generation.
Dynamic Load Profile (DLP) Process	Application	Software that calculates an average load profile for a preconfigured set of customers and publishes the profile to the Utility Web Site. Operates using daily collected and validated data, hence the title "dynamic." May be part of the Utility Web Site or some other system.
Meter Data Management System (MDMS)	System	Gathers, validates, estimates, and permits editing of meter data such as energy usage, generation and meter logs. Stores this data for a limited amount of time before it goes to the Meter Data Warehouse and makes the data available to authorized systems.
Meter Data Warehouse	System	Responsible for long-term storage of meter data including energy usage, demand, generation, events, logs, and other time-related information measured by the meter or calculated from that data. Does not contain information on the configuration, management, diagnostics, and maintenance of the meters themselves. Includes certain software applications responsible for filtering, analyzing, and reporting meter data.
Planning Data Warehouse	System	A storage location for planning-related information. Not related to usage or demand data, such as voltage and VAR histories.
SmartConnect Meter	Device	Advanced electric revenue meter capable of two-way communications with the utility. Serves as a gateway between the utility, customer site, and customer's load controllers. Measures, records, displays, and transmits data such as energy usage, generation, text messages, and event logs to authorized systems (i.e., the SmartConnect NMS) and provides other advanced utility functions.

Actor Name	Actor Type (person, device, system etc.)	Actor Description
SmartConnect Network Management System (NMS)	System	The utility's back office system responsible for remote two-way communications with the SmartConnect Meters for retrieving data and executing commands. Balances load on the communications network resulting from scheduled meter reads and to retries meters when communications fail.
Load Research OR Load Researcher	Organization, Person	Entity within the utility responsible for performing research on energy usage and demand for a variety of clients inside and outside the utility.
Load Control System (LCS)	System	Executes and monitors requested demand response resources. Sends out demand response event notifications to meters and customers.
Load Control Device	Device	Switches loads on or off or reduces load in response to events communicated by the AMI or AMI Meter. A device such as a smart thermostat that follows a set of preprogrammed rules. May be customer-owned or utility-owned.
Segment Load Calculation Process (SLCP)	System	A software application that gathers kVA and ampere loading data from the SmartConnect NMS to periodically calculate peak and average loading information for each transformer, switch, segment, circuit breaker, feeder or other element of the distribution system. Functionality is similar to the Transformer Load Calculation Engine (TLCE).
Transformer Load Management (TLM) Database	System	Stores two primary types of information: connectivity data describing which customers are connected to which transformers, switches, segments, circuit breakers, feeders or other elements of the distribution system; and historical loading data, capturing how much load is on any of these elements at a given time. Utilizes software applications to generate analyses and reports (periodically or on request) from the collected data.
Weather Sensors	Devices	Temperature and humidity sensors capable of communicating with the Meter over the Home Area Network.
End-Use Sensors	Devices	Plug-in modules that measure the energy usage on a given electrical socket and forward the information to a SmartConnect Meter over the HAN.
Utility	System	A generic term referring to the collection of systems, business functions, and organizations that form an electric utility organization. The term is used whenever the precise actor is not known or many actors utilize a service.

3. Step-by-Step Analysis of Each Scenario

This section contains detailed descriptions of each of the scenarios in this use case.

3.1 Load Research performs studies with data from a designated subset of meters

This scenario describes how the Load Research organization uses SmartConnect data to perform usage studies requiring specialized research meters. Load Research performs analyses of electric load statistics and usage patterns for any or all of SCE's rate groups and/or customer classes (market segments) using data from a designated subset of meter samples. This information is provided for pricing, rate design, revenue allocation, and supporting regulatory proceedings.

Triggering Event	*Primary*	*Pre-Condition*	*Post-Condition*
Identify the name of the event that initiates the scenario	*Identify the actor whose point-of-view is primarily used to describe the steps*	*Identify any pre-conditions or actor states necessary for the scenario to start*	*Identify the post-conditions or significant results required to complete the scenario*
Utility proposes a rate change, or requires a study in order to propose a rate change and then enlists a Load Researcher to conduct a study on the impact of the change to provide a report to regulators.	Load Researcher	SmartConnect meters have been deployed to all customers.	Load Researcher produces the requested study.

3.1.1 Steps for this scenario

Step #	Actor	Description of the Step	Additional Notes
1	Utility	Requests usage study from Load Research.	
2	Load Researcher	Determines sample size and composition required for the study. Determines that the sample set of meters needs updating.	May consult the CRM.
3	Load Researcher	Requests that SmartConnect NMS designate selected meters as load research meters.	
4	SmartConnect NMS	Reprograms meter remotely to record usage data at 15-minute intervals.	Default interval is one hour.
5	Meter	Acknowledges reprogramming. Begins recording kWh data at 15-minute intervals.	Begins recording kVAR for customers larger than 200kW.
6	SmartConnect NMS	Informs Load Researcher that meters have been reprogrammed.	
7	Meter	At end of each day, reports daily usage history to the SmartConnect NMS.	
8	SmartConnect NMS	Reports daily usage history for all meters to MDMS.	Only difference between research meters and other meters is the number of intervals they record.
9	MDMS	Validates usage data for all meters.	
10	MDMS	Stores usage history data in Meter Data Warehouse.	For the average customer, this occurs after approximately 12 months. Different for research meters? Retained indefinitely.
11	Load Researcher	Requests usage history for selected research meters after the required study interval has passed.	
12	Meter Data Warehouse	Responds with requested data.	This is 15-minute load profile data.
13	Load Researcher	Prepares the requested study.	

3.2 Load Research performs study of individual large customers

This scenario describes how Load Research performs an energy efficiency study for a large customer (>200kW).

Triggering Event	Primary	Pre-Condition	Post-Condition
Identify the name of the event that initiates the scenario	*Identify the actor whose point-of-view is primarily used to describe the steps*	*Identify any pre-conditions or actor states necessary for the scenario to start*	*Identify the post-conditions or significant results required to complete the scenario*
Customer requests an energy efficiency study.	Load Researcher	Customer has a SmartConnect Meter, but it is not yet designated as a load research meter.	Load Researcher provides the customer with the requested report.

3.2.1 Steps for this scenario

Step #	Actor	Description of the Step	Additional Notes
1	Customer	Requests energy efficiency study from Load Research.	
2	Load Researcher	Requests SmartConnect NMS to designate selected meter as a load research meter.	
3	SmartConnect NMS	Reprograms meter remotely to record usage data at 15-minute intervals.	Default interval is one hour.
4	Meter	Acknowledges reprogramming. Begins recording kWh and kVAR data in 15-minute intervals.	
5	SmartConnect NMS	Informs Load Researcher that meter has been reprogrammed.	
6	Utility	Sends temperature and humidity sensors to customer.	
7	Customer/Utility	Installs temperature and humidity sensors. Registers sensors on the Utility Web Site.	Utility may provide assistance to customers for installation of such devices.

Step #	Actor	Description of the Step	Additional Notes
8	Utility Web Site	Registers weather sensors with SmartConnect NMS and device management system.	Refer to Uses Cases C5 and C6 regarding registration.
9	SmartConnect NMS	Registers weather sensors with meter and establishes meter-sensor communications via HAN.	
10	Weather Sensors	Periodically reports weather data to meter.	
11	Meter	As part of the regular read process initiated by the MDMS, satisfies periodic and end of the day requests for daily usage histories and weather measurements to SmartConnect NMS.	
12	SmartConnect NMS	Reports daily usage history for all meters to MDMS. Reports weather data from selected meters to MDMS.	
13	MDMS	Validates usage data for all meters.	
14	MDMS	Stores usage history data and weather data in Meter Data Warehouse.	
15	Load Researcher	Requests usage history and weather history for the customer after the required study period has passed.	
16	Meter Data Warehouse	Responds with requested data.	
17	Load Researcher	Prepares the requested study.	

3.3 Load Research performs end-use studies by customer segments

This scenario describes how Load Research performs an electricity end-use study on a selected set of customers.

Triggering Event	*Primary*	*Pre-Condition*	*Post-Condition*
Identify the name of the event that initiates the scenario	*Identify the actor whose point-of-view is primarily used to describe the steps*	*Identify any pre-conditions or actor states necessary for the scenario to start*	*Identify the post-conditions or significant results required to complete the scenario*
Utility requests a study of electricity end-use.	Load Researcher	End-use study is performed on customers who are already part of the existing sample set of research meters described in the first scenario. Meters are already recording 15-minute interval usage data for the premises.	Load Researcher provides the requested study.

3.3.1 Steps for this scenario

Step #	Actor	Description of the Step	Additional Notes
1	Utility	Requests electricity end-use study from Load Research.	
2	Utility	Sends end-use sensors to selected customers.	Some end-use analysis may be performed using additional, dedicated SmartConnect meters rather than end-use sensors, as in the case of electric vehicles.
3	Customer/Utility	Installs end-use sensors and registers them using the Utility Web Site.	Utility may provide assistance to customers for installation of such devices.

Step #	Actor	Description of the Step	Additional Notes
4	Utility Web Site	Registers e-use sensors with SmartConnect NMS and the device management subsystem.	
5	SmartConnect NMS	Registers end-use sensors with meter and establishes meter-sensor communications via HAN.	
6	End-Use Sensors	Periodically reports usage for individual electrical sockets to meter.	
7	Meter	As part of the regular read process initiated by MDMS. periodically reports daily (end of day) usage history and sub-metering usage measurements to SmartConnect NMS upon request.	
8	SmartConnect NMS	Reports daily usage history for all meters to MDMS.	Includes sub-metering data from end-use sensors (approximately 2000 customers).
9	MDMS	Validates usage data for all meters.	
10	MDMS	Stores usage history, including sub-metering data, in Meter Data Warehouse.	
11	Load Researcher	Extracts usage history for the customer, including all sub-metering usage histories from the Meter Data Warehouse after the required study period has passed.	Load Researchers should have access to Meter Data Warehouse.
12	Load Researcher	Prepares the requested study.	

3.4 Load Research performs study on distributed generation

This scenario describes how Load Research performs a load study on selected customers who are providing distributed generation.

Triggering Event	*Primary*	*Pre-Condition*	*Post-Condition*
Identify the name of the event that initiates the scenario	*Identify the actor whose point-of-view is primarily used to describe the steps*	*Identify any pre-conditions or actor states necessary for the scenario to start*	*Identify the post-conditions or significant results required to complete the scenario*
Utility requests that Load Research provide a distributed generation (DG) study.	Load Researcher	Customer already has a SmartConnect meter installed at the service access point and another meter at the point of generation configured for recording at 15-minute intervals. Note: Use of SmartConnect system to remotely configure customer meters for Net Energy Metering (NEM) is discussed in Use Case D3.	Load Researcher provides the requested report.

3.4.1 Steps for this scenario

Step #	Actor	Description of the Step	Additional Notes
1	Meters	One meter records kWh used and provided, measured at service point of access, another meter records kWh generated, measured at point of generation.	
2	Meters	Periodically reports all usage data to SmartConnect NMS upon request as part of the regular read process initiated by MDMS.	
3	SmartConnect NMS	Reports daily usage history for all meters to MDMS.	
4	MDMS	Validates usage data for all meters.	
5	MDMS	Stores usage history in Meter Data Warehouse.	

Step #	Actor	Description of the Step	Additional Notes
6	Load Researcher	Requests usage history for the customer.	
7	Meter Data Warehouse	Notes that the customer in question has more than one meter and provides usage history for both meters, including designations identifying one meter as the generation meter, the other as the primary billing meter.	
8	Load Researcher	Prepares the requested study.	

3.5 Load Research performs a study on the effectiveness of demand response programs

This scenario describes how a load researcher measures the performance of DR programs. This scenario assumes that meters mark interval usage data with an identifier indicating a particular DR event. Another possible scenario would permit LCS to query and mark the data in the MDMS after the event ends. In either case, the usage history must be marked to indicate the DR event was underway at the time it was recorded.

Triggering Event	Primary	Pre-Condition	Post-Condition
Identify the name of the event that initiates the scenario	*Identify the actor whose point-of-view is primarily used to describe the steps*	*Identify any pre-conditions or actor states necessary for the scenario to start*	*Identify the post-conditions or significant results required to complete the scenario*
Utility issues a DR event and later requests a report on its performance.	Load Researcher	Customers affected by the DR event already have SmartConnect Meters remotely programmed for 15-minute intervals as required for the study. Customer has registered load control equipment such as a thermostat with the utility.	Load researcher produces the requested report.

3.5.1 Steps for this scenario

Step #	Actor	Description of the Step	Additional Notes
1	Load Control System (LCS)	Issues DR event to SmartConnect NMS. Stores notification of the event in the MDMS, ultimately made available in the Meter Data Warehouse.	This allows MDMS to store an indicator that a DR event was in progress for each interval and for each affected customer.
2	SmartConnect NMS	Sends the DR event to the selected set of customers.	
3	Meter	Forwards the DR event to load control device. Continues to record usage history.	If available or required as part of the given DR program. Some DR programs do not require a load control device.

Step #	Actor	Description of the Step	Additional Notes
4	Load Control Device	Adjusts the customer's load per previous programming and the type of event.	If available or required as part of the given DR program. Alternatively, customer takes manual action to reduce load, or chooses not to participate.
5	Customer	May choose to override DR event and load control device action.	If choice is available as part of the given DR response program.
6	Load Control Device	Returns customer's load to normal after the event is over.	If not overridden.
7	Meter	Periodically reports usage history to SmartConnect NMS upon request as part of the regular read process initiated by MDMS.	
8	SmartConnect NMS	Forwards usage history to MDMS.	
9	MDMS	Validates and stores usage history. Notes that the LCS reported a DR event previously (step 1) and updates the interval status codes for the appropriate intervals accordingly.	
10	MDMS	Periodically copies interval usage history into Meter Data Warehouse including the interval status codes indicating whether a DR event was in progress.	In addition to indicating DR events, interval status codes should also indicate whether the data was validated, edited or estimated, etc. and any outages taking place during the interval.
11	Utility	Requests report on performance of the DR event.	
12	Load Researcher	Queries Meter Data Warehouse for all usage data recorded during the particular DR event for the customers in question.	
13	Meter Data Warehouse	Responds with the requested data based on the status codes recorded for the usage data.	
14	Load Researcher	Prepares the requested study.	

3.6 Load Research uses customer information for appliance saturation and demographic studies

This scenario describes how Load Research queries the CRM system for information on customer characteristics, for the purposes of appliance saturation or demographic studies.

Triggering Event	Primary	Pre-Condition	Post-Condition
Identify the name of the event that initiates the scenario	*Identify the actor whose point-of-view is primarily used to describe the steps*	*Identify any pre-conditions or actor states necessary for the scenario to start*	*Identify the post-conditions or significant results required to complete the scenario*
Customers take a survey on the Utility Web Site and later a client requests a demographic study.	Load Researcher	None	Load Researcher provides the requested study.

3.6.1 Steps for this scenario

Step #	Actor	Description of the Step	Additional Notes
1	Customer	Participates in survey on Utility Web Site, registers in program, or provides information about business and premises to sign up for service.	
2	Utility Web Site	Stores results containing customer attributes/characteristics in CRM.	
3	Load Researcher	Queries CRM for attributes of a sample of customers.	See requirements for list of important attributes.
4	CRM	Provides response to query.	
5	Load Researcher	Prepares the requested study.	

3.7 Load Research performs study of load on individual circuits

This scenario is very similar to those discussed in other use cases regarding the use of load on individual circuits for planning purposes. The primary difference is that for Load Research studies, the data must be in 15-minute intervals, compared to 1-hour intervals for planning studies. Refer to Use Case D8 for the steps of this scenario.

Triggering Event	*Primary*	*Pre-Condition*	*Post-Condition*
Identify the name of the event that initiates the scenario	*Identify the actor whose point-of-view is primarily used to describe the steps*	*Identify any pre-conditions or actor states necessary for the scenario to start*	*Identify the post-conditions or significant results required to complete the scenario*
Utility asks Load Research to perform a study on the load of individual circuits.	Load Researcher	Sub-circuit topology including mapping of customers to circuits and segments is stored in the TLM Database. Segment Load Calculation Process is periodically calculating segment loads and storing them in the Planning Database per Use Case D8. Load Researcher preprogrammed the meters on the circuits in question for 15-minute recording intervals rather than 1-hour intervals.	Load Researcher produces report based on information provided by the Segment Load Calculation Process.

3.8 Load Research provides dynamic load profiles for customer classes to web site

This scenario describes how Load Research can provide dynamic load profiles for given customer classes based on usage profiles. This scenario assumes a software process, known as the Dynamic Load Profile, is deployed to perform the calculations. It may be stand-alone or integrated as part of another system, such as the MDMS or Utility Web Site.

Triggering Event	Primary	Pre-Condition	Post-Condition
Identify the name of the event that initiates the scenario	*Identify the actor whose point-of-view is primarily used to describe the steps*	*Identify any pre-conditions or actor states necessary for the scenario to start*	*Identify the post-conditions or significant results required to complete the scenario*
Client requests dynamic load profiles for a particular class of customers.	Customer/Client	Customers in question have SmartConnect Meters.	Client receives daily dynamic load profiles for the requested customer classes.

3.8.1 Steps for this scenario

Step #	Actor	Description of the Step	Additional Notes
1	Customer/Client	Requests online dynamic load profile from Load Research.	
2	Load Researcher	Configures DLP process and Utility Web Site for the requested profile.	
3	Meter	At the end of each day, sends usage history to SmartConnect NMS	
4	SmartConnect NMS	Forwards usage history from all meters to the MDMS.	
5	MDMS	Validates usage history and stores it in the Meter Data Warehouse.	
6	DLP Process	Requests from the CRM the list of customers having the required characteristics.	
7	CRM	Provides requested list of customers and their meter characteristics.	

Step #	Actor	Description of the Step	Additional Notes
8	DLP Process	Requests usage history for the requested list of customers.	
9	Meter Data Warehouse	Responds with usage history of customers.	
10	DLP Process	Calculates dynamic load profile for the specified list of customers and forwards the information to the Utility Web Site.	
11	Utility Web Site	Displays the dynamic load profile for the customer/client.	

4. Requirements

Detail the Functional, Non-Functional and Business Requirements generated from the workshop in the tables below. If applicable list the associated use case scenario and step.

4.1 Functional Requirements

Functional Requirements	Associated Scenario # (if applicable)	Associated Step # (if applicable)
The SmartConnect NMS and MDMS shall designate any subset of SmartConnect meters as a research meter.	1 2	2 2
If meters designated as research meters are removed, destroyed or reassigned, the SmartConnect NMS and MDMS shall automatically designate new meters as research meters in order to maintain the set of research meters at a constant size.	1	2
The SmartConnect NMS and Meter shall permit meter recording intervals to be programmed remotely.	1 2	4,5 4,5
The SmartConnect NMS and Meters shall provide kVARs for large customers (>200kW) recorded at 15-minute intervals.	1	5
The SmartConnect system shall provide 15-minute energy metering information at connection points to resale cities.	2	3
The Utility Web Site, SmartConnect NMS, CRM and meter shall permit customers to register weather sensors for communicating over the SmartConnect network.	2	7
The SmartConnect NMS, when requested, shall inform Load Research if weather sensors are installed for a customer.	2	9
The SmartConnect NMS and Meters shall forward information received from weather sensors (at least temperature and humidity) upon request as part of the regular read process.	2	11, 12
The Meter Data Warehouse shall store interval-based weather data including temperature and humidity.	2	14, 15, 16
The Utility Web Site, SmartConnect NMS, and Meter shall permit customers to register end-use sensors for sub-metering purposes within their premises.	3	3,4,5,6
The SmartConnect NMS shall respond to requests indicating whether the sub-meters required for a study are installed and operating.	3	5

Functional Requirements	Associated Scenario # (if applicable)	Associated Step # (if applicable)
The SmartConnect System, including Meter, NMS, MDMS and Meter Data Warehouse, shall permit retrieval and storage of usage information from multiple sub-metering devices located within the customer premises (e.g. for end-use studies). Currently done with IDR meter.	3	8,9,10,11
The MDMS and Meter Data Warehouse shall allow users to query usage data for a particular customer and receive all data for that customer, including multiple meters and sub-meters.	3 4	11,12 7
The SmartConnectNMS shall permit multiple SmartConnect meters to be located at a site, one of which can be designated as measuring gross generation.	4	7
The LCS shall record the time of all load control/DR events and the subset of customers addressed, making the data available to Load Research via the MDMS and Meter Data Warehouse.	5	1
The MDMS shall provide a status code with each interval of usage data indicating whether the data has been validated, estimated, edited, etc.	5	10
The MDMS and Data Warehouse shall permit status codes to be recorded with data measured at each interval, including whether the customer was experiencing an outage and/or DR event.	5	10
The MDMS and Meter Data Warehouse shall permit Load Researchers to query for usage data recorded during a specified DR event.	5	12, 13
The CRM shall provide Load Research with the following information about customers: • Premise characteristics, e.g. square footage • What appliances they have and the characteristics of each • Heavy use equipment (air conditioning, pool pumps, etc.) • Urban or agricultural area • HAN devices and their capabilities/characteristics • Distributed generation	6	3,4
The Meter Data Warehouse, Planning Data Warehouse, and TLM Database shall contain energy usage information aggregated by circuit, sub-circuit segment, and transformer point.	7	See use case D8
The DLP process shall allow Load Researchers to select a set of customers to create periodic DLP.	8	2
When the MDMS refines or corrects usage data it shall update this data in the Meter Data Warehouse.	8	5
The DLP process shall query the CRM to find customers with a given set of characteristics.	8	6

Functional Requirements	Associated Scenario # (if applicable)	Associated Step # (if applicable)
The CRM shall provide the DLP process with a list of customers that have a given set of characteristics.	8	7
The DLP process shall calculate an average load profile from a list of customer characteristics using data from the Meter Data Warehouse, and publish the profile on the Utility Web Site.	8	8,9,10
The Meter Data Warehouse shall permit the DLP process to request usage data for a subset of customers.	8	9
The Utility Web Site shall provide a means for authorized customers/clients to view load profiles for individual customers or sets of customers.	8	11

4.2 Non-Functional Requirements

Non-Functional Requirements	Associated Scenario # (if applicable)	Associated Step # (if applicable)
The SmartConnect System shall designate 20,000 to 100,000 meters as research meters.	1 2	3 2
The SmartConnect NMS shall remotely program all designated research meters to record kWh data at 15-minute intervals.	1 2	4,5 3,4
The Meter Data Warehouse shall designate a subset of data to be retained indefinitely for all 15,000 customers above 200 kW and the research sample of 100,000 residential customers to be used for historical studies.	1	10
The SmartConnect System shall collect weather data from selected locations at 1-hour intervals.	2	12,13,14
The SmartConnect NMS shall remotely program all sample sub-meters to record energy usage at 15-minute intervals.	3	5
The Meter Data Warehouse shall store energy end-use data for a minimum of 2000 customers.	3	10,11,12
The SmartConnect System shall measure and record overall load for approximately 4000 circuits at 15-minute intervals to resolve regulatory questions.	7	See Use Case D8
Load Research requires that VEE'd load profile data for designated DLP customers be in the data warehouse by 2 p.m. the following day and must be posted within 62 hours.	8	3-11
At least 12,000 customers shall be designated for DLP.	8	10

5. Use Case Models (optional)

This section is used by the architecture team to detail information exchange, actor interactions and sequence diagrams.

5.1 Information Exchange

For each scenario detail the information exchanged in each step.

This will need to be updated with any given step and requirement updates and should be in synch with sequence diagram.

Scenario #	Step #, Step Name	Information Producer	Information Receiver	Name of Information Exchanged
1	3	Load Researcher	SmartConnect NMS	Load research meters already designated and a list of meters to be designated
1	4	SmartConnect NMS	Meter	Recording intervals of 15 minutes
1	5	Meter	SmartConnect NMS	Confirmations of recording interval changes
1	6	SmartConnect NMS	Load Researcher	Confirmation of meters designated
1	7	Meter	SmartConnect NMS	Usage history – daily for individual meters
1	8	SmartConnect NMS	MDMS	Usage history – daily for all meters
1	10	MDMS	Meter Data Warehouse	Validated usage history
1	11	Load Researcher	Meter Data Warehouse	Requested usage history for subset of research meters
	12	Meter Data Warehouse	Load Researcher	Usage history for subset of research meters
2	2	Load Researcher	SmartConnect NMS	Designated load research meters
2	3	SmartConnect NMS	Meter	Recording intervals of 15 minutes
2	4	Meter	SmartConnect NMS	Confirmation of recording interval changes
2	5	SmartConnect NMS	Load Researcher	Confirmation of meters designated

Scenario #	Step #, Step Name	Information Producer	Information Receiver	Name of Information Exchanged
2	7	Customer	Utility Web Site	Registration of Device • Device I.D. • Customer account I.D. • Meter I.D.
2	8	Utility Web Site	SmartConnect NMS, CRM	Registration of Device
2	9	SmartConnect NMS	Meter	Registration of Device
2	9	Meter	Weather Sensor	Registration of Device
2	9	Meter	SmartConnect NMS	Confirmation of Device Registration
2	10	Weather Sensors	Meter	Usage Data Weather Data • Temperature • Humidity
2	11	Meter	SmartConnect NMS	Usage History – intervals of usage data Weather History – intervals of weather data
2	12	SmartConnect NMS	MDMS	Usage History Weather History
2	14	MDMS	Meter Data Warehouse	Usage History Weather History
2	15	Load Researcher	Meter Data Warehouse	Request for Usage History and Weather History for subset of meters
2	16	Meter Data Warehouse	Load Researcher	Usage History, Weather History - subset
3	3	Customer	Utility Web Site	Registration of End-Use Sensor
3	4	Utility Web Site	SmartConnect NMS, CRM	Registration of End-Use Sensor
3	5	SmartConnect NMS	Meter	Registration of End-Use Sensor
3	5	Meter	End-Use Sensor	Registration of End-Use Sensor
3	5	Meter	SmartConnect NMS	Confirmation End-Use Sensor Registered
3	6	End-Use Sensors	Meter	Sub-Metered Usage

Scenario #	Step #, Step Name	Information Producer	Information Receiver	Name of Information Exchanged
3	7	Meter	SmartConnect NMS	Usage History including sub-metered usage
3	8	SmartConnect NMS	MDMS	Usage History including sub-metered usage
3	10	MDMS	Meter Data Warehouse	Usage History including sub-metered usage
3	11	Load Researcher	Meter Data Warehouse	Request for Usage History – specific customer including sub-metered
3	12	Meter Data Warehouse	Load Researcher	Usage History – specific customer including sub-metered
4	2	Meters	SmartConnect NMS	kWh Used kWh Provided • At point of generation • At point of access • Designated which is which
4	3	SmartConnect NMS	MDMS	Usage History including multiple meters per customer
4	5	MDMS	Meter Data Warehouse	Usage History including multiple meters per customer
4	6	Load Researcher	Meter Data Warehouse	Request Usage History – per customer
4	7	Meter Data Warehouse	Load Researcher	Usage History including multiple meters per customer
5	1	Load Control System	SmartConnect NMS	DR Event • Event identifier • Event type • Event start time • Event duration • Event parameters e.g. price, level • I.D.s of affected meters
5	2	Load Control System	Meter Data Warehouse	DR Event
5	3	SmartConnect NMS	Meter	DR Event
5	5	Meter	Load Control Device	DR Event
5	7	Meter	SmartConnect NMS	Usage History

Scenario #	Step #, Step Name	Information Producer	Information Receiver	Name of Information Exchanged
5	8	SmartConnect NMS	MDMS	Usage History
5	10	MDMS	Meter Data Warehouse	Usage History including interval status codes • Validated/edited/estimated • Outage during interval • DR event during interval • Identifier of DR event • Start/end timestamp of event or outage
5	12	Load Researcher	Meter Data Warehouse	Requested Usage History – of specified event I.D.
5	13	Meter Data Warehouse	Load Researcher	Usage History including Interval Status Codes for all intervals and meters with the specified event I.D.
6	1	Customer	Utility Web Site	Customer Characteristics Program Choices Survey Responses
6	2	Utility Web Site	CRM	Customer Characteristics Program Choices Survey Responses
6	3	Load Researcher	CRM	Query
6	4	CRM	Load Researcher	Customer Characteristics Program Choices Survey Responses
8	2	Load Researcher	Utility Web Site, DLP Process	Configuration of Dynamic Load Profile
8	3	Meter	SmartConnect NMS	Usage History
8	4	SmartConnect NMS	MDMS	Usage History
8	5	MDMS	Meter Data Warehouse	Validated Usage History
8	6	DLP Process	CRM	Request for Customer List with specific attributes
8	7	CRM	DLP Process	Customer List
8	8	DLP Process	Meter Data Warehouse	Requested Usage History for list of customers

Scenario #	Step #, Step Name	Information Producer	Information Receiver	Name of Information Exchanged
8	9	Meter Data Warehouse	DLP Process	Usage History for list of customers
8	10	DLP Process	Utility Web Site	Dynamic Load History
8	11	Utility Web Site	Customer	Dynamic Load History

5.2 Diagrams

5.2.1 *Data Flow Diagram*
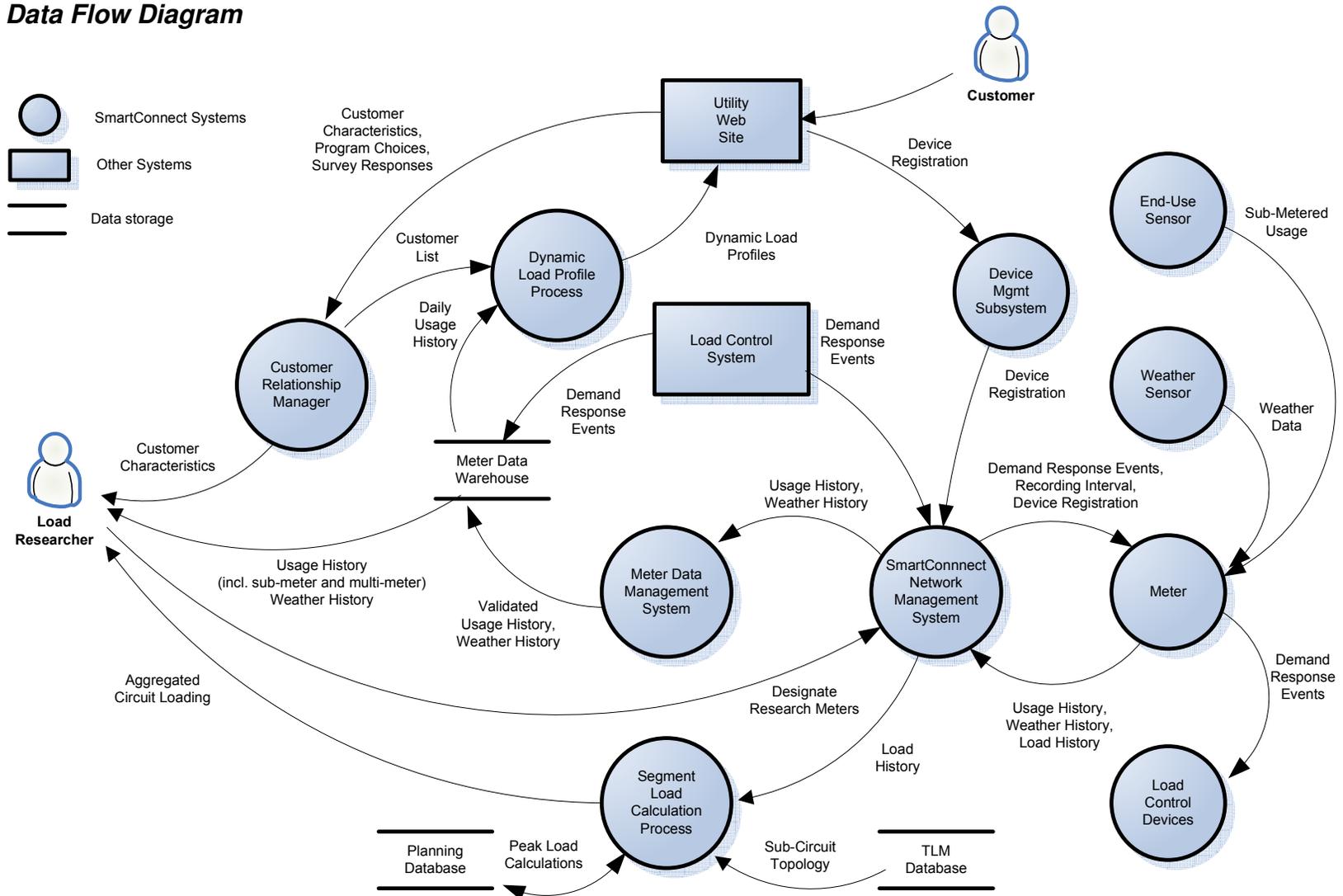
6. Use Case Issues

Capture any issues with the use case. Specifically, those unresolved issues that help the use case reader understand the constraints or unresolved factors that impact the use case scenarios and their realization.

Issue
Describe the issue as well as any potential impacts to the use case.
Need to develop a schedule for replacing existing CDAS meters with SmartConnect meters while maintaining existing samples.
Load Research prefers samples from 100% of the population. Which customers will not be covered by the SmartConnect system? May never be able to completely eliminate the use of research meters. May need to consider alternatives should 100% coverage not be achieved.
May wish to move to 15-minute intervals for all customers as the system evolves.
Are there customer privacy issues in demographic research studies?
Should data from research meters be updated in the Meter Data Warehouse sooner than data from other meters?

7. Glossary

Insert the terms and definitions relevant to this use case. Please ensure that any glossary item added to this list should be included in the global glossary to ensure consistency between use cases.

Glossary	
Term	**Definition**
CDAS	Customer Data Acquisition System - Customer Data Acquisition System - performs data collection, validation, usage calculation and data delivery services for all billing accounts employing interval data metering, including meters read by external MDMAs.
MDMA	Metering and Data Management Agent - The MDMA Mainframe application manages the interface between the billing systems and the SCE MDMA Client Server.
RTEM	Real Time Energy Meters -provided by the state metering
NEM	Net Energy Metering – existing distributed generation monitoring program
IDR	Interval Data Recorder – 15-minute interval
SCADA	Supervisory Control and Data Acquisition - The computer, communications system and remote devices that monitor and control the distribution network. Information from the SCADA network is usually updated every 2 to 4 seconds.

8. References

Reference any prior work (intellectual property of companies or individuals) used in the preparation of this use case.

9. Bibliography (optional)

Provide a list of related reading, standards, etc. that the use case reader may find helpful.