YSCP (Yokohama Smart City Project) Battery SCADA System Use Case #1
Online Power System Control by Battery Aggregation (Virtual Energy Storage)
(Version 6.0 Oct.6.2011)

1 Descriptions of Function

This use case describes interactions between the Grid operator, Grid EMS, Battery SCADA, Battery SCADA Operator and Stationary Batteries during online power system control for Battery Aggregation. Battery SCADA is used to control distributed Stationary Batteries as a Virtual Battery.

1.1 Function Name

Online power system control for Battery Aggregation.

1.2 Function ID

Identification number of the function

1.3 Brief Description

It is expected that many batteries will be deployed in the smart grid. These batteries will be small scale and distributed. The use of the energy storage capabilities of these batteries can be optimized by Battery Aggregation and control technology to manage them in a Virtual Energy Storage System. The control technology comprises a Grid EMS, Grid Operator, and communications via Battery SCADA. Two scenarios that describe control functions for Battery Aggregation are introduced in this use case.

First scenario: Load Frequency Control by Battery Aggregation (Virtual Energy Storage)

Second scenario: Reserve Margin by Battery Aggregation (Virtual Energy Storage)

1.4 Narrative

Energy storage facilities hold a key position in energy supply systems. They facilitate the task of matching variable energy supply with variable energy demand and permit interruption-free electricity supply. Optimized storage techniques are necessary for the integration of higher proportions of fluctuating energy sources. This use case offers an energy storage system coupled with an energy management system to coordinate supply and demand with the use of interoperable communications protocols to control these storage units in the grid.

The altered situation on the energy market requires new options for energy storage. In overall energy concepts in the future with high proportions of fluctuating energy sources, the demands on temporary storage of energy will tend to become intensified. Energy storage facilities can be aggregated and optimized for the improvement of stability and reliability throughout the grid.

Large-scale storage is needed at many locations throughout the grid, but is available only at limited locations. And, the capital cost of energy storage – large-scale storage for stability at low and medium voltage levels where DER is connected – is very high.

One solution is a Virtual Energy Storage System ("VESS") that aggregates multiple small energy storage units.

A VESS fully utilizes the technical possibilities of small energy storage units to meet the challenges of fluctuating energy sources within the context of a smart grid. Many small storage facilities are distributed locally and dedicated to specific applications. Some of these applications are new, such as those for the stabilization of the distribution system due to the requirements of high penetrations of renewable energy; others are more typical, such as applications for back-up power and power quality. The energy storage potential of small units is considerable when aggregated and controlled using a sophisticated information and communication system.

A VESS offers a range of new possibilities for energy storage facilities in the smart grid. Among these are:

- Grid support (ensuring stability) with energy storage facilities and consolidating corresponding storage requirements
- Transfer of aggregated energy storage from disparate local sites throughout the grid, as needed
- Options for shifting capacity.

Greater storage capacity is one of the solutions for increased variable generation on the grid. However, it is needed in greater quantities than are available from single sources, located at customer sites, substations, or in microgrids only from multiple sources at distant locations. Combining energy storage units from multiple sites in a VESS can provide support under unpredictable and uncertain circumstances to reduce these requirements on the grid. Offering system operators an additional resource and tool for grid management.

After small-scale energy storage units are aggregated by the direct controlled VESS, prosumers can follow dispatch orders delivered by the VESS which functions as the energy supplier of the prosumer group. The VESS thus minimizes overall system costs while assuring energy supply to prosumers.

This Use Case provides insight into how battery energy storage can be aggregated and controlled as a VESS. The benefits of a VESS are achieved through "economies of intelligence" with the help of intelligent control schemes. The term "economies of intelligence" is defined as the creation of economic benefit by the use of control systems to utilize installed capacity optimally, thereby reducing costs.

Small-scale storage technologies are frequently located close to the customer side. When aggregated, they have great potential to contribute to grid stability. However, these storage facilities are usually deployed in way that confines their value and presents challenges in relation to:

- Optimized DER operation related to time varying onsite demand requirements, ambient conditions and electricity prices;
- Coordinated control of many small units in the electric power system; and
- Efficient electricity market participation to benefit both power system operation and DER owners

To realize these benefits, the concept of Virtual Energy Storage (VES) is proposed. VES provides a generic and flexible solution for the integration of storage into power system operations.

Diversity Benefits of Energy Storage in a Virtual Energy Storage System

- Real-time unit coordination increases efficiency.
- Each party gets to offer and store the energy it considers optimal, according to its objectives.
- Provides a framework within which:
    - Efficiently utilizes energy storage resources as part of integrated operations
    - Allows the benefits physically available from a broader portfolio of storage/flow/generation capacity
    - Allows these benefits to be optimally distributed

A VESS is the **aggregation of multiple energy storage units** that can be utilized in the same manner as conventional storage. Energy storage units at multiple locations are combined to form a "virtual energy storage" resource that is managed by a central control facility.

The communication protocol is the backbone of a VESS facility. IEC 61850-7-410 is the primary communications protocol.

A VESS is defined as a collection of energy storage units, controlled by an EMS with the objective of exchanging electricity with the external grid. This is analogous to a VPP which is a centrally controlled cluster of distributed generators.

The EMS manages the individual charge and discharge activity in response to needs at the feeder, station, or system level.

This use case shows the ways in which different Actors can cooperate in operating a VESS for technical and commercial objectives. Technical objectives can be ancillary services (e.g. balancing services). Commercial objectives can be providing electricity and electricity attributes to different types of markets or minimizing energy costs for clusters of households. An important Actor in VESS control that determines the control decisions for the energy storage units.

Integrating a VESS system to the grid requires the ability to manage new levels of complexity in remote sensing, control, and dispatch to make optimal use of these new resources and integrate them into the larger system portfolio.

A VESS comprises different energy storage units that are controllable regarding active power by means of a central Supervisory Control and Data Acquisition (SCADA) system.

The communications system for controlling active power output of the batteries directly connected to the low voltage network comprises Remote Terminal Units (RTUs) situated at every battery unit and a central SCADA system for configuration of the setup, controlling active power flows from and to the batteries and measuring the results.

This SCADA system allows direct control of the batteries within the Area EPS by the system operator.

1.4.1 Overview of Functions

Online power system control by Battery Aggregation consists of two sub functions that are described in the following scenarios:

1. Load Frequency Control by Battery Aggregation (Virtual Energy Storage)

2. Reserve Margin by Battery Aggregation (Virtual Energy Storage)

VESS can be used for Active Power (LFC, Reserve, and Load Following).

1.4.2 Load Frequency Control by Battery Aggregation (Virtual Energy Storage)

An overview of the Load Frequency Control by Battery Aggregation function is shown in Fig. 1 below.

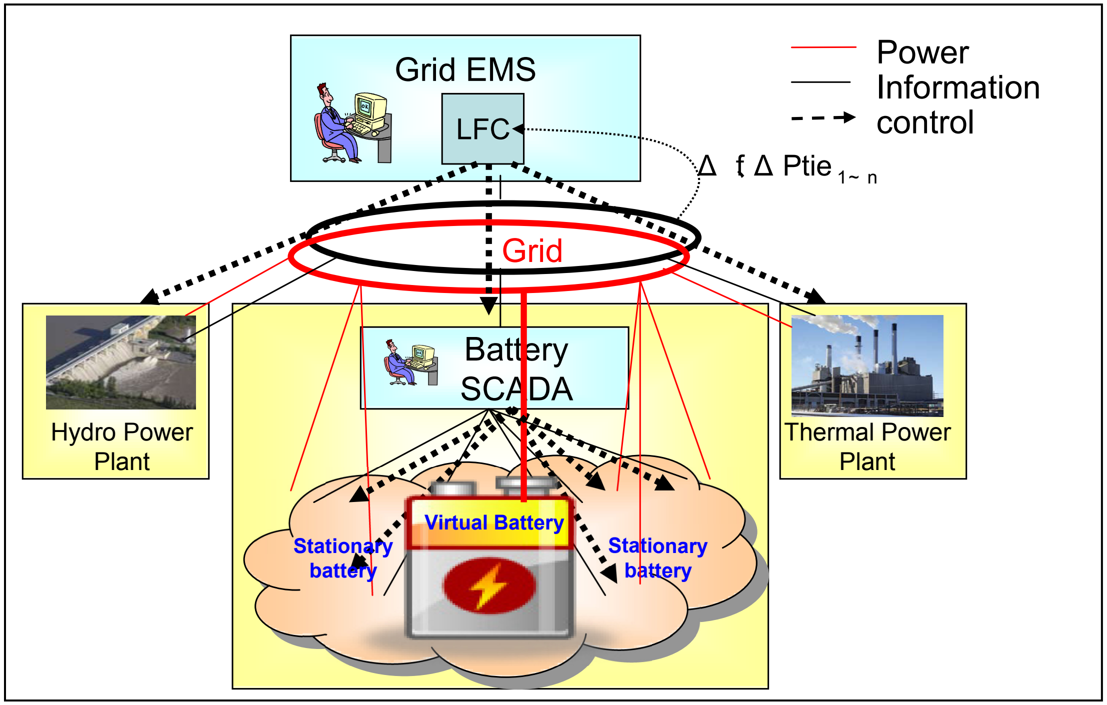


Fig.1 Overview of LFC by Battery Aggregation

"Battery SCADA", defined in Section 1.5 Actor (Stakeholder) Roles, plays an important role. It controls the Stationary Batteries in the grid.

Load Frequency Control (LFC) by Battery Aggregation is as follows:

1. Grid Operator specifies the total capacity of batteries to be used for LFC beforehand.

Battery SCADA assigns Stationary Batteries to be used for LFC.

2. Grid EMS calculates control value to be controlled by Battery SCADA and sends it to the Battery SCADA.

3. Battery SCADA receives the control value and calculates a charging/discharging control value for each Stationary Battery. Then, Battery SCADA sends it to each Stationary Battery.

4. Each Stationary Battery receives a charging/discharging control value from Battery SCADA and charges or discharges according to the charging/discharging control value. It also sends current status of each Stationary Battery – active power and state–of-charge (SOC) – to the Battery SCADA.

5. After receiving the status of active power and SOC of each Stationary Battery, the Battery SCADA calculates the total output power, total output, (upper limit and lower limit) of the Stationary Batteries for LFC and sends them to the Grid EMS.

6. LFC function of the grid EMS enables a Grid Operator to display the total output power, total output upper limit and total output lower limit of Stationary Batteries for LFC as if a grid operator had a Virtual Battery for LFC.

1.4.3 Reserve Margin by Battery Aggregation (Virtual Energy Storage)

Reserve Margin by Battery Aggregation (RMBA) is as follows:

1. RMBA enables a Grid Operator to specify the total capacity of batteries for RMBA.

2. RMBA enables a Battery SCADA operator to determine Stationary Batteries to be used for RMBA.

3. RMBA controls Stationary Batteries to charge for RMBA.

4. RMBA enables a grid operator to command Stationary Batteries that are charged for RMBA to discharge.

5. RMBA enables a Grid Operator to display the total output power of Stationary Batteries as if a grid operator had a Virtual Battery for RMBA.

1.5 Actor (Stakeholder) Roles

Grouping (Community) '		Group Description
Actors inside of Smart Grid		*Actors that perform their specific function inside of Smart Grid*
Actor Name	*Actor Type (person, organization, device, system, or subsystem)*	*Actor Description*
Grid EMS	System	LFC function of Grid EMS controls generators to maintain Grid frequency. In case of emergency, Grid EMS sends discharging command to Stationary Batteries via Battery SCADA. Grid EMS provides man-machine interface for Grid Operator.
Grid Operator	Person	Grid Operator monitors and controls grid frequency. Grid operator specifies the total capacity of Stationary Batteries for Load Frequency Control, and for RMBA.
Battery SCADA	System	Battery SCADA controls Stationary Batteries to charge/discharge according to the LFC control value sent from Grid EMS. Battery SCADA provides man-machine interface for Battery SCADA operator. Battery SCADA communicates only with Invertors or customer-side EMS. It has no relation to the Inverter-Battery Protocol. The interface with Battery SCADA to inverter is to be standardized by IEC

Grouping (Community)'		*Group Description*
Actors inside of Smart Grid		*Actors that perform their specific function inside of Smart Grid*
Actor Name	*Actor Type (person, organization, device, system, or subsystem)*	*Actor Description*
		61850 (mapped to DNP 3.0).
Battery SCADA Operator	Person	Battery SCADA operator monitors and controls the Stationary Batteries via Battery SCADA. Battery SCADA operator specifies the Stationary Batteries for LFC, and RMBA.
Stationary Battery	Device	"Stationary Battery" means Battery and Inverter (PCS). Stationary Battery charges or discharges according to the control signal from Battery SCADA.

The relationships between the Actors (Stakeholder) Roles are shown in Fig. 2 below.

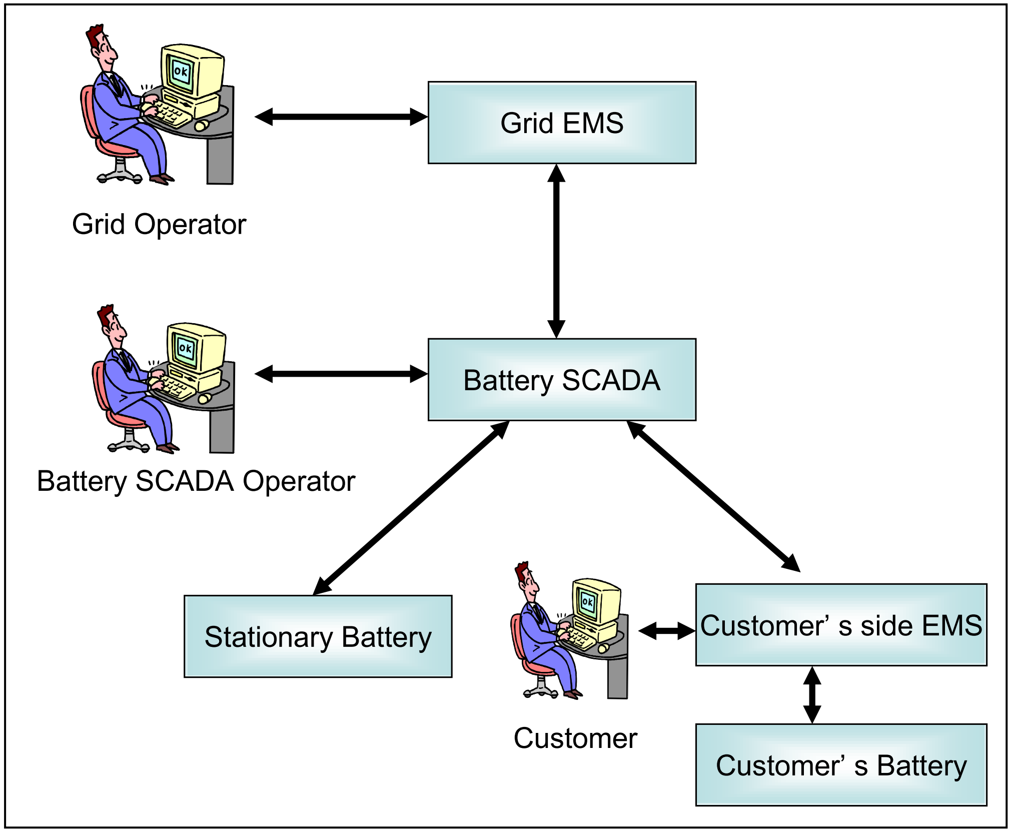


Fig. 2 Actor Relationships

1.6 Information exchanged

Information Object Name	*Information Object Description*
Total capacity of Stationary Batteries for LFC	Total capacity of the Stationary Batteries that the Load Frequency Control (LFC) function is able to use.
Stationary Batteries for LFC	The Stationary Batteries that the LFC function is able to use.
The total capacity of Stationary Batteries for RMBA	Total capacity of Stationary Batteries that the RMBA function is able to use.
Stationary Batteries for RMB.	Stationary Batteries that the RMBA function is able to use.
Grid data	Grid data consists of Δ f and Ptie. Using this data, the Grid EMS calculates a control value for generators and Battery SCADA. Where Δ f is the deviation of frequency and Ptie is the tie line flow.
LFC control value	This is the value to be controlled by the Battery SCADA. This value is calculated by the Grid EMS.
Current value of each Stationary Battery	The current value of each Stationary Battery includes the active power and SOC of each Stationary Battery.
Charging/Discharging command	This is a command for the Stationary Battery. Upon receiving this command, the Stationary Battery charges or discharges.
Current status of Virtual Battery for LFC	Current status of Virtual Battery for LFC; includes the total active power, the total output upper limit, and the total output lower limit of all stationary batteries for LFC.
Current status of Virtual Battery for RMBA	Current status of Virtual Battery for RMBA; includes the total output power and the total output upper limit of all Stationary Batteries for RMBA.

Information Object Name	*Information Object Description*
Display Request of Current status of Virtual Battery for LFC	This is an operator request to display the current status of the Virtual Battery for LFC.
Display Request of Current status of Virtual Battery for RMBA	This is an operator request to display the current status of the Virtual Battery for RMBA.
Activation Operation Command to use reserve margin	This is a command to activate operation to use reserve margin.

1.7 Activities/Services

N/A

1.8 Contracts/Regulations

Contract/Regulation	*Impact of Contract/Regulation on Function*

2. Step by Step Analysis of Function

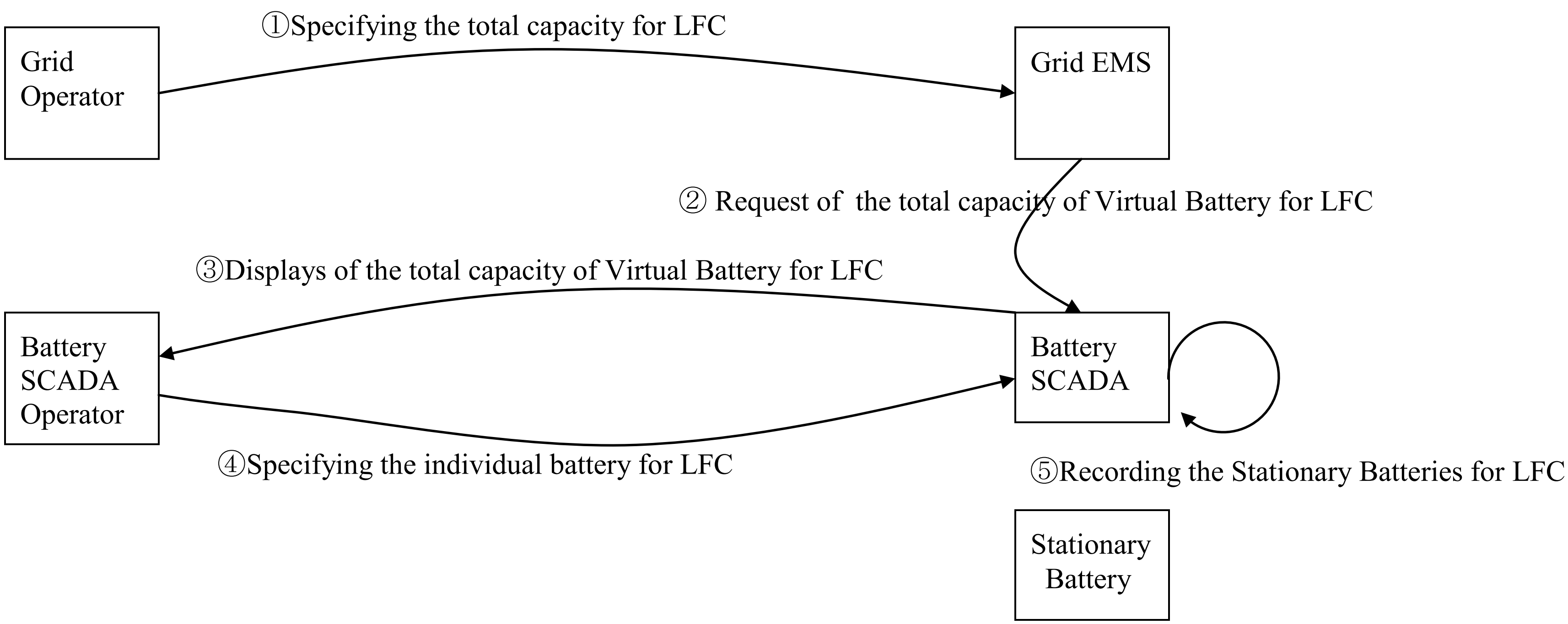
2.1 Steps to implement function – Load Frequency Control by Battery Aggregation (Virtual Energy Storage).

2.1.1 Preconditions and Assumptions

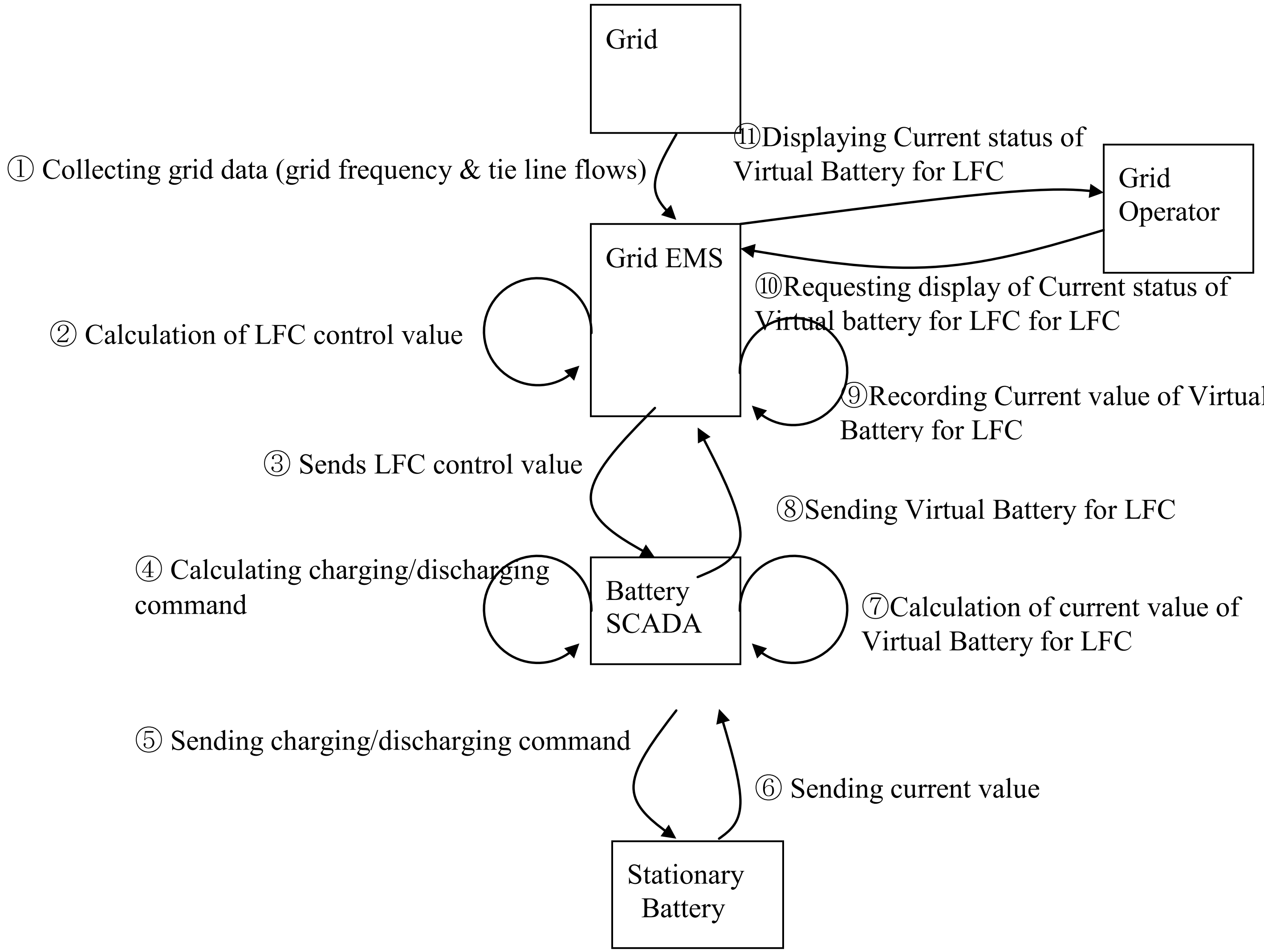
Actor/System/Information/Contract	*Preconditions or Assumptions*
Grid Operator	Grid Operator monitors Grid frequency. Grid Operator specifies the total capacity of batteries for LFC.
Grid EMS	LFC Function installed in Grid EMS controls generators and Stationary Batteries via Battery SCADA.
Battery SCADA operator	Battery SCADA Operator monitors Stationary Batteries for LFC. Battery SCADA Operator specifies the Stationary Batteries for LFC.
Battery SCADA	Battery SCADA controls Stationary Batteries for LFC.
Stationary Battery	Stationary Batteries are controlled by the Battery SCADA.

2.1.2 Sequence Diagram of LFC

(1) Specifying the total capacity of batteries for LFC



(2) Controlling Stationary Batteries for LFC and monitoring the Virtual Battery for LFC



2.1.3 Steps – Load Frequency Control by Battery Aggregation (Virtual Energy Storage)

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
#	*Triggering event? Identify the name of the event.*[1]	*What other actors are primarily responsible for the Process/Activity? Actors are defined in section1.5.*	*Label that would appear in a process diagram. Use action verbs when naming activity.*	*Describe the actions that take place in active and present tense. The step should be a descriptive noun/verb phrase that portrays an outline summary of the step. "If …Then…Else" scenarios can be captured as multiple Actions or as separate steps.*	*What other actors are primarily responsible for Producing the information? Actors are defined in section1.5.*	*What other actors are primarily responsible for Receiving the information? Actors are defined in section1.5.* *(Note – May leave blank if same as Primary Actor)*	*Name of the information object. Information objects are defined in section 1.6*	*Elaborate architectural issues using attached spreadsheet. Use this column to elaborate details that aren't captured in the spreadsheet.*	*Reference the applicable IECSA Environment containing this data exchange. Only one environment per step.*
1.1.1	At the time for LFC capacity preparation work	Grid Operator	Specifying the total Capacity of batteries for LFC	Grid operator specifies the total Capacity of batteries for LFC	Grid Operator	Grid EMS	The total capacity of Stationary Batteries for LFC		
1.1.2	Completion of capacity specifying	Grid EMS	Sending the total Capacity of batteries for LFC	Grid EMS sends the total Capacity of batteries for LFC to Battery SCADA	Grid EMS	Battery SCADA	The total capacity of Stationary Batteries for LFC	DNP3.0	

[1] Note – A triggering event is not necessary if the completion of the prior step – leads to the transition of the following step.

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.1.3	Upon receiving The total capacity of Stationary Batteries for LFC	Battery SCADA	Displaying the total Capacity of batteries for LFC	Battery SCADA displays the total Capacity of batteries for LFC	Battery SCADA	Battery SCADA Operator	Total capacity of Stationary Batteries for LFC function		
1.1.4	Upon displaying the total capacity of Stationary Batteries for LFC	Battery SCADA Operator	Specifying the Stationary Batteries for LFC	Battery SCADA operator specifies the Stationary Batteries for LFC	Battery SCADA Operator	Battery SCADA	Stationary Batteries for LFC		
1.1.5	Completion of specifying the Stationary Batteries for LFC	Battery SCADA	Recording the Stationary Batteries for LFC	Battery SCADA records the Stationary Batteries for LFC	Battery SCADA	Battery SCADA	Stationary Batteries for LFC		
1.2.1	Every 1 second	Grid EMS	Collecting grid data	Grid EMS collects grid frequency and tie line flows	Grid	Grid EMS	Grid data	DNP3.0	
1.2.2	Completion of collecting grid data	Grid EMS	Calculation of LFC control value	Grid EMS calculates control value to maintain Grid frequency	Grid EMS	Grid EMS	LFC control value		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.2.3	Completion of Calculating LFC control value	Grid EMS	Sending LFC control value	Grid EMS sends Load Frequency Control to Battery SCADA	Grid EMS	Battery SCADA	LFC control value	DNP3.0	
1.2.4	Upon receiving LFC control value	Battery SCADA	Calculating charging / discharging command	Battery SCADA calculating charging/ discharging command for each Stationary battery	Battery SCADA	Battery SCADA	Charging / discharging command		
1.2.5	Completion of calculating charging/discharging command	Battery SCADA	Sending charging / discharging command	Battery SCADA sends charging/discharging command to each Stationary Battery	Battery SCADA	Stationary battery	Charging / discharging command	DNP3.0 mapping to IEC61850	
1.2.6	Upon receiving charging/discharging command	Stationary Battery	Charging / Discharging Sending current value	Stationary Battery charges or discharges Stationary Battery sends current value to Battery SCADA	Stationary Battery	Battery SCADA	Current value of each Stationary Battery	DNP3.0 mapping to IEC61850	

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.2.7	Upon receiving current value of each Stationary Battery	Battery SCADA	Calculation of current value of Virtual Battery for LFC	Battery SCADA calculates current value of Virtual Battery for LFC	Battery SCADA	Battery SCADA	Current value of Virtual Battery for LFC		
1.2.8	Completion of calculation current value of Virtual Battery for LFC	Battery SCADA	Sending Virtual Battery for LFC	Battery SCADA sends current value of Virtual Battery for LFC to Grid EMS	Battery SCADA	Grid EMS	Current value of Virtual Battery for LFC	DNP3.0	
1.2.9	Upon receiving Current value of Virtual Battery for LFC	Grid EMS	Recording Current value of Virtual Battery for LFC	Grid EMS records Current value of Virtual Battery for LFC	Grid EMS	Grid EMS	Current value of Virtual Battery for LFC		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.2. 10.1	Upon operator request	Grid Operator	Requesting display of Current status of Virtual Battery for LFC	Grid Operator requests display of Current status of Virtual Battery for LFC	Grid Operator	Grid EMS	Display Request of Current status of Virtual Battery for LFC		
1.2. 10.2	Receiving display request	Grid EMS	Displaying Current status of Virtual Battery for LFC	Grid EMS displays Current status of Virtual Battery for LFC	Grid EMS	Grid Operator	Current status of Virtual Battery for LFC		

2.1.4 Post-conditions and Significant Results

Describe any significant results from the Function

Actor/System/Information/Contract	*Preconditions or Assumptions*
Grid Operator	Grid Operator continues to monitor the Grid frequency.
Grid EMS	LFC Function installed in Grid EMS continues to control generators and Stationary Batteries via Battery SCADA.
Battery SCADA Operator	Battery SCADA Operator continues to monitor Stationary Batteries for LFC.

Actor/System/Information/Contract	*Preconditions or Assumptions*
Battery SCADA	Battery SCADA continues to receive LFC control value from Grid EMS and to control Stationary Batteries for LFC.
Stationary Battery	Stationary Battery continues charging / discharging according to the command from Battery SCADA.

2.2 *Steps to implement function –Reserve Margin by Battery Aggregation (Virtual Energy Storage)*

2.2.1 Preconditions and Assumptions

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Actor/System/Information/Contract	*Preconditions or Assumptions*
Grid Operator	Grid Operator specifies the total capacity of batteries for RMBA.
Grid EMS	Grid EMS does not control Stationary Batteries via Battery SCADA.
Battery SCADA Operator	Battery SCADA Operator specifies the Stationary Batteries for RMBA.
Battery SCADA	Battery SCADA does not control Stationary Batteries.
Stationary Battery	Stationary Batteries are controllable, but not controlled.

2.2.2 Sequence Diagram of RMBA

(1) Specifying the total capacity of batteries for RMBA and Monitoring the virtual battery for RMBA

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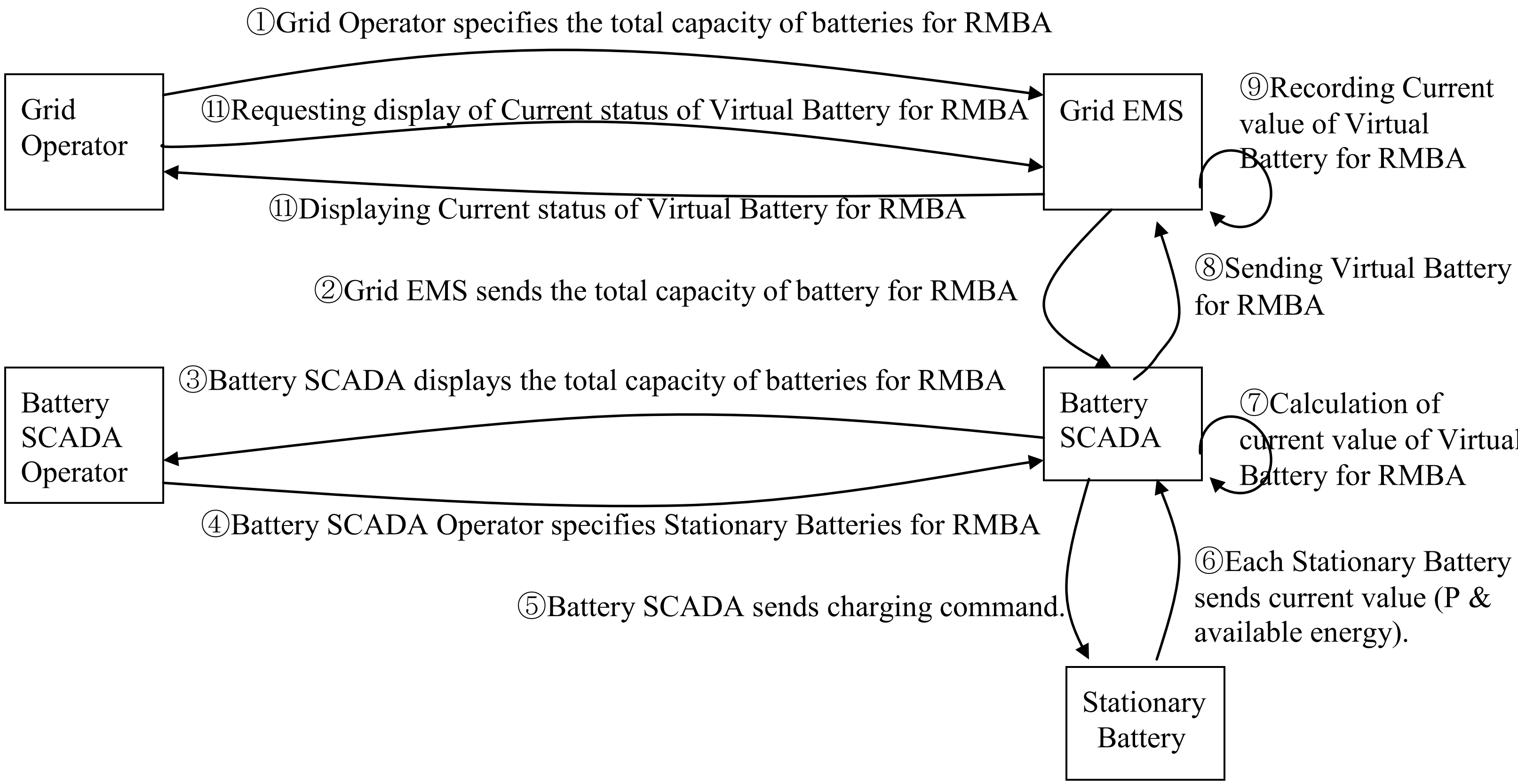
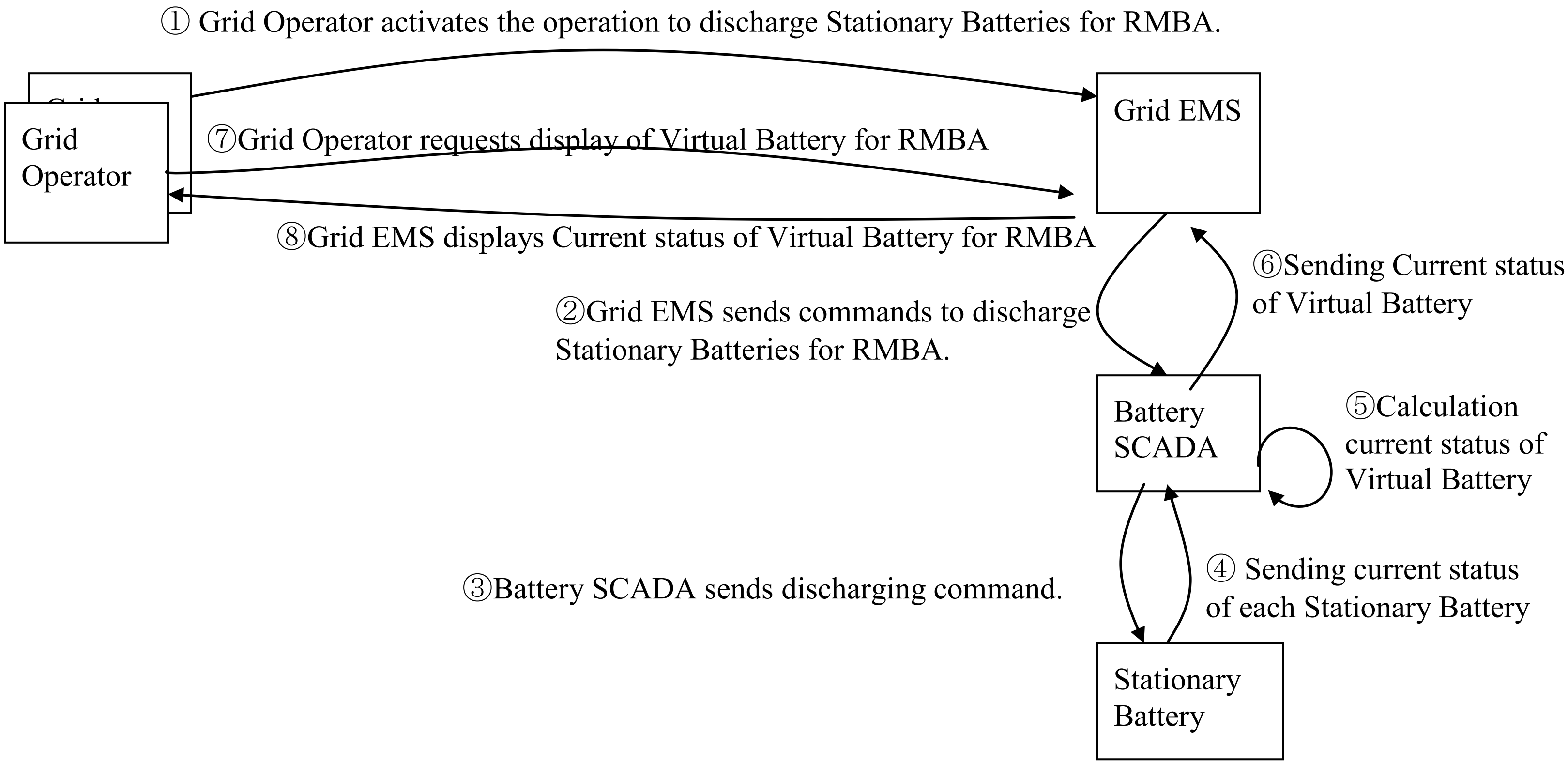


(2) Discharge stationary batteries for RMBA



2.2.3 Steps – Reserve Margin by Battery Aggregation (Virtual Energy Storage)

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.1.1	At the starting time of Reserve Margin preparation	Grid Operator	Specifying the capacity of reserve margin of Stationary Battery	Grid Operator specifies the capacity of reserve margin of Stationary Batteries	Grid Operator	Grid EMS	The total capacity of Stationary Batteries for RMBA		
2.1.2	Completion of specifying the total capacity of Stationary Batteries for RMBA.	Grid EMS	Sending the total capacity of Stationary Batteries for RMBA.	Grid EMS sends the total capacity of Stationary Batteries for RMBA to Battery SCADA	Grid EMS	Battery SCADA	The total capacity of Stationary Batteries for RMBA	DNP3.0	
2.1.3	Upon receiving the total capacity of Stationary Batteries for RMBA	Battery SCADA	Displaying the total capacity of Stationary Batteries for RMBA.	Battery SCADA displays the total capacity of Stationary Batteries for RMBA.	Battery SCADA	Battery SCADA Operator	The total capacity of Stationary Batteries for RMBA		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.1.4	Completion of Displaying the total capacity of Stationary Batteries for RMBA	Battery SCADA Operator	Specifying the Stationary Batteries for RMBA	Battery SCADA operator specifies the Stationary Batteries for RMBA	Battery SCADA Operator	Battery SCADA	The Stationary Batteries for RMBA		
2.1.5	Completion of specifying the Stationary Batteries for RMBA	Battery SCADA	Sending charging/discharging command	Battery SCADA Sending charging/discharging command to Stationary Batteries for RMBA	Battery SCADA	Stationary Batteries	Charging/discharging command	DNP3.0 mapping to IEC61850	
2.1.6	Upon Receiving charging /discharging command	Stationary Battery	Charging or discharging Sending current value	Stationary Battery charges or discharges and sends current value	Stationary Battery	Battery SCADA	Current value of each Stationary Battery	DNP3.0 mapping to IEC61850	
2.1.7	Upon receiving current value	Battery SCADA	Calculation of current value of Virtual Battery for RMBA	Battery SCADA calculates current value of Virtual Battery for RMBA	Battery SCADA	Battery SCADA	Current value of Virtual Battery for RMBA		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.1.8	Completion of calculation current value of Virtual Battery for RMBA	Battery SCADA	Sending Virtual Battery for RMBA	Battery SCADA sends current value of Virtual Battery for RMBA to Grid EMS	Battery SCADA	Grid EMS	Current value of Virtual Battery for RMBA	DNP3.0	
2.1.9	Upon receiving Current value of Virtual Battery for RMBA	Grid EMS	Recording Current value of Virtual Battery for RMBA	Grid EMS records Current value of Virtual Battery for RMBA	Grid EMS	Grid EMS	Current value of Virtual Battery for RMBA		
2.1. 10.1	Upon operator request	Grid Operator	Requesting display of Current status of Virtual Battery for RMBA	Grid Operator requests display of Virtual Battery for RMBA	Grid Operator	Grid EMS	Display Request of Current status of Virtual Battery for RMBA		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.1. 10.2	Receiving display request	Grid EMS	Displaying Current status of Virtual Battery for RMBA	Grid EMS displays Current status of Virtual Battery for RMBA	Grid EMS	Grid Operator	Current status of Virtual Battery for RMBA		
2.2.1	At the time of grid event occurs, Grid operator decides to use reserve	Grid Operator	Activating operation of using reserve margin	Grid Operator commands Grid EMS to activate reserve operation	Grid Operator	Grid EMS	Activation Operation Command of using reserve margin		
2.2.2	Upon receiving Activation Operation Command of using reserve margin	Grid EMS	Sending activation Operation command of using reserve margin	Grid EMS Sends activation Operation command of using reserve to Battery SCADA	Grid EMS	Battery SCADA	Activation Operation Command of using reserve margin	DNP3.0	
2.2.3	Upon receiving Activation Operation Command of using reserve margin	Battery SCADA	Sending discharging command and discharges	Battery SCADA sends discharging command and discharges to each Stationary Battery	Battery SCADA	Stationary Battery	discharging command	DNP3.0 mapping to IEC61850	

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.2.4	Upon receiving discharging command	Stationary Battery	Sending current status	Stationary Battery discharges and sends current status of each Stationary Batteries to Battery SCADA	Stationary Battery	Battery SCADA	Current Status of each Stationary Battery	DNP3.0 mapping to IEC61850	
2.2.5	Upon receiving current Status of each Stationary Battery	Battery SCADA	Receiving current status of each Stationary Battery And calculation current status of Virtual Battery	Battery SCADA receives current status from Stationary Battery And it calculates total of Stationary Battery output and virtual SOC	Battery SCADA	Battery SCADA	Current status of each Stationary Battery Current status of Virtual Battery for RMBA	DNP3.0 mapping to IEC61850	
2.2.6	Completion of calculating of current status of Virtual Battery	Battery SCADA	Sending Current status of Virtual Battery	Battery SCADA sends Current status of Virtual Battery to Grid EMS	Battery SCADA	Grid EMS	Current status of Virtual Battery for RMBA	DNP3.0	

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
2.2.7.1	Upon operator request	Grid Operator	Requesting display of Current status of Virtual Battery for RMBA	Grid Operator requests display of Virtual Battery for RMBA	Grid Operator	Grid EMS	Display Request of Current status of Virtual Battery		
2.2.7.2	Receiving display request	Grid EMS	Displaying Current status of Virtual Battery for RMBA	Grid EMS displays Current status of Virtual Battery for RMBA	Grid EMS	Grid Operator	Current status of Virtual Battery for RMBA		

2.2.4 Post-conditions and Significant Results

Describe any significant results from the Function

Actor/Activity	*Post-conditions Description and Results*
Grid Operator	Grid Operator continues to monitors the Grid.
Grid EMS	Grid EMS continues to monitor Stationary Batteries for RMBA.
Battery SCADA Operator	Grid EMS Operator continues to monitor Stationary Batteries for RMBA.
Battery SCADA	Battery SCADA continues to monitor Stationary Batteries for RMBA.
Stationary Battery	Stationary Batteries for RMBA continue to discharge.

3 Auxiliary Issues

3.1 References and contacts

ID	Title or contact	Reference or contact information
[1]	CEMS2Battery SCADA Project	
[2]		

3.2 Action Item List

As the function is developed, identify issues that still need clarification, resolution, or other notice taken of them. This can act as an Action Item list.

FUTURE USE

ID	Description	Status
[1]		
[2]		

3.3 Revision History

No	Date	Author	Description
0.	08-21-2011	H. Miyaji	Draft for Review 1
1	08-30-2011	Y. Ebata	Reviewed and revised 1
2	09-02-2011	Y. Ebata & H. Hayashi	Reviewed and revised 2
3	10-01-2011	Jim Reilly	Reviewed and revised 3
4	10-04-2011	Y. Ebata & H. Hayashi	Reviewed and revised 4
5	10-05-2011	Jim Reilly	Reviewed and revised 5
6	10-06-2011	Y. Ebata & H. Hayashi	Reviewed and revised 6