Distributed Energy Resource Controller Adjusts System Settings in Response to Voltage Excursion

Version 1.1

January 5, 2010

1 Descriptions of Function

This use case describes how a Distributed Energy Resource Controller will be able to adjust the system settings when there is a significant amount of Distributed Energy Resources connected to a circuit.

1.1 Function Name

Distributed Energy Resource Controller Adjusts System Settings in Response to Voltage Excursion.

1.2 Function ID

IECSA identification number of the function

1.3 Brief Description

This function describes the sequence of activities required for providing voltage regulation when significant Distributed Energy Resources are connected to a circuit.

1.4 Narrative

With the implementation of multiple Distributed Energy Resources on the Electric Power System comes the question of controlling those resources to maintain the utility's standard of high quality power service to its customers. To ensure this high quality service, Voltage Sensors are placed on the Electric Power System at critical points to monitor the system voltage. In the event of a Voltage Excursion, the Voltage Sensors will send an alarm back to the Distributed Energy Resource Controller. The Distributed Energy Resource Controller will initiate a scan of the Voltage Sensors and relevant Load Meters in the effected area and compute an optimal solution. The Distributed Energy Resource Controller will then send commands to curtail or initiate the charge cycles on selected DER Storage units to include PHEV and/or EV. The Distributed Energy Resource Controller will also send new setpoints for the effected DER Devices and Voltage Regulation Tap Changers.   The effected equipment accepts the new system setpoints and allows the Electric Power System to regain normal operation.

1.5 Actor (Stakeholder) Roles

Grouping (Community) '		Group Description	
DER Actors		Actors used by DER Use Case	
Actor Name	Actor Type (person, device, system etc.)	Actor Description	
DER Storage	Device	Energy storage device that is connected to the Electric Power System	
DER Device	Device	Equipment controlled by DERC. Could include generation and load devices.	
Distributed Energy Resource Controller (DERC)	System	System located in the substation that coordinates Distributed Energy Resources. Monitors operations schedules, status and controls operation of DER Device equipment.	
Electrical Power System (EPS)	System	All of the equipment required to deliver quality electrical power to the end user at utilization voltage	
Load Meter	Devices	Collects energy and demand data per time period	
Voltage Regulation Tap Changer	Device	Device that changes taps based on system setpoints to regulate voltage.	
Voltage Sensor	Device	Device capable of reporting to the DERC on System Voltage. This may be a standalone sensor, an AMI meter, or sensor connected to an IED for other purposes	
PHEV/EV	Device	Plug-In Hybrid Electric Vehicle (PHEV0 or Electric Vehicle (EV) connected to the Electric Power System to charge vehicle batteries or to discharge energy to the Electric Power System.	

1.6 Information exchanged

Describe any information exchanged in this template.

Information Object Name	Information Object Description
Voltage Event	Voltage deviation from current profile limits.
Voltage Scan	A scan initiated from the DERC on the Voltage Sensors in the effected area once a Voltage Event has been reported to the DERC.
Load Meter Scan	A scan initiated from the DERC on the Load Meters in the effected area once a Voltage Event has been reported to the DERC.
Optimal Solution	A calculated solution to the current Voltage Event using existing equipment in the effected area.
Charge Commands	A command from the DERC to curtail or initiate the storage charge cycle on the effected energy storage equipment.
Discharge Commands	A command from the DERC to curtail or initiate the storage discharge cycle on the effected energy storage equipment.
Charge Orders	An order from the DERC to curtail or initiate the storage charge or discharge cycle on the effected PHEV and/or EV equipment.
Voltage Setpoints	DERC calculated Voltage Setpoints for the DER Devices to operate at to maintain system standards
Voltage Bands	DERC calculated new set points for Voltage Regulation Tap Changers to operate within to maintain system standards
Acceptance of New Setpoints	Acceptance by the DER Device of the DERC calculated setpoints

1.7 Activities/Services

Describe or list the activities and services involved in this Function (in the context of this Function). An activity or service can be provided by a computer system, a set of applications, or manual procedures. These activities/services should be described at an appropriate level, with the understanding that sub-activities and services should be described if they are important for operational issues, automation needs, and implementation reasons. Other sub-activities/services could be left for later analysis.

Activity/Service Name	Activities/Services Provided

1.8 Contracts/Regulations

Identify any overall (human-initiated) contracts, regulations, policies, financial considerations, engineering constraints, pollution constraints, and other environmental quality issues that affect the design and requirements of the Function.

Contract/Regulation	Impact of Contract/Regulation on Function

Policy	From Actor	May	Shall Not	Shall	Description (verb)	To Actor

Constraint	Type	Description	Applies to

2   Step by Step Analysis of Function

Describe steps that implement the function. If there is more than one set of steps that are relevant, make a copy of the following section grouping (Steps to implement function, Preconditions and Assumptions, Steps normal sequence, Post-conditions) and provide each copy with its own sequence name.

2.1 Steps to implement function – Name of Sequence

Name of this sequence.

2.1.1 Preconditions and Assumptions

Describe conditions that must exist prior to the initiation of the Function, such as prior state of the actors and activities

Actor/System/Information/Contract	Preconditions or Assumptions
DER Device	Able to alter delivery voltage, and or provide or consume VARS

2.1.2 Steps – Name of Sequence

Describe the normal sequence of events, focusing on steps that identify new types of information or new information exchanges or new interface issues to address. Should the sequence require detailed steps that are also used by other functions, consider creating a new "sub" function, then referring to that "subroutine" in this function. Remember that the focus should be less on the algorithms of the applications and more on the interactions and information flows between "entities", e.g. people, systems, applications, data bases, etc. There should be a direct link between the narrative and these steps.

#	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.*

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[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	Voltage Deviation	Voltage Sensor	Voltage Sensor Detects Voltage Deviation	Voltage Sensor (could be AMI Meter) detects Voltage Event (voltage deviation from current profile limits) and signals DERC	Voltage Sensor	DERC	Voltage Event	Need to differentiate between normal tap changer operations	
1.2a		DERC	DERC Voltage Scan	DERC initiates scan of surrounding Voltage Sensors	Voltage Sensors	DERC	Voltage Scan	IEC61850	
1.2b		DERC	DERC Load Scan	DERC initiates scan of relevant Load Meters	Load Meters	DERC	Load Meter Scan		
1.3		DERC	DERC Computes Solution	DERC Computes Optimal Solution	DERC	DERC	Optimal Solution		
1.4a		DERC	Storage Orders	DERC sends Charge Commands or Discharge Commands to the relevant DER Storage Systems in the effected area.	DERC	DER Storage	Charge Commands or Discharge Commands	DERC curtails or initiates Storage charge cycle or curtails or initiates Storage Discharge cycle	
1.4b		DERC	PHEV/EV Orders	DERC curtails or initiates PHEV/EV charge cycle with Charge Orders	DERC	PHEV/EV	Charge Orders		

#	Event	Primary Actor	Name of Process/Activity	Description of Process/Activity	Information Producer	Information Receiver	Name of Info Exchanged	Additional Notes	IECSA Environment
1.4c		DERC	DER Setpoint	DERC sends new Voltage Setpoints to DER Device	DERC	DER Device	Voltage Setpoints		
1.4d		DERC	Voltage Regulation Tap Changers	DERC orders new set points for the Voltage Regulation Tap Changers	DERC	Voltage Regulation Tap Changers	Voltage Bands		
1.5		DER Device	Setpoint Update	DER Device accept New Setpoints	DERC	DER Device	Acceptance of New Setpoints		
1.6				System continues operation at New Setpoints					

2.1.3 Post-conditions and Significant Results

Describe conditions that must exist at the conclusion of the Function. Identify significant items similar to that in the preconditions section.

Describe any significant results from the Function

Actor/Activity	Post-conditions Description and Results

2.2   Architectural Issues in Interactions

Elaborate on all architectural issues in each of the steps outlined in each of the sequences above. Reference the Step by number. Double click on the embedded excel file – record the changes and save the excel file (this updates the embedded attachment).

2.3 Diagram
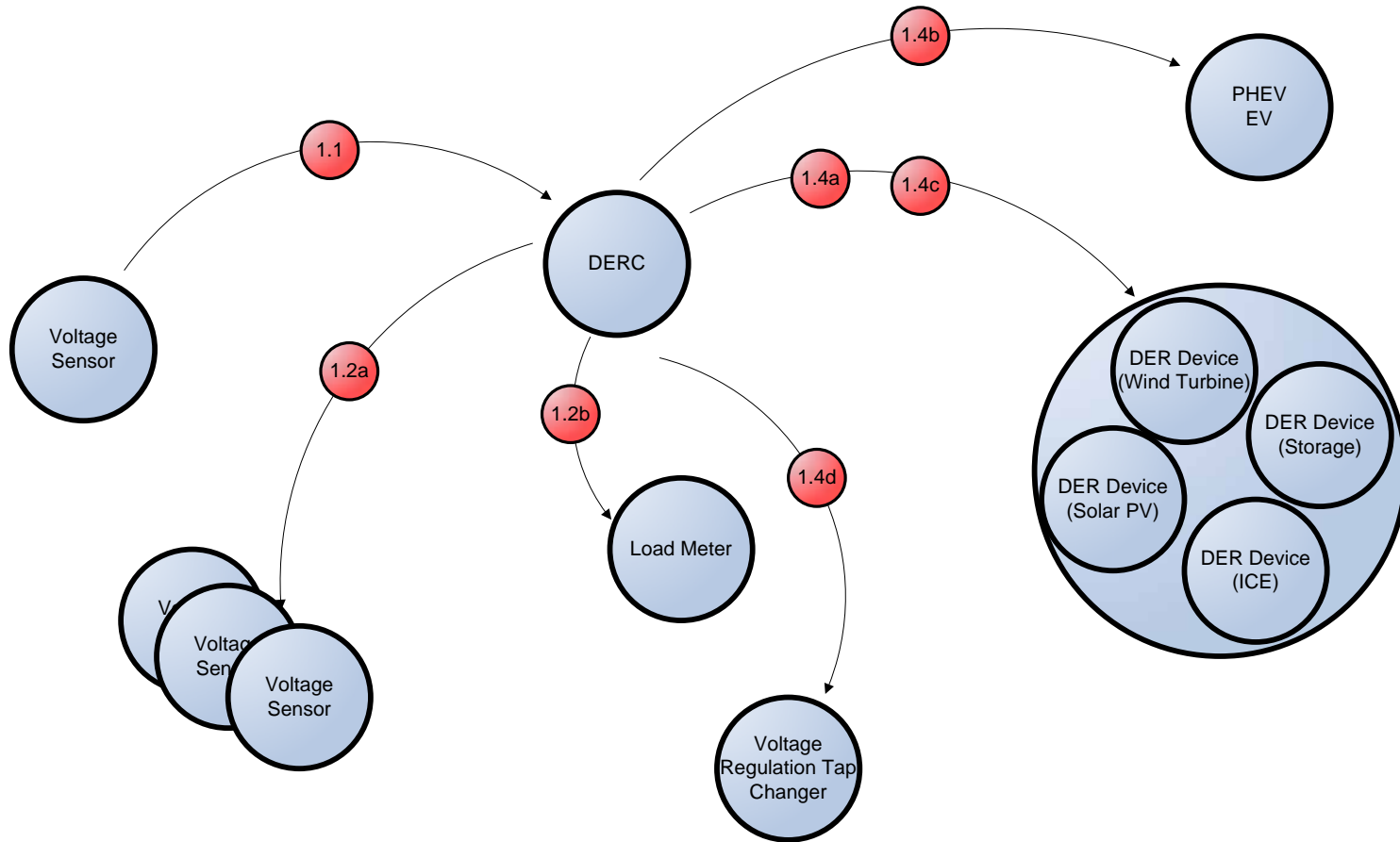
3 Auxiliary Issues

3.1 References and contacts

Documents and individuals or organizations used as background to the function described; other functions referenced by this function, or acting as "sub" functions; or other documentation that clarifies the requirements or activities described. All prior work (intellectual property of the company or individual) or proprietary (non-publicly available) work must be so noted.

ID	Title or contact	Reference or contact information
[1]		

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.

ID	Description	Status
[1]		

3.3 Revision History

For reference and tracking purposes, indicate who worked on describing this function, and what aspect they undertook.

No	Date	Author	Description
1.0	10/24/09	Charles Vincent	Develops initial voltage regulation use case.
1.1	1/5/10	Brian D. Green	Minor changes to actors and narrative.