Help the Grid User or the Grid Operator improve the quality of supply

***1 Description of the use case***

***1.1 Name of use case***

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| --- | --- | --- |
| ***Use case identification*** | | |
| ***ID*** | ***Area /Domain(s)/ Zone(s)*** | ***Name of use case*** |
|  | Area: Energy System  Domain: Energy Storage | GBUC-Help the Grid User or the Grid Operator improve the quality of supply |

***1.2 Version management***

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| --- | --- | --- | --- | --- |
| ***Version management*** | | | | |
| ***Version No.*** | ***Date*** | ***Name of author(s)*** | ***Changes*** | ***Approval status*** |
| 0.1 | 2014.03.10 | Joseph Maire, Gauthier Delille | First draft (name, short description) | WD Working Document |
| 0.2 | 2014.05.27 | Denis Bonneau | Complements | WD Working Document |
| 0.3 | 2014.07.24 | Joseph Maire, Gauthier Delille | Complements (scope, objective) | WD Working Document |
| 0.4 | 2014.09.18 | Gauthier Delille | Complements (complete description, Smart Grid Functions) | WD Working Document |

***1.3 Scope and objectives of use case***

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| ***Scope and objectives of use case*** | |
| ***Scope*** | Use of an Electrical Energy Storage in normal operating conditions or during faults to maintain quality and continuity of supply of a part of the distribution network near real-time operations (via active filtering, re-energisation of part of the network, etc..)  The provision of ancillary services to System Operators such as frequency regulation is out of the scope of the Use Case. |
| ***Objective(s)*** | * Allow the Grid User to avoid power outages and damages to electric equipments, as well as to respect his contractual obligations towards the Distribution Grid Operator, * Allow the Distribution Grid Operator to respect his contractual obligations towards Grid Users (by maintaining the power supply within ranges specified by authorities...). |
| ***Related business case(s)*** | * Deliver EES Services at best-cost. |

**1.4 Narrative of Use Case**

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| ***Narrative of use case*** |
| ***Short description*** |
| The Generic Business Use Case describes how the EES Operator uses an Energy Storage to help the Customer or the Distribution Grid Operator improve the quality and ensure the continuity of supply (via frequency regulation, energising a non-loopable feeder during an outage, etc.). The EES may be used to avoid load shedding or to compensate for electrical disturbances. |
| ***Complete description*** |
| The growing penetration of renewable energy sources and the development of new electricity usages such as Demand Response and Electric Vehicle tend to increase the complexity of the missions of Grid Operators, whose major responsibility is to ensure quality and continuity of supply in a cost-efficient way.  Quality of electricity can be defined as the ability to maintain the major characteristics of the waveform, i.e. voltage and frequency, within predetermined limits. Frequency is generally directly influenced by the balance between load and generation. Voltage (values and waveform) depends on the characteristics of the networks, on the operation of the grid equipment and protection systems, on external events, and on the characteristics and operation of loads or generators.  Maintaining power quality within acceptable ranges becomes more difficult as the size of the network decreases. Small power systems, such as island power systems for instance, can be particularly impacted by rapid variations of local generation or consumption.  Storage can be used to shift upward or downward the immediate consumption of active and reactive power in a very fast and controlled way. It can thus contributes to solve electrical disturbances or prevent power outages. Applications may include active filtering, re-energisation of a non-loopable feeder during an outage, or dynamic frequency control support.  ***1-Improve continuity of supply by re-energising part of the network during a power outage***  Storage can be used to restore supply and feed local loads following a power outage. Depending on the available energy capacity and on its initial state of charge, it can bring back-up power during the totality or only a part of the event. During such intentional islanding events, the electrical energy storage is used as a voltage source and not as a current injector synchronized to the mains.  Following the detection of a fault, the Grid Operator manages the reconfiguration of the grid and requests the EES Operator to start-up the electrical energy storage. At the end of the event, suitable procedures must be defined to ensure proper reconnection of the isolated grid powered by the storage to the rest of the network.    ***2-Perform active filtering for the Grid Operator***  Through their power conversion systems, energy storage devices can be used to perform active filtering: voltage and harmonic compensation, balancing between phases, etc. When ensuring power quality is particularly challenging, the Grid Operator can rely on such capabilities to meet its contractual obligations towards Grid Users. For this kind of services, storage is a competitor of more traditional options such as grid reinforcement, passive filters, etc.  ***3-Perform active filtering for the Grid User***  Through their power conversion systems, energy storage devices can be used to perform active filtering: voltage and harmonic compensation, balancing between phases, etc. When highly non linear loads generate high amounts of disturbances, the Grid User can rely on such capabilities to meet its contractual obligations towards its Grid Operator. For this kind of services, storage is a competitor of more traditional options such as passive filters, etc.  ***4-Avoid load-shedding in islands by performing dynamic frequency control support***  In electrical islands, frequency excursions are sizeable and automatic load shedding is often required in response to disturbances. Moreover, the displacement of conventional generation with wind and solar plants, which usually do not provide inertial response, further weakens these power systems. Fast-acting storage, by injecting power within instants after the loss of a generating unit, can back up conventional generation assets during the activation of their primary reserve, thus making it possible to reduce the need for load-shedding in weak systems. |

**1.5  *Key Performance Indicators***

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| ***Key performance indicators*** | | | | |
| ***ID*** | ***Name*** | ***Calculation*** | ***Scope*** | ***Objective*** |
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***1.6  Use case conditions***

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| ***Use case conditions*** |
| ***Assumption*** |
| * A contract is in place between the Grid User / Grid Operator and the EES Operator. |
| ***Prerequisite*** |
| * Configuration of the EES. |

***1.7 Further information to the use case for classification / mapping***

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| ***Classification information*** |
| ***Relation to other use cases*** |
| GBUC-Make necessary contracts with customers and relevant parties |
| GBUC-Configure EES to be able to provide services to relevant parties |
| GSUC-Make measurements at PCC (f, V) |
| GSUC-Compute power reference in real-time |
| GSUC-Charge storage |
| GSUC-Discharge storage |
| GSUC-Inject reactive power |
| GSUC-Consume reactive power |
| GSUC-Balance phases |
| GSUC-Perform harmonic compensation |
| GSUC-Perform blackstart and act as a voltage source |
| GSUC-Synchronise with the grid |
| ***Level of depth*** |
|  |
| ***Prioritisation*** |
|  |
| ***Generic, regional or national relation*** |
| Generic |
| ***Nature of the use case*** |
| Business Use Case |
| ***Further keywords for classification*** |
| Quality of supply, continuity of supply, frequency regulation, power electronics |

**1.8 General remarks**

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| ***General remarks*** |
| Some of the services described in the Use Case may not necessarily be relevant in large power systems, but have a particular interest in island power systems.  Besides, to be efficient from a technical and economic perspective, some of these services would require the use of large storage units.  Considering the current technological state of EES systems, some of these services may not be cost-efficient, their costs exceeding their overall benefits. The combination of EES services and their provision to various stakeholders of the Electric Power System may be considered as a cost-efficient solution to share the benefits of storage. |

**2 Diagrams of use case**

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| ***Diagram(s) of use case*** |
| *Use Case Overview diagram*    *Domain Overview diagram*    *BUC-SUC Relations diagram* |

***3 Technical Details***

***3.1 Actors***

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| ***Actors*** | |
| ***Grouping*** | ***Group Description*** |
|  |  |

| ***Actor name*** | ***Actor type*** | ***Actor Description*** | ***Further information specific to this Use Case*** |
| --- | --- | --- | --- |
| EES Operator | Role |  |  |
| Grid User | Role |  |  |
| Grid Operator | Role |  |  |

***3.2 References***

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| --- | --- | --- | --- | --- | --- | --- |
| ***References*** | | | | | | |
| ***No.*** | ***References Type*** | ***Reference*** | ***Status*** | ***Impact on use case*** | ***Originator / organisation*** | ***Link*** |
|  |  |  |  |  |  |  |
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***4 Step by step analysis of use case***

***4.1 Overview of scenarios***

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| --- | --- | --- | --- | --- | --- | --- |
| ***Scenario conditions*** | | | | | | |
| ***No.*** | ***Scenario name*** | ***Scenario description*** | ***Primary actor*** | ***Triggering event*** | ***Pre-Condition*** | ***Post-Condition*** |
| 1 |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |

***4.2 Scenarios***

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenario name:** | | **No. 1 – X** | | | | | | |
| ***Step No.*** | ***Event*** | ***Name of process/ activity*** | ***Description of process/ activity*** | ***Service*** | ***Information producer (actor)*** | ***Information receiver (actor)*** | ***Information exchanged (IDs)*** | ***Requirements   R-IDs*** |
|  |  |  |  |  |  |  |  |  |
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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenario name:** | | **No. 2 – X** | | | | | | |
| ***Step No.*** | ***Event*** | ***Name of process/ activity*** | ***Description of process/ activity*** | ***Service*** | ***Information producer (actor)*** | ***Information receiver (actor)*** | ***Information exchanged (IDs)*** | ***Requirements   R-IDs*** |
|  |  |  |  |  |  |  |  |  |
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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenario name:** | | **No. 3 – X** | | | | | | |
| ***Step No.*** | ***Event*** | ***Name of process/ activity*** | ***Description of process/ activity*** | ***Service*** | ***Information producer (actor)*** | ***Information receiver (actor)*** | ***Information exchanged (IDs)*** | ***Requirements   R-IDs*** |
|  |  |  |  |  |  |  |  |  |
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***5 Information Exchanged***

|  |  |  |  |
| --- | --- | --- | --- |
| ***Information exchanged*** | | | |
| ***Information exchanged ID*** | ***Name of information*** | ***Description of information exchanged*** | ***Requirements IDs*** |
|  |  |  |  |
|  |  |  |  |

***6 Requirements (optional)***

|  |
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| ***Requirements (optional)*** |

|  |  |  |
| --- | --- | --- |
| ***Category ID*** | ***Categories for requirements*** | ***Category description*** |
|  |  |  |
| ***Requirement ID*** | ***Requirement description*** | |
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|  |  |  |
| --- | --- | --- |
| ***Category ID*** | ***Categories for requirements*** | ***Category description*** |
|  |  |  |
| ***Requirement ID*** | ***Requirement description*** | |
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***7 Common Terms and Definitions***

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| ***Common Terms and Definitions*** | |
| ***Term*** | ***Definition*** |
|  |  |
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***8 Custom Information (optional)***

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| --- | --- | --- |
| ***Custom Information (optional)*** | | |
| ***Key*** | ***Value*** | ***Refers to Section*** |
|  |  |  |
|  |  |  |