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SYSTEMS REFERENCE DELIVERABLE

colour inside

Generic smart grid requirements –
Part 2-2: Market related domain

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FOREWORD

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IEC SRD 62913-2-2, which is a Systems Reference Deliverable, has been prepared by IEC systems committee Smart Energy.

The text of this Systems Reference Deliverable is based on the following documents:

Draft SRD	Report on voting
SyCSmartEnergy/88/DTS	SyCSmartEnergy/97/RVDTS

Full information on the voting for the approval of this Systems Reference Deliverable can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC SRD 62913 series, published under the general title *Generic smart grid requirements*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Under the general title *Generic smart grid requirements*, the IEC SRD 62913 series consists of the following parts:

– *Part 1: Specific application of the Use Case methodology for defining generic smart grid requirements according to the IEC systems approach*;

– Part 2: is composed of five subparts which refer to the clusters that group several domains:

  - *Part 2-1: Grid related domains* – these include transmission grid management, distribution grid management, microgrids and smart substation automation;
  - *Part 2-2: Market related domain*;
  - *Part 2-3: Resources connected to the grid domains* – these include bulk generation, distributed energy resources, smart home / commercial / industrial / DR-customer energy management, and energy storage;
  - *Part 2-4: Electric transportation related domain*;

IEC SRD 62913 refers to 'clusters' of domains for its different parts so as to provide a neutral term for document management purposes simply because it is necessary to split in several documents the broad scope of smart grid.

The document for each domain is composed as follows.

- Purpose and scope.
- Business analysis: to address domain's strategic goals and principles regarding its smart grid environment. It also lists business use cases and system use cases identified, their associated business roles and system roles (actors) and the simplified role model highlighting main interactions between actors.
- Generic smart grid requirements: extracted from Use Cases described in Annex B.
- Annex A lists links between domains, technical committees and gathered materials (existing standardization documents, user stories, Use Cases and functional architectures).
- Annex B includes a complete description of Use Cases per domain based on IEC 62559-2.
- Bibliography.

The purpose of this document is to define the generic smart grid requirements of the market related domain, based on the methods and tools developed in IEC SRD 62913-1.

This analysis is based on the business input from domain experts as well as existing material on grid management in a smart grid environment when relevant. Table 1 highlights the domains and business use cases described in this document.

Table 1 – Content of IEC SRD 62913-2-2:2019

Domain	Content	Scope
Market	Described with 1 business Use Case and 6 system Use Cases identified	

GENERIC SMART GRID REQUIREMENTS –

Part 2-2: Market related domain

1 Scope

This part of IEC SRD 62913 initiates and illustrates the IEC's systems approach based on Use Cases and involving the identification of generic smart grid requirements for further standardization work for market related domains, based on the methods and tools developed in IEC SRD 62913-1.

It captures possible "common and repeated usage" of a smart grid system, under the format of "Use Cases" with a view to feeding further standardization activities. Use Cases can be described in different ways and can represent competing alternatives. From there, this document derives the common requirements to be considered by these further standardization activities in terms of interfaces between actors interacting with the given system.

To this end, Use Case implementations are given for information purposes only. The interface requirements to be considered for later standardization activities are summarized (typically information pieces, communication services and specific non-functional requirements: performance level, security specification, etc.).

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
active demand definition
demand offered for the purposes of, but not restricted to, providing active power management, voltage and frequency regulation and system reserve

3.1.2
aggregation
process of combining data from various sources

[SOURCE: ISO/IEC 29182-2:2013, 2.4.2]

3.1.3
dispatchable generation source
source of electricity that can be dispatched at the request of power grid operators or of the plant owner

Note 1 to entry: That is, generating plants that can be turned on or off, or can adjust their power output according to an order.

3.1.4
flexibility
modification of electricity injection and/or extraction, on an individual or aggregated level, in reaction to an external signal in order to provide a service within the energy system

Note 1 to entry: This definition is based on EURELECTRIC, Active Distribution System management. A key tool for the smooth integration of distributed generation, 2013.

3.1.5
flexibility aggregator
entity that buys and aggregates the flexibility of consumption (demand response) and distributed generation in order to value them on the market and through the transportation products (adjustment mechanism, capacity market)

Note 1 to entry: Flexibility aggregator contracts with end-customer directly or through an intermediary like an energy supplier.

3.1.6
quality of service
collective effect of service performance which determines the degree of satisfaction of a user of the service

Note 1 to entry: The quality of service is characterized by the combined aspects of service support performance, service operability performance, serveability performance, service integrity and other factors specific to each service.

[SOURCE: IEC 60050-191:1990, 191-19-01]

3.1.7
security
<of an electric power system> ability to operate in such a way that credible events do not give rise to loss of load, stresses of system components beyond their ratings, bus voltages or system frequency outside tolerances, instability, voltage collapse, or cascading

Note 1 to entry: In the context of smart grid, the term ‘security’ may be too vague. In this document it may be replaced by ‘operational reliability’ or ‘operational security’ to reflect the real practices of, for example, NERC or ENTSO-E.

[SOURCE: IEC 60050-191:1999, 191-21-03]

3.1.8
work programme
schedule for operations related to the creation, maintenance, and repair of network assets on the transmission or distribution grid

[SOURCE: evolvDSO, D2.1 Business Use Cases Definition and requirements, 2014]

3.2 Abbreviated terms

BRP	Balance Responsible Party
CBA	Cost Benefit Analysis
EHV	Extremely High Voltage
DER	Distributed Energy Resources
DR	Demand-Response
DSO	Distribution System Operator
FCR	Frequency Control Reserve
FRR	Frequency Restoration Reserve

HV	High Voltage
HVDC	High Voltage Direct Current
LV	Low Voltage
MV	Medium Voltage
RR	Restoration Reserve
SGAM	Smart Grid Architecture Model
TSO	Transmission System Operator

4 Market

4.1 Purpose and scope

4.1.1 Clause objective

The purpose of Clause 4 is to present a business analysis of the market domain in a smart grid context, and more specifically to describe the smart grid requirements of the domain using the generic Use Case approach as defined in [1][1]. This analysis is based on a European perspective, and will need to be extended to other regions (such as North-American markets).

4.1.2 General context

4.1.2.1 General

Two technological trends are impacting the electric power system:

- the development of distributed renewable energy sources, which are intermittent;
- the development of smart grid technologies.

4.1.2.2 An electric power system perspective – the need to strengthen the management of balance between demand and supply through interconnected transmission grids

The functioning of the electric power system requires maintaining the balance between supply and demand at any time, in order to avoid situations leading to load shedding or even blackouts, which could have dramatic economic consequences.

The electric power system, in which balance between demand and supply is managed at the level of transmission networks by the TSO, provides the following benefits.

- It contributes to ensure security of supply and cost optimization to the benefits of consumers, by reducing and localizing the impacts of faults and other unexpected events, and by using the most efficient generation capacities at each synchronous area at first and if not existing at the national level.
- It offers a better use and increases the value of intermittent renewable energy sources, by mitigating their variations (see for example North-South grid interconnections in Germany).
- It allows solidarity between regions which have high penetration of distributed renewable energy sources and others with lower shares of renewable energy sources.

To ensure the reliability of the electric power system, stakeholders can rely on the following key players:

[1] Numbers in square brackets refer to the Bibliography.

- regulated actors, like system and grid operators, who manage the networks and ensure physical balance between production and consumption in their balancing zone for system operators;
- deregulated actors (such as suppliers/retailers, flexibility aggregators, producers, or electricity traders/brokers), who operate within a balancing zone, on which balance responsible parties have a financial responsibility.

4.1.2.3 Evolutions needed for the electric power system

4.1.2.3.1 A need for more flexibilities

First, the development of renewable energy sources, more particularly wind and solar power, increases the variability and uncertainties on balance between supply and demand. The electric power system will need more flexibility to maintain this balance and further face new challenges.

A global cost benefit analysis (CBA) should be achieved to assess the economic relevance of the flexibility versus grids developments.

4.1.2.3.2 New constraints in distribution networks

The increased penetration of distributed generation from renewable energy sources into distribution and transmission networks tends to generate operational problems. The risk to violate grid operational constraints increases.

Grid operators have traditionally managed these constraints in the long term with network reinforcement, investments, and in the operational time horizon by switching actions, emergency control of customers and, if other means fail, by disconnection of less critical feeders and customers.

Otherwise the result is an uncontrolled wider and longer nonselective blackout.

A more dynamic management of the grid would allow grid operators to optimize network investments and to reduce the risk of blackouts and a loss or limitation of customers' physical access to the market.

With the increasingly dynamic power flows, it also becomes necessary to take into account the dynamic grid constraints in the electricity markets in a fair and transparent way.

4.1.2.3.3 Expected benefits of smart grid technologies on flexibilities and network management

Furthermore, smart grid technologies, including the deployment of smart metering systems for residential and business customers and communicating electrical equipment, will enable the development of further flexibilities and contribute to the reliability and efficiency of the electric power system.

These flexibilities, which can be defined as a modification of injection and/or extraction on an individual or aggregated level, in reaction to an external signal in order to provide a service within the energy system, may be traded within the electricity market, to deliver ancillary services, services to grid operators, for the TSO for balancing purposes, or to allow an optimization of production costs for instance.

Flexibilities can be incentivized and remunerated by:

- a variation of electricity prices (purchased or supplied),
- a variation of network tariffs,
- a direct compensation for the provider of the flexibility.

Furthermore, the activation of localized flexibilities (injection or extraction) can allow system and grid operators to solve specific grid constraints. These local flexibilities, developed by actors within their balancing zone, impact the balance between supply and demand and therefore have to be taken into account in its management at a system level.

Table 2 lists some examples of flexibility products based on active demand, as well as their main characteristics.

Table 2 – Examples of flexibility products based on active demand

Active demand product	Conditionality	Typical example
Bi-directional conditional re-profiling	Conditional (real option)	Having the capacity to provide a specified demand modification during a given period in a bi-directional range [y, x] MW, including both demand increase and decrease. The delivery is called upon by the buyer of the active demand product (similar to a reserve service).
Conditional re-profiling	Conditional (real option)	Having the capacity to provide a specified demand modification during a given period. The delivery is called upon by the buyer of the active demand product (similar to a reserve service).
Scheduled re-profiling	Unconditional (obligation)	Obligation to provide a specified demand modification (reduction or increase) at a given time to the product buyer.

The business analysis of the market domain will detail how these flexibilities can be provided and used by various roles of the electric power system within the electricity market.

4.1.3 Overview of electricity market

The purpose of electricity market is to allow actors of the electric power system to purchase and sell energy and energy-related products and services. Trading can take place:

- on stock exchanges – such as EPEX Spot for instance;
- via mutual agreement (direct or brokered).

Even though the domain is referred to as “market” in the singular, it is more accurate to speak about “electricity markets” in the plural. Indeed, separate marketplaces or market mechanisms with specific sets of rules, roles, and objectives may exist in the same zone and even be coordinated.

The business analysis of the domain focuses on the flexibility products and services traded within electricity markets which allow market players to execute/enable their business processes. These internal processes are out of the scope of this document.

4.2 Business analysis

4.2.1 General overview

The electricity markets are going to have a preponderant place for the whole electric power system. The development of new electricity usages and the integration of DER need reliable and efficient market mechanisms. To contribute to the security of the system and to obtain the best deals between market participants, the development of market facilities, market products and a better cooperation between actors are required.

Flexibility products and services may be traded within existing or new markets and market mechanisms – depending on various elements such as legal rules, the time scale or geographic scale.

Here are some major improvements expected for the main domain business roles from the integration of flexibility products and services within electricity markets.

- End-customers may benefit from better energy supply contracts and reduced electricity bills if they accept to modulate their consumption and participate in the market (via a supplier, a flexibility aggregator/operator, or another third party).
- Suppliers will be able to propose to their customers flexible offers and create value with attractive tariffs, by developing active demand offers combined with competitive tariffs during off-peak periods and/or less competitive tariffs during peak periods for instance. This flexibility can create value on energy markets or allow system or grid operators to solve network constraints. Suppliers may also participate in a capacity market or mechanism – when such a market/mechanism has been implemented.
- Flexibility aggregators will develop, offer and manage various flexibility products and stakeholders for grid users (consumers, producers, and/or prosumers), system operators, or grid operators.
- System operators and grid operators may obtain (new) flexibilities to ensure the network reliability, plan work programmes and ultimately realize investments – as long as these flexibilities meet certain requirements according to the legal framework.
- Producers may rely on new levers to sell their production, plan their investments and works, and self-insure against business risks – by buying flexibilities.

A strong coordination between certain roles will be needed to prevent market side effects and ensure the overall optimization of the system. More specifically, Transmission system operators and grid operators may have to reinforce their cooperation to prevent situations where their actions on a given network would generate unacceptable constraints on another network, or situations where they compete for the same products. Different models may be proposed, with shared portfolio or separate markets/mechanisms for instance. These models should be assessed through a global analysis taking into account all the aspects of the system to select the most economically efficient option, complying with the legal framework.

Regarding the potential use of flexibilities by system and/or grid operators, the following points should be noted.

- Local flexibilities obtained by grid operators may benefit the overall electric power system, provided that the benefits for the grid exceed their costs (additional energy costs, management costs, loss of opportunity, etc.). Regulation mechanisms would have to be implemented to manage the activation and ex-post certification of such flexibilities. Grid operators may have to pay compensations for their use.
- Several ways to request local flexibilities may exist; grid operators should be incited to use the most cost-efficient ones.
- Flexibility price signals should combine their value for the grid and their value for the market. Flexibilities exist in limited number. A strong coordination between flexibilities activated for grid purposes and flexibilities activated for market purposes should therefore be targeted, in order to avoid reducing their value and as a result the incentive for the customer.

It is proposed that the focus of the market should be the support of power system stakeholders' activities via the use of flexibilities in marketplaces. Several new and evolving business processes are proposed in 4.2.2, and could be described as business use cases.

4.2.2 List of business roles and business use cases of the domain

The business use cases listed are a result of the business analysis carried out previously – the list is not exhaustive, and it is likely to grow as new Use Cases come to light.