

FLEXIBILITY MARKET FACILITATION THROUGH DSO AGGREGATOR PORTAL

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ABSTRACT

Flexibility market and mechanisms are being set up in France as peak management solution. ERDF, as French main DSO, developed with Schneider Electric a new tool called "Aggregator Portal" in order to facilitate the development of Aggregated Demand Response (DR) by providing new services to Aggregators : ex-ante grid safety and security insurance and ex-post assessment of DR.

INTRODUCTION

Electricity specificities management needs flexibility for System's stakes : production/demand balance, reliability control during peak conditions, and transforming production assets integrating intermittent renewable. Historically, Demand Response (DR) has been mostly offered by consumers connected to the Transportation grid. Since System issues grow in Transition context, French energy policies ask for quick development of DR capacities. Smaller and smaller aggregated flexibilities are thus incentivized to participate to new markets and mechanisms. Those new adjustment capacities are mainly connected to Distribution networks.

As French main DSO, ERDF is responsible for Distribution networks security, quality of supply, losses compensation and plays an important role in national CAPEX control in Energy Transition. Distribution flows are getting more and more complicated so renewable producers and electric vehicle smart integration is a real challenge. Diffuse DR can impact Distribution networks by growing local peak loads and generate constraints. Thus, if not correctly integrated, those new flexibilities represent risks for networks security, reliability and quality of supply and losses control. Managing this risk requires new tools based on ICT and state of the art software engineering.

Flexibility management is a new challenge for DSO's who are working on their future roles. ERDF position is to facilitate the development of Aggregated DR by providing new services to Aggregators:

- Ex-ante grid safety insurance considering Demand Response portfolios;
- Ex-ante grid safety insurance considering Demand Response activations schedules;
- Ex-post Assessment of Demand Response realization.

New business models require the development of innovative equipments. ERDF and Schneider Electric, global specialist in energy solutions, signed a partnership for developing and testing innovative tools in this purpose. One of these tools, supporting the role of ERDF

as a Neutral Market Facilitator (see reference [1]), is designed to experiment DR challenges and called "Aggregator Portal".

GENERAL ARCHITECTURE

The figure below presents the Aggregator Portal as a key component of a global active management architecture. Since aggregated DR sites will be connected on Distribution side, flexibility management shall involve several actors including DSO. Thus, the Aggregator Portal is a gateway between aggregators' systems and ERDF's Information System. From the external side, the portal enables support of multiple market mechanism using a modular platform enabling services decomposition and reuse. From the internal side, the portal connects with two main systems, the Distribution Management System (DMS) and Data Analysis Platform (DAP).

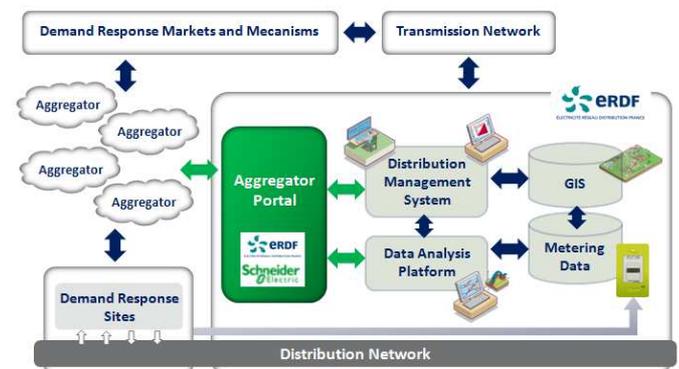


Figure 1 : Global Flexibility management architecture

The DMS is a suite of technical tools for distribution grid management such as network performances analysis (security of equipments, quality of supply and technical losses) and operation management. Connected to the Aggregator Portal, this tool anticipates the impacts of DR activations on network management. In areas like Lyon equipped with smart meters the DMS integrated new data to provide more accurate and reliable results for Low Voltage (LV) grids (see reference [2]).

The DAP is a statistical analysis platform that processes metering data to feed predictive models (consumption (see reference [3]) and production depending on weather conditions) and assess load cut-off, duration, power rebound and energy report of DR activations (see reference [4]).

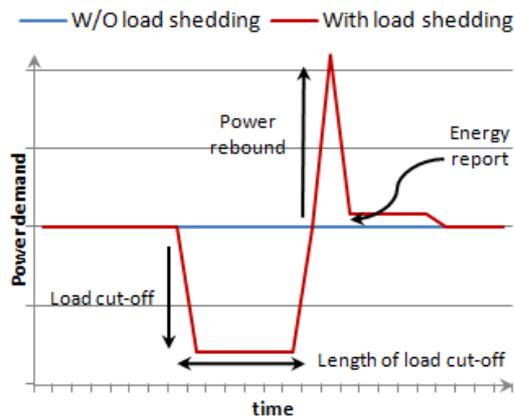


Figure 2: Impacts of load control on the electric demand (source : reference [5])

MAIN FUNCTIONALITIES

The specifications of the Aggregator Portal have been written with a Use Case methodology SGAM. The overall purpose is to manage the impacts of DR activations on the distribution network.

Use Case #1 – Aggregator Registration

On aggregator request, the DSO creates a personal account and sends back the registration (login and password) to the aggregator. The aggregator then fills his administrative data through the gateway so that the DSO can check the status of the aggregator in the portal database and notifies back the validation of the aggregator's profile through the Aggregator Portal.

Use Case #2 – Aggregator Portfolio Management

Once registered, the aggregator uploads his portfolio in the portal. His portfolio contains the collection of sites and their contractual data (i.e. consumer ID, direction, maximal power, load type, supplier ID, etc...). The DSO then validates the portfolio using the portal in two steps :

- Step 1 – Administrative validation : the gateway sends an automated request to the DSO's customer data base to verify each site's contractual data;
- Step 2 – Technical validation : the gateway sends an automated request to the ERDF's DMS to anticipate the impacts of the portfolio DR activations on the distribution network. Considering critical but realistic conditions and portfolios already registered from other aggregators, the DMS assesses the risk of the corresponding DR activations. At this stage, without knowing precisely the activations' characteristics (time, duration, sites' clusters, etc...) these risks are qualified and quantified using a probabilistic and predictive approach for each site. Thus, the aggregator can anticipate activation restrictions on its portfolio and prepare his activation strategies considering distribution network capacities.

This procedure of Portfolio Management can be done on a monthly basis.

Use Case #3 – Ex-ante Demand Response Activation Management

Depending on day-ahead flexibility markets conditions and DR resources availability, the aggregator defines activation scheme on a daily basis. At this stage flexible sites are structured into DR clusters and time activation and duration are precisely defined. The aggregator submits this activation scheme to the DSO through the Aggregator Portal for technical approval.

After a consistency control in respect with previous steps, the Aggregator Portal automatically sends the activation scheme to ERDF's DMS. This time, the DMS uses updated input data such as real weather and operational conditions of the distribution grid to estimate the impacts of DR activation. In case of electrical constraints, congestion or quality issue, the DSO sends back the activation scheme highlighting DR clusters responsible for constraints. Iterations with aggregator, strongly facilitated by the Aggregator Portal, allow adjustments to be done in DR activation scheme to ensure safe DR activation.

Use Case #4 – Ex-post Demand Response Activation Assessment

After DR activation, the aggregator declares into the portal the flexibility program that have been sold in flexibility markets or mechanisms. For each DR cluster, the ERDF builds a mirror panel composed of clusters of non-flexible sites using a "panel method" (baseline method, see ref. [4]). Each characteristic of the cluster DR activation, load shedding, duration, bounce and report, are then assessed comparing the aggregated load curve of the DR cluster and the reference load curve of the mirror cluster. These characteristics are certified by DSO as a neutral stakeholder and published into the Aggregator Portal.

TECHNICAL ASPECTS

The technical specifications define a standardized, component oriented platform that could be accessible from all stakeholders using a web portal interface.

The aggregator portal is based on Schneider Electric StructureWare Flexible Resources Operation software solution. This software solution which is J2EE based technology offers powerful deployment capabilities of functional components to create a modular and extensible solution. This software solution brings modularity in order to easily adapt and implement ERDF policy that will help supporting the role of ERDF as a Neutral Market Facilitator.

Functional modules can be customised using graphical user interface and then dynamically deployed in the production environment.

StructureWare Flexible Resources Operation will ease integration of multiple systems between aggregators'

systems and ERDF's toolbox using advanced service modelisation. This modelisation is based on model driven architecture and standardised interfaces that can be assembled on demand and tailored to application ecosystem. Services are available through standardised WSDL / SOAP / HTTP integration mechanisms.

Interface will be implemented using standardized based protocols like CIM market or IEC 61968 for example according to information data type.

As part of the GreenLys project described below, the Aggregator portal will be hosted within ERDF control center in Lyon and will be compliant with ERDF information system architecture requirements. Hosting platform is standard Apache, MySQL package. It provides a secure web interface accessible from any aggregators and ERDF to easily support the use cases defined in the previous chapter.

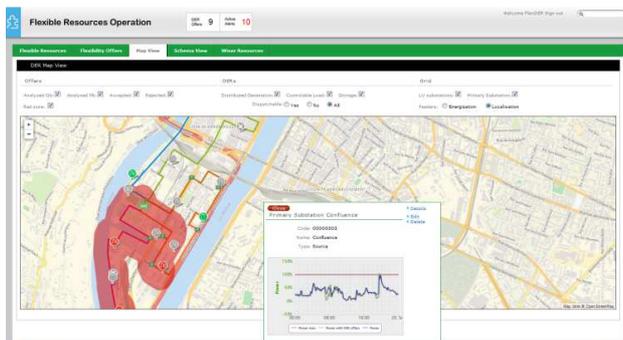


Figure 3 : Aggregator Portal graphical interface

TEST IN GREENLYS PROJECT

With a target of several hundred residential tester consumers and several dozen commercial sites in Lyon and Grenoble, GreenLys is an experimental Smart Grid project which heralds the energy supply model of the future over the whole electricity supply chain: from the producer to the end consumer, including all those involved in the transportation, distribution and supply of electricity, thus linking all the various stakeholders in the electricity market, including DSO and aggregator (see project's website <http://www.greenlys.fr/>). Engaged in 2012, GreenLys aims to test innovative solutions at all levels of the grid and propose a cost/benefit analysis covering the overall value chain and between individual stakeholders.

GreenLys feedbacks are now built on more than 20 000 DR activations on more than 400 customers. Based on those consistent field tests, accurate predictive models have been built and integrated into ERDF DMS. This calculation tool called "ERABLE" is a prototype based on PowerFactory (DIgSILENT) (see reference [6]). ERDF DMS includes a simulation mode allowing multi-scenarios assessment based on real network data and

smart meter measures.

Using this tool, a set of simulations have been run on the 2,000 real LV networks of the GreenLys area in Lyon, to feed a comprehensive technico-economic analysis of DR impacts. Current distribution network design rules use natural load diversity to ensure that equipments can handle the local peak made of aggregated consumptions. DR activations introduce risks of increased local peak loads in case of synchronous power rebound (see references [5] and [7]).

The figure below shows a snapshot of ERABLE results drawing a map of real LV networks highlighting new constraints due to DR synchronous activations. Those results prove that in this configuration DR leads to real risks on distribution grids during critical peak conditions.

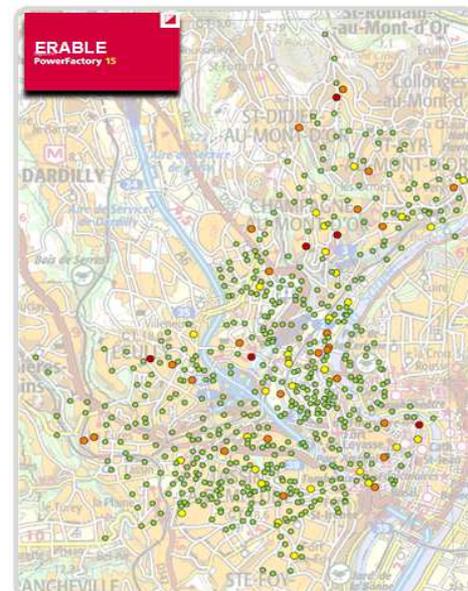


Figure 4 : Snapshot of ERABLE DMS results (each point represents a LV network of the GreenLys area in Lyon)

The graphic below aggregates the technico-economic consequences of those new constraints for several DR roll-out scenarios without DSO/Aggregator coordination. For example a 100% DR roll-out leads to huge investments on LV grids to eliminate all risks : nearly 8% of the LV infrastructure as to be reinforced in this case.

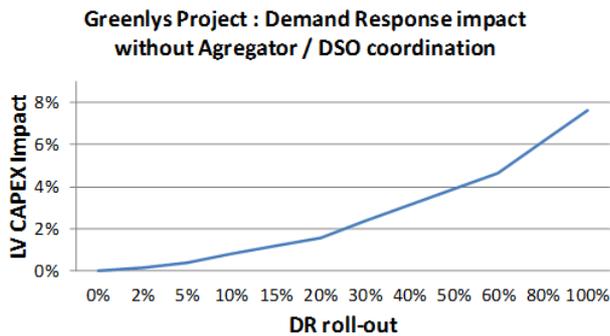


Figure 5 : Economic impact of Demand Response in the distribution grid side without Agregator Portal

Those results clearly show that DR activation can have strong negative impacts on distribution grids. The distribution grid's retrofitting to ensure total resilience is not a smart option considering reinforcement costs and DR activation restrictions only occur a few hours a year. The coordination between aggregator and DSO, allowed by the Agregator Portal, is thus a high value mechanism.

CONCLUSION

The aggregator Portal developed by ERDF and Schneider Electric is a powerful tool for flexibility market facilitation, allowing smart data exchanges between DSO and aggregators to anticipate security and quality risks for local supply and adjust DR activation strategies. This coordination mechanism is a least cost solution to avoid substantial network reinforcements and provide smart services from DSO. Other interaction should be considered, interactions with TSO for example, but this issue is not studied in Greenlys project. Other ERDF projects, Smart Grid Vendée for example, work on this topic.

This gateway, compatible with ERDF DMS, as been presented in details. This key innovation solution is currently being integrated into ERDF Information System and further return on his use in the Greenlys project will be published.

ACKNOWLEDGMENT

We warmly thank the ADEME and the Future Investment Program for the support and funding of smart grid projects. We sincerely thank the cities of Lyon and Grenoble for their involvement and motivation in our joint projects. Special thanks to all the partners working with us in the GreenLys consortium.

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