fenix

Flexible Electricity Networks to Integrate the eXpected 'energy evolution'

... a step towards the future of electricity network

Bulletin 6
1/2009

The FENIX Scenarios – Outlines of the Southern Demonstration

Editorial

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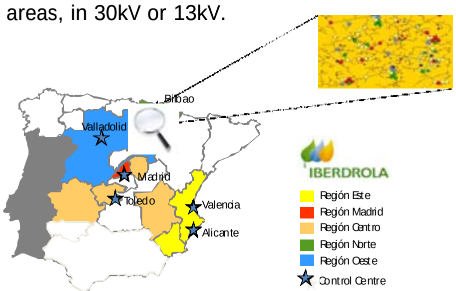
Welcome to the this 6th edition of the project bulletin. It gives the "*Outlines of the Southern Demonstration*". We are in our last year of project and there is a lot of activity in the FENIX Southern Scenario in this phase of the project.

FENIX overall aim is to integrate DER and demand side response cost effectively in the operation and development of the network. The key delivery mechanism is the Large-Scale Virtual Power Plant (LSVPP). To undertake proof of this concept two physical demonstrations are deployed: one in the UK hosted by EDF Energy, and a second one in Spain which is described here.

Alava a place for FENIX

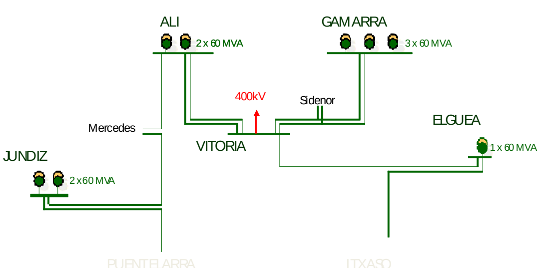
Iberdrola as Southern Demonstration leader, selected an interesting piece of network in Alava province, 3000 km² of land in the North of Spain, as the place to demonstrate the main concepts of FENIX.

Alava distribution network provides service to 169,000 low voltage customers from which 70% are urban, 12% sub-urban and 17% rural areas, in 30kV or 13kV.



One of the attractive things of Alava is the neat boundary between transmission and distribution. The distribution power system is connected to the transmission electricity network by means of eight HV/MV transformers rated 60 MVA each for a total installed capacity of 480 MVA.

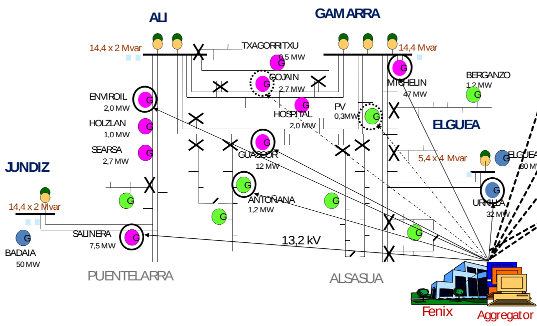
Alava TSO – 220kV network



This distribution network includes 1.907 Km of lines (80% aerial and 20% underground cables).

Although the design for the 30kV sub-transmission network is meshed it is operated radial with several open circuit breakers in order to reduce the short circuit capacity. As result, for FENIX project purposes, there is a clear identification of where the output of a given DER is reflected at the transmission-distribution border transformers.

Alava DSO 30-13kV simplified network



The second aspect which makes Alava attractive is the portfolio of generation units, all of them belonging to the special regime category: several renewable technologies and large CHP units representing a total installed capacity in the range of 170 MVA, what is about 35% of the transformers capacity linking transmission and distribution networks.

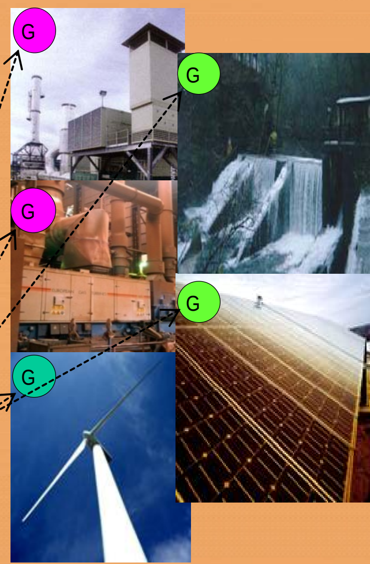
One outstanding fact of some CHP units is that, although there are industrial processes running and requiring the heat load, they are capable of providing some control margin over the active power production.

Fenix Architecture

An architecture for a massive penetration of DER is an outcome of the project and was presented in the previous bulletin. It includes the figure of a new actor called "Aggregator", who establishes commercial relationship with DERs and helps them to maximize their contributions to the network. Competition is granted as many Aggregators can provide services in one zone.

This FENIX architecture has been adapted and deployed in Spain, including different developments and hardware pieces:

- A parallel control system (FENIX control system) to the one run by the utility has been installed not to interfere with the real operation, but updated in real time with all the SCADA values of Alava.
- A DEMS (Distributed Energy Management System) acting as VPP, has been adapted to the scenario needs in order to do the aggregation/desegregation functions.
- A device called FENIX BOX (FB) is used to communicate DER with the VPP, which is piece of hardware capable of exchanging information and interoperating with the controls of the generation unit. The link used for the demo will be GPRS and IEC-104 protocol.



DER of different technologies participate on the demonstration

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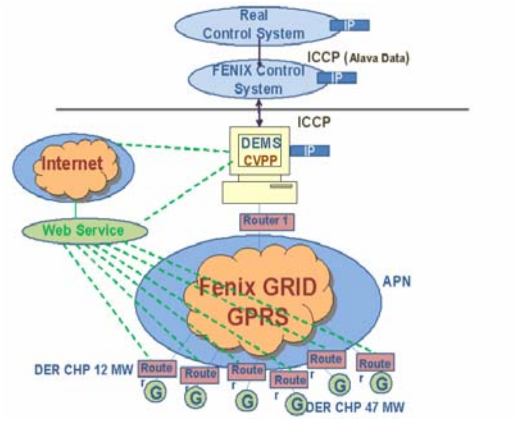
More information about the FENIX project is available on the FENIX homepage:

www.fenix-project.org

The architecture requires a web connection with the DER to exchange bids and schedules, but also a real time connection to visualize their output and send setpoints.

For the Southern Demonstration GPRS has been selected for this real time link as it can provide very simple massive access to DER (but PLC, satellite or others could have also done). Locally a device call FENIX-box provides the real time link between DER an aggregator.

Demo Architecture



What will be demonstrated?

To prove FENIX concepts, different use cases where defined in WP2, and some of them will be demonstrated in Alava in real world:

1) The Day Ahead Market

The portfolio of units is taken to the market by a FENIX entity called “Aggregator” which makes use of the VPP architecture. Each DER communicates its position to the Aggregator through a web page, the VPP aggregates all bids into a single one and places it in the Spanish Market (OMEL).

After clearance the VPP disaggregates the assigned output of each unit and gives it to each DSO to perform technical validation of the scheduled output.

DSO rejects or accepts each bid depending on its technical feasibility. Technical aggregation of the bids is done and communicated to the TSO who finally validates the injection proposed for the boundary points.

2) Tertiary Reserve

Tertiary reserve is an ancillary service for deviation correction. Participating generators have to be able to deliver or cease to deliver a certain amount of active power within fifteen minutes and hold it for two hours. As a fast response is required the information exchange between the VPP and the DER must be in real time.

If the balancing market is open by the TSO, the VPP gets the notification and disaggregates it, to send the corresponding active power set points to the required DER through the communication link.

3) Voltage Control

Controllability and visualization of DER can also contribute to control the quality of service on the distribution grid nodes by managing the reactive power amount each DER is able to give. Also, DER can help to maintain a certain voltage level at substation high voltage bars predetermined by the TSO.

For that purpose a Distribution Management Tool (DMS) called Volt VAr Control (VVC) has been developed. It is an OPF based algorithm which helps to determine what actions need to be taken to maintain the voltage levels. There are three possible actions; changing the reactive power output of DER, changing transformer taps, switching capacitor banks.

Thus, the VVC determines the reactive power needed from each DER and a set point of reactive power is sent in real time to each of them.

4) Network contingencies

Once a mechanism for DER to offer their flexibility exists, and this is provided by FENIX solution, it can be used in many other different network situations, some of them will be simulated in this demonstration:

• DER can help to avoid load shedding in the case a conventional unit is lost

• DER can help the DSO to keep service in an area where a substation has been lost, without too many network reconfiguration.

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As you can see we have a nice piece of network here that opens a lot of possibilities. I encourage all of you to follow the outcomes of the Southern Demonstration and its evolution.

What brings Alava new? Which is the added value of this demonstration?

1) The use of DER capacities to give system support, no other System Operator does that.
2) Aggregation of different DER technologies to reduce uncertainty (not allowed by Regulation in Spain).
3) Check on feasibility of generation schedules in the Distribution Network (currently is only done at TSO level).
4) Provide tertiary reserve with DER (Special Regime in Spain is not considered to provide it).
5) The use of VVC optimizing Distribution networks that considers DER outputs as a control variables.
6) Allow Back-up units to inject energy into the network to give system support (not allowed by Regulation)

Aggregation presents two main advantages:

✓ Integration of different generation technologies minimizing unpredictability. Flexibility to re-adapt and compensate the bid, thus optimizing the profit for all stakeholders. (e.g. if wind is not blowing cogeneration can spring for it and compensate)

✓ Facilitates small generation units to take part in the day-ahead market. It simplifies the interfaces with the TSO, DSO and the Market.

Next FENIX bulletin

The next FENIX bulletin will be published in March 2009.
Subject: New developed features (EDF, Siemens, Areva, ZIV, Gamessa, Ecro, ECN)

Conference

CIRED, 8-11th June , Prague 2009
For further information see: **www.cired2009.org**

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