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IGREENGrid Newsletter 1

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Abstract

This document provides the contents of the Newsletter 1 of the IGREENGrid Project. The contents are consistent with the conclusions of the Salzburg meeting.

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1 Introduction and scope of the document

This document provides a draft of the contents of the Newsletter 1 of the IGREENGrid Project. The contents complies the Salzburg meeting

2 The words of the Project Coordinator

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The integration of renewable distributed generation into the electricity networks is becoming an increasing challenge facing Electricity Distribution Companies across Europe. Some European countries have experienced a steep increase of distributed renewable energy sources connected to the electrical distribution networks over recent years. This has created a range of problems that have to be addressed and has led to the development of novel solutions using new technologies to find the most effective and economical means to address these problems.

The European project IGREENGrid aims to study this subject from a new perspective. Instead of developing a specific idea, the project proposes to extract the most relevant European R&D experiences in integrating renewables and analysing the difficulties detected by the eight electricity utilities which make up the team, as well as the solutions that are proposed to tackle the range of challenges that are being experience on the distribution networks.

The objective is to share knowledge, jointly assess alternatives under a common framework and evaluate the possibility of transferring the most promising solutions to other countries with different regulatory contexts, network sizes, levels of renewable energy penetration and other relevant factors.

In this first IGREENGrid newsletter we are presenting a brief summary of the scope and findings of three of the associated project demonstrators (in Austria, Greece and Germany) which are collaborating with IGREENGrid project, that the whole team expect will be interesting for everyone.

3 German Demo description

"Grids for Future Electricity Supply", is a German project demonstrator led by RWE Deutschland from July 2009 to June 2011. The consortium includes ABB, Consentec and TU Dortmund. It worked on economic solutions for sustainable distribution grids. The demonstration phase took place in the Eifel region of Bitburg-Prüm in Rhineland-Palatinate (Germany) in a rural area.

The aim of the "Grids for Future Electricity Supply" research project (a.k.a. "Future Grids / Smart Country") was to develop and demonstrate innovative grid concepts serving as a basis for smart grids including an economic and technical analysis. The base study relays on desk studies conducted over reference network simulations and it is completed with the field deployment of several DER integration solutions. The proposed grid concepts consider an increased use of Information and Communications Technology (ICT) as well as other intelligent technologies ranging from voltage regulators based on power electronics to approaches utilising flexible supply voltages in the grid.

Website: http://www.zukunftsnetze.de/

Scope of Demo:

- Use of Reference Network Analysis
- Use of an Active Voltage Regulation unit at MV/LV substation and at MV feeder.

Figure 1: Active Voltage Regulator at LV

Figure 2: Active Voltage Regulator at MV

- Use of a biogas plant uploaded with a large storage at the MV/LV substation.

Figure 3: Local storage at LV

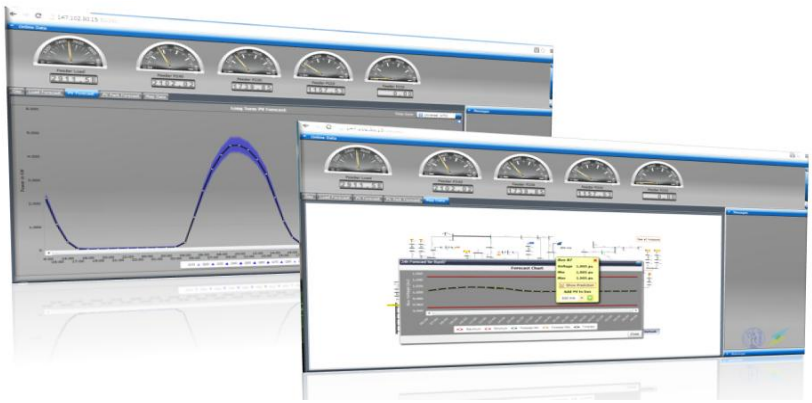
Findings

- Some of the theoretical results obtained from the project have been incorporated to the planning and maintenance guidelines. Others should follow after the verification phase for field devices.
- Innovative voltage controllers connected along the circuits could contribute to regulate the voltage in the MV grid.
- Use of an Active Voltage Regulation unit at MV/LV substation and at MV feeder reduces the current and the voltage drop along the feeder.
- Measures of voltage at certain points in the grid could help to optimize the regulation of the bus bar voltage in a distribution network.
- The use of local biogas storage could buffer PV production peaks increasing the local balance and optimizing the use of the available capacity of network assesses.

4 Greek Demo description

The objectives of the Greek demo project include testing, demonstration and evaluation of advanced management tools and monitoring applications concerning the RES (Renewable Energy Sources) installations at MV (Medium Voltage) Distribution networks using the smart metering infrastructure (AMI) with AMR (Automatic Meter Reading) connected to the telemetry centre of HEDNO, who is the demo leader.

The core of the demo project is to use the data available from two different systems, the DMS (Distribution Management System) and the AMR system. The Greek Demo project exploits data collected from electronic meters installed at MV customers and RES (PVs) connected to two MV feeders located at Sperchiada, in Central Greece. The MV lines are fed by HV/MV substations and they are feeding MV/LV substations, MV loads (mainly industrial/commercial customers) and RES installations.



Scope of Demo:

The outcome of the demo project is a set of distribution management tools, which are based on the AMR infrastructure for data acquisition of MV Networks and deploy several advanced functions extending the main functions of stochastic RES (PV) forecasting and probabilistic load flow. More specifically, advanced functions are implemented, such as improved monitoring of the system state, identification in advance and management of congestion and operational limits violations (e.g. overvoltages), RES Hosting Capacity Evaluation Studies, assessment of the impact of P-V control policies for DER and related production set-points.

This is the first attempt to utilize the AMR data for the support of the power system operation and planning. One of the main objectives of the demo project is to enhance the grid operators' visibility of abnormal situations in the grid, caused mainly by the high RES penetration.

One of the major achievements of the demo project is the identification of reverse power flows at the primary substation by the grid operator. This was not possible before, because the only available measurements were the net flows without any indication of direction. In the developed

functionality the AMR data of the previous day are creatively combined with the real-time measurements at the substation level to provide the flow composition and direction.

One of the objectives of the demo is the localization of operational limits' violation for the day ahead. Based on the 24 hour forecasting functions and the probabilistic load flow outcomes, the grid operator is warned about potential abnormal situations and can order the crews to apply grid reconfiguration by changing the state of selected sectionalizing switches.

The demo applications also include functions focusing on enhanced planning capabilities; based on past RES production and applying probabilistic load flow the RES hosting capacity can be better estimated, enabling a wider exploitation of the installed equipment. Moreover, P-V control policies as a means to increase the RES hosting capacity can be conveniently assessed.

Findings:

The demo tool developed and installed in Sperchiada is valuable to the HEDNO network operator rural areas, where very limited means for monitoring and control of the network are available. The only measurements are the past day 24 hour PV productions and loads at the MV customers and the pure current flows at the HV/MV substation, i.e. at beginning of the distribution feeders. Moreover, not all MV disconnecting switches are telecontrolled. Using the developed functionalities the operator is provided:

- Improved monitoring facilities of the network power flow components distinguished in PV production and demand. In this way, reverse flows can be identified.
- Better management of congestions of voltage limits violations due to timely warnings 24 hours ahead
- Clear picture of RES penetration and its effects providing probabilities of limits violations
- Means for conducting control studies for seasonal network local reconfiguration and PV set points specifications.

5 Austrian Demo description

The objectives of the Austrian Smart Grid projects, deployed in the smart grid model region Salzburg and the smart grid pioneer region Upper Austria, are to find an efficient way for the integration of RES. The solutions developed in this project for LV and MV networks must fulfil technical and economic objectives and are assessed and validated accordingly.
The related projects which started in 2010 and are partly completed are led by the Austrian Institute of Technology, Salzburg Netz GmbH and Netz Oberösterreich GmbH. The consortiums include DSOs, industrial suppliers, universities and R&D institutes.

The projects are focused on medium scale DER integration including DG & active buildings in MV networks and PV & e-mobility integration in LV networks.

Website: http://smartgridssalzburg.at

Scope of Demo:

ZUQDE project located in Lungau (Salzburg):

- MV Voltage Control, with a Voltage VAR Controller (VVC), using State Estimator. It optimises the set points for the HV/MV OLTC transformer and reactive power of DG generators (small hydro power) via applications in the Distribution Management System (DMS).
- Various optimisation criteria are possible (e.g. minimisation of losses)

DG DemoNet – Validation project located Lungau (Salzburg):

- MV Voltage Control located at the HV/MV substation using voltage measurement at "critical nodes" for dynamic control of the OLTC transformer and hierarchical control of generators reactive power.

DG DemoNet – Smart LV Grid project located in Eberstalzell, Littring and Köstendorf:

- LV Local Voltage Control including local control loops without communication between actuators and remote sensors.
- LV Distributed Voltage Control using remote voltage measurements from selected smart meters in order to find the optimal transformer tap setting.
- LV Coordinated Voltage Control using remote voltage measurements from selected smart meters in the network to determine the optimal tap changer setting and optimising the operation of DERs (PV inverters) and e-mobility by modifying Q(U) and P(U) characteristics.

HiT project located in Salzburg:

- Aims at changing buildings into smart grids participants by optimizing thermal and electrical demand and production.
- LV and building/e-car self-supply maximization of buildings self-supply using the Building Energy Agent (BEA) which works on data from PV-inverters and measurements from Smart Meter and controls home automation components and e-car charging station and also a local controllable CHP generator.

- Customer Engagement in Buildings using an ambient device, website or households devices.

Findings:

- Hosting capacity can be significantly increased by the implementation of voltage control concept in MV networks without reinforcing the network (postponement): active voltage control can be an alternative to grid reinforcement.
- At MV level, voltage control with State Estimator coupled with a Voltage VAR Controller (VVC) or direct coordinated voltage control have been implemented and could be validated successfully.
- Smart meters can be used as sensors for operational tasks (voltage control).
- The use of smart metering system in the LV network improves the information of consumers regarding energy usage and generation.
- The control of local actuators like PV inverters, transformers with on-load-tap changer and e-vehicle charging stations can help to maintain the local voltage into the limits.
- By maximizing the consumption of locally generated renewable electricity, DRES can be more efficiently integrated into distribution networks.
- Some challenges have been identified:
    - The economic value of the reinforcement deferral depends on the asset age and is complex to evaluate.
    - The smart grids concepts require some additional costs (mainly OPEX) which cannot be directly charged to the DER. The allocation of these additional costs needs to be clarified (e.g. distribution among all users). Moreover, this OPEX increase might have negative impacts on the DNO business model under the current regulatory framework.
    - (Old) generators already connected to the network are in general not able to provide a significant contribution to the voltage control. Besides the technical capabilities of the generators, generator owners are very reluctant to make any change in the local control (“never change a running system”).
    - The allocation of the losses of revenue when implementing active power curtailment needs to be clarified and is under existing rules not foreseen as such.
    - The complexity of the network planning is increasing since the smart grids controllers must be taken into account. Standards models for standards tools are not yet available, making the planning process complex. The amount of data

needed for the planning is very large and shall not be neglected. Simplified planning rules are necessary in practise.

- The complexity of the network operation is increasing: some dedicated courses are necessary and in case of severe network failure, the presence of smart grids controllers may complicate and delay the restoration.
- The question of reliability needs to be carefully addressed: in case of failure of some of the smart grids components, the system shall be able to further operate in a safe (though non optimal) status.
- The projects followed a common approach during the demonstration with a first phase of open-loop test followed after successful completion by a close-loop phase.
- The issue of security has been evaluated in one project and shall be further investigated.
- Achieving customer engagement and a willingness to change consumption patterns and habits is time-consuming. This requires information specifically prepared for each target group with the intention of utilizing their freedom of action in using the household devices for supporting the grid operation and improving DRES integration.

6 SiNGULAR Project

SiNGULAR is an European-level project funded under the 7th Framework Program (FP7). SiNGULAR investigates the effects of large-scale integration of renewables and demand-side management on the planning and operation of insular electrical grids, proposing efficient measurements, solutions and tools towards the development of a sustainable and smart grid.

The project goal is the generation of effective solutions and information in order to maximize the integration of insular and highly variable energy resources. The operation and planning tools and procedures will be applied in different insular electrical grids, located in five countries across Europe for extensive demonstration, allowing the development of generalized guides of procedures and specific grid codes for future generation of smart insular electrical grids

http://www.singular-fp7.eu/home/

SiNGULAR
Smart and Sustainable Insular Electricity Grids Under Large-Scale Renewable Integration

7 SuSTAINABLE Project

The SuSTAINABLE project will develop and demonstrate a new operation paradigm, leveraging information from smart meters and short-term localized predictions to manage distribution systems in a more efficient and cost-effective way, enabling a large-scale deployment of variable distributed resources. The SuSTAINABLE concept is based on the cloud principle.

The SuSTAINABLE concept also involves an active management of distributed flexible resources by DSOs. A multi-objective decision-making scheme will be designed to keep network voltage inside operational constraints, to minimize DG energy spillage related to network constraints, to minimize operational expenditures related to high reliability and continuity of service for loads and generators, to minimize aging of automatic tap changers subjected to sudden variations of power flows, and to maximize the balancing and ancillary services to be provided to TSOs when necessary.

http://www.sustainableproject.eu/

8 Athens Public workshop

A common public workshop, with IGREENGrid, SINGULAR and SuSTAINABLE projects, has been organized in Athens on the 11th April 2014.

In addition of these three projects, the public workshop benefited from the participation of evolvDSO project and EDSO4SG.

The objective of the workshop was to share the first results of the projects, to highlight the most important challenges and issues which DSOs will face to in the next years and to present the definition of the future DSOs roles.

One of the most important issues is to establish a good interaction with the national and European regulators in order to develop the new regulatory framework.