



IEA Implementing Agreement for a Co-operative Programme on Smart Grids (ISGAN)

ISGAN Annex 6 Workshop on Power Transmission and Distribution Interaction -a challenging MMORPG*

Workshop Summary

Prepared for:
IEA ISGAN Annex 6 Operating Agent

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ISGAN Annex 6: Power T&D Systems

This Workshop summary has been prepared on July 2nd, 2013 by Helfried Brunner, Austrian Institute of Technology supporting the Operating Agent for ISGAN Annex 6 Power T&D (Carl Ohlen, STRI)

*Wikipedia: Massively Multiplayer Online Role-Playing Game

1 Workshop scope and agenda

1.1 Background

On behalf of Michael Hübner, Austrian Federal Ministry for Transport, Innovation and Technology and Carl Ohlen, ISGAN Annex 6, Power Transmission and Distribution Systems and the Salzburg AG, a workshop on MMORPG* for Power Transmission and Distribution Interaction was organized in association with the Austrian Smart Grid Week 2013 in May in Salzburg.

The planned rapid growth of both distributed and large scale wind and solar power generation will require a “smarter” and more powerful transmission and distribution system, which are able to host the increasing share of renewable energy resources as well as active consumers and new market players. New and old players will have different roles in the power system both when it comes to commercial and technical interaction. There is a need to further discuss who is doing what in real time and planning ahead.

Currently at almost all network levels individual solutions and approaches for network operation and planning are under development. From an overall system point of view there is still a lack on experiences and solutions for the interaction of new control and planning approaches as well as new market players at different voltage levels in particular between transmission and distribution level.

1.2 Objective

Aim of the workshop was to discuss the future interaction of distribution and transmission network interconnection requirements, controls and policies. In session 1 the focus was on the differences as well as the synergies of harmonized requirements for network interconnection of generation units. The requirements are strongly influencing the future active integration of generators and consumers in network operation via different control concepts. In session 2 the interaction of distribution system and transmission network level has been discussed. How a future smart distribution network including different controls (i.e. voltage control concepts, reactive power management, and demand response) is going to influence the transmission network operation and vice versa.

Finally in session 3 the design of new roles in future electricity MMORPG (i.e. aggregators, flexibility operators) and the interaction of those new market players were presented. The focus was on discussing the interaction as well as the integration of those new players at different voltage levels in policy and regulation.

1.3 Workshop program

Programme Monday May 13:

09:00 Welcome : Opening and objectives of the Workshop, Michael Hübner, BMVIT, Austria and Carl Ohlen, STRI, Operating Agent IEA ISGAN Annex 6

09:10 Presentation of IEA ISGAN Annex 6 and the results of the previous ISGAN Annex 6 Workshop in Milan, Carl Ohlen, Operating Agent Annex 6

09:30 Presentation of earlier results within IEA ENARD Annex 2 activities on distribution networks, Helfried Brunner, former IEA ENARD Annex 2 operating agent

Session 1: Network interconnection requirements at different voltage levels

09:40 Transmission network interconnection requirements and expectations from the distribution networks: ENTSO-E (Michel Bena, RTE)

10:05 Overview of international distribution grid interconnection requirements, Benoit Bletterie, Austrian Institute of Technology

10:30 Discussion on transmission and distribution interconnection requirements

11:00 Break

Session 2: Interaction of transmission and distribution controls

11:30 Smart Grid Gotland, Johan Soderbom, Vattenfall

11:55 Intelligent Substation, Michel Bena, RTE

12:20 Pacific Northwest project in USA. Ronald Belton, PNNL

12:45 Panel discussion on transmission and distribution controls interaction

13:15 Lunch Break

Session 3 Transmission and Distribution Policy – Design of new roles in a Smart Grid and Interaction of new players at distribution and transmission level

14:30 Consumer integration, Ludwig Karg B.A.U.M.

14:55 EcoGrid Project, Example of Demand Response, Kjetil Uhlen, SINTEF

15:20 Balancing and Reserve Services from distribution and transmission level – EU Project eBadge, Christoph Gutschi, cyberGRID

15:45 Discussion of new roles and the interaction of new player in the electricity system

Closing Remarks

16:15 Workshop conclusion and closing remarks, Helfried Brunner and Michael Hübner

16:30 End of Workshop

2 Workshop Summary

In the beautiful city of Salzburg around 35 international experts from 8 different countries (including USA and Korea) joint the Annex 6 workshop on power transmission and distribution interaction within the Austrian Smart Grid Week 2013.

After a short summary of the ISGAN Annex 6 as well as the former IEA ENARD (Electricity Networks Analysis, Research and Development) Annex 2 (DER system integration in distribution networks), Michel Bena (RTE on behalf of ENTSO-E) presented the current discussions concerning network codes and the interfaces with DSOs. In particular two initiatives were highlighted:

- Requirements for Generators (RfG)
- Demand Connection Code (DCC)

Both codes are recommended by ACER for the EC to be adopted urgently as binding European rules. Additionally he presented the ENTSO-E Research and Development Roadmap¹. One out of 6 innovation targets addressed in the roadmap is focusing on Joint TSO/DSO R&D. It was discussed that network codes are crucial tools to ensure Europe's ambitious energy goals.

Benoit Bletterie (Austrian Institute of Technology) gave an overview of international distribution grid interconnection requirements (overview of selected countries). Currently there is no EU-wide regulation on DER grid connection. The fundamental differences are in terms of scope, objectives, area of application and detailing of content. The latest trends on DER interconnections, mainly resulting in additional service provision by DER, are the following:

- Specification of a normal operating range
 - for voltage
 - for frequency
- Reactive power provision
 - reactive power management
 - voltage control purpose
- Active power management
 - power reduction to avoid congestions (system security)
 - Power reduction in case of over frequency (droop)
- Fault Ride Through
 - Stay online instead of "disconnect at first sign of trouble"
 - Active network support by injection of reactive power

Following issues were addressed in the discussion round:

- Currently mainly two approaches can be observed: decentralized solutions versus centralized solutions
- Harmonization of grid codes is required in a global market
- More demonstration activities are needed in order to gain experiences how DER can provide system services

One of the possible new roles in future markets can be an independent aggregator (e.g. for demand response). So far the role of an independent aggregator is not successful in Europe. Mainly the utilities are responsible for portfolio management and pooling.

¹ <https://www.entsoe.eu/about-entso-e/working-committees/research-and-development/entso-e-rd-roadmap/>

In session 2 the focus was on the technical interaction of transmission and distribution networks. Most of the projects are focussing on the individual system level. Johan Söderbom presented different measures from Vattenfall in the smart grid evolution and the on-going Smart Grid Gotland project in particular. In the recent years there was a clear focus towards customer centric view. In Gotland it is shown how new technology can improve power quality in a rural grid areas with large quantities of installed wind power. One goal is to make it possible for customers to actively participate on the electricity market in order to create flexibility.

Ronald Melton (PNNL) presented the Pacific Northwest Smart Grid demonstration project in the United States. 13 different activities have been funded for a 5 year period in 5 different states. In total 60.000 metered customers are involved. Aim is to develop communications and control infrastructure using incentive signals to engage responsive assets to facilitate integration of wind and other renewables. The costs and benefits will be quantified and the results will contribute to standards development. The concept of transactive nodes was introduced: A transactive node includes an agent of sorts (i.e., a computer and its software applications) that orchestrates each transactive node's responsibilities to economically balance energy, incentivize energy consumption or generation, activate its own responsive generation and/or load resources and to exchange both transactive incentive signals (TIS) and transactive feedback signals (TFS) with each of its neighboring transactive nodes. The concept was presented with the example of local electric vehicle charging.

Michel Bena (RTE, France) presented the concept of an intelligent substation supporting the energy transition, system resilience, and integration of new actors (in particular renewable resources integration). From 2013 to 2016 two substations will be equipped with latest primary technologies, control command systems and ICT. Enhanced communication between TSO and DSO will be tested and evaluated.

In general it was shown and discussed that no critical mass of projects focussing on DSO-TSO interaction is available so far. One critical issue is the necessary time for setting up field tests and demonstration activities on transmission and distribution interface level as well as the related costs.

In session 3 new roles in the electricity system were presented and discussed. The focus was on the future role of electricity consumers. Ludwig Karg (B.A.U.M consult) presented experiences regarding consumer integration gained within the German e-energy program. Electricity saving in the amount of 10% can be reached by dynamic tariffs (in enterprises up to 20%). The main reason for flexible tariffs is to adjust the load curves via flexibility. So far flexible operation of generation works better than flexible operation of loads. On distribution system level differences in grid topologies and different challenges within these grids require specialized solutions. Urban and rural networks have to be addressed differently. It was highlighted that human beings behave differently according to the social background (referring to Maslow). The main message was: "It is all about people".

Kjetil Uhlen presented the EcoGrid project located on the island of Bornholm. The EcoGrid EU concept meets the increasing need for balancing services in order to integrate a high share of RES. ICT systems and innovative real time market solutions are introduced too enable small consumers to offer TSOs additional and more efficient balancing services (in the time frame of minutes to seconds). 2000 participating customers in the demonstration are expected to be recruited.

Christoph Gutschi (cyberGRID, Austria) gave an overview about the future role of VPPs in Europe. An advanced ICT solution, provided by cyberGRID, matches up a variety of distributed generation resources with demand response capabilities (industrial and commercial) and aggregates those resources into a clean energy asset that acts like a conventional peaking power plant. Virtual Power Plants can be deployed on a GW-scale at utility level. Possible applications of VPP are: Energy markets, capacity/reserve markets, grid services and customer relations. Within the EU project eBADGE an optimal pan-European intelligent balancing mechanism is going to be designed and piloted on the borders of Austria, Italy and Slovenia. The mechanism is also able to integrate

Virtual Power Plant Systems that can assist in the management of the electricity transmission and distribution grids in an optimized, controlled and secure manner.

Following topics and issues have been raised in the discussion round: On distribution system level it seems that in future DSOs more and more act like TSOs. This is an evolutionary process. Nevertheless a harmonization between TSO and DSO on a national level is required. Concerning the interaction between TSO, DSO and consumer there will be a change from a unidirectional relationship towards a bidirectional relationship. For TSO – DSO interaction and service provision from DER currently no market for inertia and reactive power is available. In general the current markets are not suitable to give incentives for service provision. Additionally it is still an open question whether it will be market based or mandatory in future.



Figure 1: Workshop location

At the end of the workshop, among the panellist and the participants, the top issues of importance, which need to be solves for Smart Transmission and Distribution interaction have been identified. Most of the issues need to be accompanied by a mind shift:

- How to optimize the entire system (What is the objective function?)
- Integrated modelling of the dynamics in transmission and distribution (e.g. inertia, reactive power)
- Provision of inertia (technically)
- Create a price on ancillary services
- Increased flexibility
- Resources for peak load (especially with high EV penetration)
- Forecast information sharing between transmission and distribution level
- Information and communication technologies at both levels and the interfaces
- Long term back-up. How much do we need and what can be provided at distribution system level?
- How can we become future ready?

The issues will be considered in the further work of IEA ISGAN Annex 6.

For further details the individual workshop presentations are available on the IEA ISGAN Annex 6 website.