DISCUSSION MEETING

Group **C6** (Distribution Systems and Dispersed Generation)

Thursday 28th August 2014

SUMMARY

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Preferential Subject 1: Planning of distribution networks with high penetration of DER and new loads

The morning session with 20 prepared presentations answering 14 questions was structured with three subtopics to discuss important issues that were identified in the paper contributions for this session:

- Subtopic 1 – Planning (Papers C6-104, C6-106 and C6-105)
- Subtopic 2 – Load and generation models (Papers C6-102, C6-103)
- Subtopic 3 – Operation of distribution systems (Papers C6-101, C6-107, C6-109 and C6-110)

Important conclusions from the discussions are:

1. The integration of operation models into planning tools is fundamental for a proper design of active and smart distribution systems. It was clearly stated the need of managing uncertainties and the difficulties caused by the application of probabilistic methods. Solutions have been proposed to reduce the computational burden based on engineering/practical considerations.

2. Planning models require high-level load and generation modelling. The use of big data techniques to extract significant information for planning studies is still a fascinating and challenging open field for research and practical applications.

3. Input data and load/generator/storage models have to be carefully chosen according to time scales of planning/simulation studies. The importance of avoiding complex models is emphasised; simple models need to be applied only when and where it is necessary.

4. New load models are necessary with plug-in electric vehicles and fast recharge stations. Novel load profiles have been presented for fast charging and wireless charging. During the discussion, it emerged the strict correlation between traffic models and charging load profile.

5. Integrated, multi-energy, multi-services planning is fundamental in the field of smart cities. Examples of integrated operation models applied to real cases have been proposed that showed both the importance of integration and the burden of computation time.

6. Demand Side Integration (DSI) and Active Demand have to be included in planning. DSI might be useful for power system operation as the reduction of demand and the increase of Renewable Energy Sources (RES) are creating new issues to distribution systems and to the entire power systems. Scenario analysis are necessary to take into due consideration the reduction of demand in long term planning.

7. Interesting analysis of communications systems have been provided. The use of Power Line Carriers (PLC) in harmonic polluted LV systems was clarified and a classification of the communication system for voltage regulation was provided with reference to voltage regulation in Japan. It also emerged that wireless systems might be used, but the position and the number of antennas has to be carefully chosen.

8. The relationship between TSO and DSO at the planning/operation stage was analysed. An interesting "cellular model" for distribution system capable to make the DSO responsible for spinning and non spinning reserve in small independent cells has been proposed. The transfer of functions from TSO to DSO still requires regulatory and legislative actions.

Preferential Subject 2: Operation and control of active distribution networks

PS2 deals with:

- Voltage estimation and supervision using AMIs
- Novel methods for operation and control of distribution networks with high share of Dispersed Generation (DG)
- Energy storage and Electric Vehicles (EV)
- System interconnection requirements/standards for DG
- Wireless communication for protection

This session was structured around three subtopics:
- Subtopic 1 – Novel methods for operation and control of distribution networks (Question Q2-1 to Q2-5, 17 contributions, for 10 papers)
- Subtopic 2 – Energy Storage and electric vehicles (Question Q2-6 to Q2-8, 4 contributions, for 6 papers)
- Subtopic 3 – System interconnection requirements and radio communication for protection (Question Q2-9 to Q2-10, 2 contribution, for 2 papers)

Some of the highlights of the sub-topic-wise discussions with a number of spontaneous contributions are described in the following paragraphs.

Sub Topic 1 – Novel methods for operation and control of distribution networks

The state estimation especially in the Low Voltage distribution system is not usually furnished with a number of measurements and control devices. However, some successful cases were introduced in which the comparative results between measurement data at the secondary substation and the state-estimation algorithm by Power Flow and State Estimation by JAVA and MATLAB (PRICE GEN Project, Spain), are shown to be quite encouraging. Also the smart meter data based voltage estimation in low voltage was reported with an error ratio of 0.08% (Japan). (Q2-1)

The data collection method used for automatic meter readings, the communication bandwidth and the data collection interval are main concerns when smart meters are introduced and developed. As a concrete example, mobile phone, wireless multi-hop and PLC were selected as communication methods between substations and smart meters according to area's circumstance. (Q2-2)

A large penetration of renewable energy sources such as PV systems may lead to voltage fluctuation depending on the weather conditions. To keep voltage level appropriately, tap-changer transformers are mainly used at MV/LV networks (feeders). In specific cases, the partition of LV line by introducing small capacity transformers, the reactive power/active power control using controllable resources such as BES, EV and so on, are introduced. (Q2-3)

As the intermittency of RES is likely to have significant effect on the distribution networks, the prediction technology can enhance the performance of the network operation. Smoothing effects of short time and long term variation from the measured data of solar irradiance and the forecasting irradiance using weather forecasting model with GSM data are shown to be effective. (Q2-4)

The reconfiguration of the distribution network sections with sectionalizing switches is one of the solutions to manage the distribution network with a large penetration of RES. The shifting of the point of sectionalizing in secure operation, EV charging management by market incentives during congestion, or shedding off customers loads in emergency as dealing overloading of distribution line, are shown to be some application examples. In addition, it is shown that the reconfiguration can enhance the flexibility and expected life span of storage system. (Q2-5)

2.2 Sub Topic 2 - Energy Storage and electric vehicles

Low Carbon Technology such as integration of RES and EV to the distribution networks is a major concern all over the world. On the other hand, this may have effects on the power quality.

A large number of EVs are expected to spread rapidly worldwide. Therefore, the charging schedules might be determined with a statistical view applying smart meter data combined with various energy management strategies such as the rapid-charger allocation and vehicle

management. A homogeneous distribution of charging processes during the night is probably going to be quite effective to reduce the peak-load. (Q2-7)

Sub Topic 3 – System interconnection requirements and radio communication for protection

The standardization of system interconnection requirements including the communication between different smart devices, is quite important for realizing the efficient operation and control of the active distribution networks with a large share of DGs. Especially the issues regarding the standardization of power system protection relays need to be identified/addressed, and the standards considering the environmental impact due to the increased DG penetration need to be reviewed. (Q2-9, Q2-10)

Preferential Subject 3: New roles and services of distribution systems for transmission system operation

Few papers were relevant for PS 3, but, the discussion has been really interesting and profitable addressing three main topics:

- Provisioning of ancillary services from DG and RES
- Reactive power regulation between TSO and DSO
- Data exchanges between TSO and DSO to operate the "active grid"

The most advanced experiences in the new roles and services provision have been in place in Germany and Italy due to the high presence of DG at MV and LV levels. However, the issue is debated all around the world.

The fluctuation of the DG output poses new challenges for the system's security, which today is assured by the TSOs' dispatching of energy. Some regulations started to ask in the connection codes or operational rules new requirements (e.g. support during over-frequency transients, P-f regulation, Q/V support, etc.) in order to contribute to the power system's security. But this is no more sufficient in high penetration scenario of DG on MV and LV networks.

The discussion also focused on what features must be provided, without any economic recognition, from DGs due to "technical requirements" and what could be provided as a "service" based on a market scheme.

Market schemes definition is still to be addressed and some pilot project in the EU context may help in the evaluation of the economic convenience of the transactions. The matter needs further specific investigation.

Another important issue is relevant to the actors (TSO, DSO, aggregators, DGs, etc), their responsibilities and the assurance of the requested service (e.g. entity of DG output reduction, Q regulation/flexibility, etc.).

Due to the complexity of the matter, which involves technical, economic and regulatory competencies, it has been proposed to further investigate the subject in future C6 Sessions and WGs.