DISCUSSION MEETING

SUMMARY

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

Tuesday 28th August 2012

Chairman: Nikos Hatziargyriou (Greece)
Secretary: Christine Schwaegerl (Germany)

Special Reporters:
Geza Joos (PS1. Planning and operation of active distribution networks including Dispersed Generation (DG), Storage and Demand Side Integration (DSI))
Joao A. Pecas Lopes (PS2. Integration of Electric Vehicles (EV) in power systems)
Joseph Maire (PS3. Electricity supply of rural and remote areas including islands)

Preferential Subject 1: Planning and operation of active distribution networks including dispersed generation, storage and demand side integration

The PS1 session (8h45 – 12h45, and 14h00 – 15h30) was structured around three subtopics, dealing with subjects discussed in the 17 paper contributions. A total of 38 written contributions were submitted to 23 questions posted. Some of the highlights of the discussions include:

a) *Active distribution networks – general considerations, implementation, operational issues, smart meter deployment – Question Q1.1 to 1.8*, 18 contributions, for 6 papers

The issues of accountability, responsibility, and reliability and security of the supply were raised in relation to the reliability calculations for distributed generation, modelled using information related to equipment failure rates and forecasting tools (in response to contributions under question Q1.1).

Cost-benefit analyses of Volt/Var regulation business cases have been carried out in a number of implementations. In the case of one utility, the results were used to successfully argue for a rate increase filed with the energy regulator (Q1.3).

The issue of whether voltage regulation by distributed generation should be allowed or has been implemented was discussed. It was pointed out that standards, such as IEEE 1547 and utility grid codes in general do not allow for this. However, there are discussions on its feasibility, as reflected by addenda to standards such as the addendum IEEE 1547.8, and by studies and pilot projects in industry and researcher centres (Q1.4).

Regarding the suitability of developing standards for the specification of smart meters, it was pointed out that such standards do not exist at this time, and that utilities usually draw up specifications based on their needs and operating practices. It was suggested that standards may be desirable if the functions of smart meters are extended and data is used in multiple contexts (Q1.5).

In response to the issue of the use of smart meter data as an input in the management of the power grid at the transmission level (Q1.6), it was argued that the information could be used in applications such as frequency regulation, monitoring solar panel production, and in implementing aggregator services.

New or enhanced functionalities of smart meters could include uses in fault detection, identifying commercial losses, identifying congested corridors and predicting and forecasting load profiles. Regarding the 15 year horizon, it was indicated that smart meters could be used to monitor new devices, such as power electronic interfaces. The issue of privacy and security of the data was raised (Q1.7).

Regarding demand response, the Green Button initiative (EPRI-USA implementation, DOE sponsorship) was mentioned as an initiative, supported by 70 utilities, to involve consumers in load management. It was indicated that the data is available, in a standardized format, to, among others, aggregators. Other issues raised included the need to increase customer awareness and the use of dynamic tariffs. Limitations on the use of smart meter data by transmission system operators (TSO) were pointed out (Q1.8).

b) Active distribution networks – modelling requirements, data and standards – 5 questions, 7 contributions – Q1.9 to 1.13, 7 contributions – 4 papers

The importance of cost-benefit considerations in implementing smart grid technologies was discussed. It was indicated that EPRI has published a study and methodology to help make a business case and quantify costs and benefits. A similar initiative is being carried out in Europe. Some of the difficulties in making a business case were pointed out, including the justification for the large investment required and the issue of benefit allocation. Many of the smart grid deployments have occurred because of financial incentives, stimulus packages, and funding of demonstration projects by governments. It was indicated that in some cases, the projects have had limited business justification for the customer, but a case could be made from the utility perspective (Q1.10).

Real time simulators are being used in a number of distributed generator integration studies. The necessity of including information and communication technologies was pointed out, given such operating characteristics as latency and synchronization, which may impact operation. These may be included in the simulation packages. The need in some cases to include energy management and demand side management was indicated (Q1.13).

c) Managing a high penetration of distributed energy resources, including storage, electric vehicles and demand response – Q1.14 to 1.23, 13 contributions – 7 papers

Distributed generation is increasingly being monitored by distribution system operators. It is pointed out by some operators that distributed generators smaller than 1 MW are usually not monitored. In addition, distributed generation is not at this time integrated into the base load generation (Q1.14).

Storage is being promoted for a number of applications, including, among others, making renewable generation less variable, and for peak shaving. It is pointed out that there is a need for standardized models for storage devices, given that the large spectrum of available devices and options makes a comparative evaluation difficult. It was mentioned that concentrated storage (at the substation level, for example), rather than distributed storage, was more efficient, and that storage was expensive. It was argued that grid expansion was more cost effective. Other issues addressed included the need to involve regulators in the management of storage, and that storage should include thermal storage in addition to electrical storage (Q1.16).

Regarding customer involvement in demand management, it was pointed out that people are difficult to convince and interest in the process, particularly over time It was argued that some of the solutions include large time of the day price differentials, and clear market signals and messages to consumers (Q1.17).

Distributed generators could provide ancillary services such as voltage and frequency regulation. It is pointed out that in general at this time utility grid codes and standards, such as IEEE 1547, do not allow implementation of such functions, because of issues related, among others, to islanding and islanded operation. However, codes are evolving to allow distributed generation to actively participate in system support, for example through low voltage ride through requirements. In the context of a high penetration of distributed generation, this generation may be required to provide these and other ancillary services (Q1.18).

On the subject of electricity pricing signals as a means of implementing demand response, the issue of voluntary participation, as proposed, on a trial basis, in some jurisdictions, as opposed to automatic mechanisms, to which customers may adhere if they wish, was discussed. The question of the feasibility of price adjustments during the day, as opposed to set day-ahead price posting was judged too complicated for the customer to handle (Q1.21).

The issue of power curtailment of renewable generation as a solution to handle an excess of generation was the subject of much debate. It was argued that independent wind plant operators were willing to curtail their production voluntarily, if asked, given that the impact on the overall energy produced was limited (about 2 to 5 % was mentioned, as a maximum), and that this curtailment may only be rarely requested. It was pointed out that the amount of curtailment depends to some extent on the level of penetration of wind and on other system issues, such as congestion. Others argued that power producers should be compensated for lost revenue, and such a measure was implemented in some jurisdictions. It was pointed out that some wind turbine generators, even if not producing power, can still supply ancillary services, such as a contribution to primary frequency response, for which there is a market and financial compensation (Q1.22).

Preferential Subject 2: Integration of EV in Power Systems

Six papers dealing with EV grid integration are presented under the scope of this Preferential Subject. The main issues addressed were dealing mainly with:

a) EV and SmartGrid /MicroGrid simultaneous deployment, together with renewable energy increase, leading to the identification of enabling technologies and advanced control approaches.
b) Identification of changes in the operation of the system that are needed in order to mitigate impacts due to a large deployment of EVs.
c) Identification of standardisation requirements on EV charging infrastructure.
d) Location of metering devices for EVs (onboard versus at charging points).
e) The need to assure interoperability for high power charging scenarios to facilitate the introduction of EVs.
f) Define specification for the design of future energy supply systems for fast charging of the vehicle batteries while avoiding solicitations of the local distribution system.

Seven questions were developed as a basis for discussion under these headings. Important discussions based on 9 prepared contributions, during the session are summarized below. Some spontaneous contributions appeared also during discussion.

Important conclusions from these discussions are:

1. It is most important to identify control and management solutions to mitigate the negative impacts that EV may bring to power system operation. Specific tools are needed to evaluate system impacts and risks due to the presence of EV as well as perform cost benefit analysis. Most critical problems due to the increased penetration of EV are expected to take place at distribution grids, particularly at LV networks.

2. Aggregators are new players that will manage EV integration in terms of market participation. A strong interaction between Aggregators and DSOs needs to be established in the future in order to validate the charging profiles that Aggregators will manage and that will been settled in electricity markets during daily operation. Under this framework the definition of the flux of information and the communication protocols need to be defined.

3. EV loads are premium consumers that expect to charge their batteries whenever they need, without any limitations from the grid. However flexibility of the EV battery charging and the fact that the prices of electricity may be different from period to period will make EV consumers to adhere to controlled charging solutions.

4. Designing EV solution along AMI development by grid or utility companies will increase interoperability as EV charging is standardised on the same basis as electricity distribution. As smart grids initiatives generally are led by the power distribution entity, standardisation of implementation processes, equipment and systems will be easier. It was then suggested that fixed meter will be a more integrated (with power grid) solution, easier to implement and that provides more cost effective solutions. In this case meters can also serve as interfaces that will help managing the provision of ancillary services from EVs. This will allow also increased interoperability.

5. Forecast of the charging profiles, such that they include the mobility profiles, are crucial to fully integrate electric vehicles into the electric grid. This forecast should be able to deal with geographical locations of these charging profiles, since it may be witnessed a big difference from region to region. This task would be assigned to Aggregators.

6. Standardization on communication solutions between EV and the Aggregators / DSOs and standardization of charging infrastructures, like charging points, needs to be further developed. European EV manufacturers, standardisation bodies and governance all support the adoption of the international standards being developed, namely IEC 61851. Additional effort needs to be developed, together with standardization bodies, in order to make the standards capable to respond to the advanced needs that the adoption of a smart grids paradigm requires, namely in what concerns flexible management of EV battery charging.

7. In order to manage effectively the integration of EV on distribution grids, communication requirements with EVs need to become more effective, namely regarding reliability and latency.

8. The fundamental information to optimize the EV charging process should be provided by the EV together with the power system operator. Willingness to allow a controlled battery charging, battery SOC, starting and parking times should be provided by EV. Forecasts of the renewable generation and information on the current and foreseen situation of the power system should be provided by the DSO and can then be exploited by the management system to charge batteries from EVs.

Preferential Subject 3: Electricity supply of rural and remote areas including islands

6 papers have been received coming from Australia, China, Germany, Greece, New Zealand, Spain. Most of authors are affiliated to utilities but some contributions came also from research centers, universities and manufacturers.

As an introduction to the discussion, it is underlined that one common driver of all this papers is the economy in rural and remote area. This situation opens opportunities for new solutions or innovation and eases the apparition of real business model for them. Another common driver is sustainability with ambitious goals as far as the renewable are concerned. Also, technical problems are increased by the absence of strong link with others systems.

The first question was about diesel role in such systems: cheap, robust, flexible to some extent, easy to maintain, it appears to still be there for a while… but its impact on environment as to be reduced. Two main ways appear: the use of bio fuel or the association with renewable energy sources. In such isolated places, some of them are already competitive taking into account the cost of fuel and its transport. The easiness of this exercise depends on the characteristics of those alternative sources and mainly on their predictability and intermittency. Sources such as hydro, geothermal,… are easier to cope with than wind or sun and are generally preferred when available.

It naturally introduces the second question on the ways to compensate the insufficient flexibility of diesel generators in front of wind and solar production rough intermittency while keeping the stability of the system. Beyond curtailment or energy dissipation (for instance through resistive frequency controller), the use of a battery system is generally needed (BESS) and several examples shows that its control has reached an industrial level and is properly working. Nevertheless, the sizing of this expensive storage device re-opens the discussion on the limits of operation acceptable by diesel engines to spare their life time. An interesting alternative might be the Diesel UPS that is increasing the permanent rotating inertia of the system and might help to reduce the diesel share without endangering the stability of the system. But in that field, the return of experience is still light.

The third question was dealing about efforts to optimize the sizing of components and operations rules to reduce the energy spilled in case of an high penetration of renewable intermittent energy. The important factor is to keep a reasonably balance in the production mix while improving on line operation thanks to real time monitoring, improved production forecast, load control when available (using flexibility of big customer first), and in the future power storage using the different available technologies as soon as they will be cost effective ready in a multi functional approach. Of course, size of the systems matters: with wide systems, geographical dispersion of intermittent production is possible limiting common mode in the production intermittency.

The last question was about the use of Stand Alone Power System as an alternative to renewing remote rural distribution lines as described in paper. The approach is rather new. Its acceptance by local authority and regulation is generally very much related to its business model that should be attractive compared to the cost of refurbishment and maintenance of the line (tree management, …) with the same (or even enhanced) quality of service for the final customer.