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SPECIFIC WORK GUIDE ON "DISTRIBUTED GENERATION"

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1. Introduction

We will begin by introducing the concept of Distributed Generation (DG) orDecentralized Energy, which has gained so much momentum in the past few years. DG consists of generating electricity near the points of consumption (even at the very point of consumption). It is the counterpart to centralized generation which is currently the prevailing way on the conventional networks, and which is based on largeelectric power plants, normally far away from the centers of consumption.

In reality, DG is not a new concept, since Edison in his conception of the first distribution grid conceived it as a distributed network, withgeneration units in every building. What happened is that this grid was conceived in direct current, and after alternating current, medium- and high-tension transformers and transport won the battle, the DG idea was dropped.

But it has reappeared in recent years due to the need for greater generating power and the saturation of the current transport and distribution networks. Moreover,

theoutbreak of large-scale renewable energies and the increase in environmental awareness strengthen the idea of DG. In principle, DG includes any form of generation (and accumulation) of electrical energy, but acquires special interest when dealing with generation by renewable energies.

There are numerous advantages to distributed generation and they cover different focuses, just as it is shown, for example, in the report by theEuropean Renewable Energy Council (EREC) of Greenpeace International, called “Energy [R]evolution, a Sustainable World Energy Outlook”, where you can read: “Sustainable decentralized energy systems produce fewer carbon emissions, are cheaper and involve less dependence on imported fuel. They also create more jobs and empower local communities. Decentralized systems are safer and more efficient.”

With regards to constraints, it also has them, perhaps the most important one being the great inertia of the current centralized network, with its already established mechanisms little agile to incorporate new forms of flexible generations like DG.

2. Micro-generation

The generation units in the case of DG are normally much smaller than the centralized generation units. However, even within that smaller size, the distributed generation units can be classified by size, with everything from large generation centers in the range of MW units to several hundred MW, as for example such developed sectors nowadays as the currentwind parks or photovoltaic power stations, to very small producers, typically of less than 100 kW, which is known as micro-generation, now in the launch phase above all in certain countries.

This range of generation includes (or is scheduled to include in the more or less near future): photovoltaic generation, fuel cells … and wind power generation which, to differentiate it from "large wind power", that of the parks, it is often called "micro wind power".This range of power is especially associated with self-consumption, the

possibility of the consumerproducing *in situ* part of the energy that he himself consumes.

3. Developed countries and developing countries

Although DG is proposed nowadays above all in developed countries, its use in developing countries seems equallydesirable. Universal access to energy (one of the millennium's aims) observes diverse levels of electrification: in developing countries, they vary from a level of pre-electrification in isolated homes, to electrification through centralized networks of different qualities; but let's now analyze what the energy access model is like which we use in developed countries. The energy access which we enjoy is unlimited; obviously it is not, but we use it as if it were. The only limitation is the money it costs us, not the availability of energy. Therefore, there is too large of an abyss between the "developed" model and the "developing" model.

On the one hand, the quality of the energy supply in developing countries must improve more and more, towards the parameters in terms of quality of the supply which are handled in the developed countries. And this must be done using systems which include renewable energies together with concepts of energy efficiency, so that the environmental effect is not disastrous.

On the other hand, in the developing countries awareness must grow (it is already doing so, but it must do so much more) that the current energy model cannot last, either with regards to the forms of energy generation or regarding the levels of energy consumption. The application of thisconsciousnessmust lead to stabilization and reduction of energy consumption and to introduce more and more renewable generation. The implementation of large quantities of non-concentrated renewable generationin large power stations takes us to the concept of distributed generation, which is such a current issue nowadays.

4. Smart grids

The meeting point between both models would thus appear on the boundary of both situations posed, which is none other than that ofgeneration systems with the ability

for self-management, even to the point of working non-interconnected, which has been called*Smart grids*). In the case of developing countries it would come from below; that's to say, from small consumerswithout consumer habits and without electricity distribution networks, it would reach the possibility of very different non-interconnected systems according to the population, consumption, etc. Although some of these systems already exist, the cost of development which must be invested in them so that they can be competitive and reliable is so great, that it is truly hard to carry out. In developed countries, by contrast, the meeting point would be reached of generation systems able to run non-interconnected from above; that's to say, starting with large already existing centralized grids, which through the connection of large quantities of renewable generation, through a change in the management and running of the network, through improvements in the control of the generation and electric parameters, one would reach the capacity to separate sections of the grid and manage them independently, thus becoming non-interconnected systems if the operation of the network so requires. Of course, the size of these systems would depend on the population hub to power and on consumption. The difference with regards to the cost of development in order to carry out this transformation, which of course will be huge, is that it is bearable and justifiable in the developed world.

The great benefit is that this is a model exportable to the rest of the planet, regardless of thehost country's economic power.

5. 100% Renewable

Is it possible for this to happen? In light of the current situation, it is certainly hard to envision that this process could be carried out; but there are indicators which make us think that it is not so implausible. There are regions in some developed countries which are now considering production of 100% of consumed energy from renewable sources; this is not exactly the case that is posed (which would be closer to seeking 100% in power, which is more sophisticated technically), but it is a big first step towards it. One especially interesting case to study is that of islands, particularly appropriate systems to apply this model to. Some islands (of a certain size) are already known to be considering electrification using only renewable energies. Furthermore,

the increase in renewable power connectedto the gridis imposing more and more technical requirements on generation in order to improve its reliability and flexibility. This is also a necessary step to reach the model. The concept of a smart grid which is currently being so promoted is theembryo of a model like the one described. Therefore, the changes which are taking place in the large distribution networks nowadays are pointing in the direction of the described model even though they obviously don't know it.

6. Bibliography

- Guía Básica de la Generación Distribuida (Basic Guide for Distributed Generation). Community of Madrid.2007.http://www.madrid.org/bvirtual/BVCM005776.pdf
- Smart Grids y la evolución de la red eléctrica (Smart Grids and the Evolution of the Electric Grid). Industrial Observatory of the Electronic and ICT Sector. 2011. http://www.minetad.gob.es/industria/observatorios/SectorElectronica/Actividades/2010/Federaci%C3%B3n%20de%20Entidades%20de%20Innovaci%C3%B3n%20y%20Tecnolog%C3%ADa/SMART_GRIDS_Y_EVOLUCION_DE_LA_RED_ELECTRICA.pdf

7. Information about basic techniques, methods and material resources on Internet

- consume.fenie.es
- www.madrimasd.org
- www.energias-renovables.com
- www.futured.es

8. Suggestions and ideas about possible work and discussion themes

- Storage for Distributed Generation
- Mini-grids and Distributed Generation
- Smart Grids
- Self-Consumption and Distributed Generation

- Distributed Generation and Renewable Energies
- Distributed Generation in Spain
- Development of Distributed Generation in other countries
- Energy Systems with100% Renewable Energies