# Real Problems in Utility High Voltage Network due to Grid Connected Photovoltaic Power Generation. The experience of Endesa

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## Extended Abstract.

Photovoltaic (PV) systems require connection to a utility power grid to work effectively as energy sources. Due to the increasing demand of PV power generation in the general amount of power generation within the network grid, we observed that connection problems have occurred as a result of these installations and have become greater than ever. These problems flow to our power grid and may affect the quality parameters of our clients. In addition, a greater degree of custom engineering of the utility-PV interface and inverter's technology is to be expected as the size of PV system grows in relation to utility system capacity.

In order to avoid the increasing amount of power quality problems related to the interconnection of PV plants and our utility grid, we understand that a close study of these problems are needed. Endesa is one of the largest power companies in the world, and based in our long experience since the PV technology was born, in the connection of large PV plants to our power grids. We will discuss these issues like support of future massive implantation of this kind of technologies.

We have detected different kinds of problems associated to different types of PV installations:

Some problems are due to a dysfunction of the faulted-phase relay protection on Substations (Sub.) not originated in all cases by phase imbalance of the PV inverters. This protection operates when an open phase is detected, due to a wiring break of one of the 3 wires during normal operation. Several imbalances such as that to the relay appear but they were not imbalances. The faulted-phase relay causes the major number of interruptions and power HV lines reclosing. This behaviour is independent of technologies, topologies and manufacturer's fabrication and is present in ALL cases studied. The solution in all cases was to disconnect the relay in lines connected to PV plants except in a specific plant, where manufacturer changed the software with success. In the rest of power lines not connected to PV plants, the relay works effectively. The clue could be in the parameters (response curves and software programming) of the relay when is connected to PV plants. This can be a future line of investigation for manufacturer's engineering

Other problems are related to an abnormal stationary (resonant) state of generation just after islanding of the plant, where frequency and amplitude of the power signal are in a corrupted stable state caused by the inverters. Some inverters use this technique to switch off the installation when islanding. This islanding effect is not regulated properly by all PV plants. Fortunately, its influence in the general amount of generation and quality values of Endesa power grid is currently negligible.

The final problem to be discussed is related to switch-on sequencing and associated starting inverter's problems due to harmonics generation. We discovered a surprisingly conclusion. Initially, we could expect that harmonics generation of the PV plants, especially in the switch-on and switch-off processes when generation power is under 20% of nominal power and the harmonics has its greater values, causes great harmful effects to our power grid, but we observed that do not show several problems to Endesa power grid in normal conditions.
As final conclusion, inverter is the most important element in a PV plant, observing quality parameters and signal balance. Taking into account that inverters are only a very small part in the high economic inversion of this kind of plants, it is not recommended the use of cheap or not well-tested models. Furthermore, a more specific legal and technical regulation by International Organizations and Governments of these equipments will be welcome in order to maintain the quality parameters of the utility grid.