

Simulations of a possible configuration of Premium Power Park

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Abstract

The voltage dip and the sudden electrical energy interruption are, probably, the most important disturbances of the power quality in the electrical system. In order to increase the reliability of a power distribution system, there are traditional methods of solving power quality problems (for example replacing overhead lines by underground cable, installing current limiters or with neutral system compensation) but also the Custom Power (CUSPO), devices based on power electronic technology able to mitigate the network perturbations and the loads impact on the grid.

These equipments can be used by a single sensitive customer but also by an industrial or commercial office park that need a “premium” quality performance; this concept is the guideline for Premium Power Park (PPP). The basic concept of a Premium Power Park is to ensure better power supply quality level than the standard one offered by the distribution system and also diversified levels depending on customers’ needs, thanks the use of different kind of Custom Power devices.

Starting from the analysis of typical sensitive loads and CUSPO requirements, ERSE, in the frame of the Research Fund for the Italian Electrical System, has studied a possible configuration of Premium Power Park. The main results of this study are an increased knowledge on the combined operation of Custom Power devices in a PPP and a general methodology to approach the design of this kind of “premium networks”.

This paper describes the Premium Power Park (PPP) studied by ERSE.

The PPP is just an approach to a premium power system to study the combined operation and the interactions of a Static Transfer Switch (STS), a Dynamic Voltage Restorer (DVR) and a Distribution Static Compensator (D-STATCOM) in close electrical proximity.

Starting from the investigation of the typical CUSPO devices operation and of their interactions with sensitive loads, a possible configuration of PPP for a MV distribution network with different Power Quality levels has been defined. In particular, in the PPP two different quality levels are provided: one where the interruptions and the voltage dips compensation is granted by the STS and an other one where the voltage dips compensation is granted by the DVR. The depth of the compensated dip depends on DVR design and on its coordinated operation

with the STS, which ensures interruptions compensation too.

Furthermore a D-STATCOM ensures the compensation of the voltage variations due to disturbing loads.

The study has been conducted with the following steps:

- pre-design and characterization/modelling of the single devices and loads with simulations to understand their behaviour;
- devices control system definition and criteria development for the detection of voltage disturbance affecting line-to-line network voltages;
- simulations of the whole Premium Power Park in order to investigate the combined operation of the devices to ensure the defined power quality levels during network and load disturbances.

The system response to different power disturbances has been simulated in ATPdraw (Alternative Transient Program).

The model developed by ERSE provided an adequate basis for a general methodology to study the theoretical design of a Premium Power Park based on Custom Power devices.

Key words

Premium Power Park, Power Quality, Static Transfer Switch, Dynamic Voltage Restorer, Distribution STATCOM