ELECTRA REX

A Researcher Exchange Programme for Smart Grids

European Liaison on Electricity Committed Towards long-term Research Activity Integrated Research Programme

DETERMINATION AND VALIDATION OF A PROTECTION SCHEME WITH DISTRIBUTED INTELLIGENT ELECTRONIC DEVICES FOR THE WEB-OF-CELLS

M. Valov

Fraunhofer IWES, Koenigstor 59, 34119 Kassel, (*Germany*)

In the light of flexibility and unpredictability of a new grid concept, so called Web-of-Cells, adaptive protection systems become an important issue. In this context, the work performed during the ELECTRA Researcher Exchange Programme outlined an approach for determining and validating an adaptive protection system where a protection scheme using distributed intelligent electronic devices (IED) was proposed. The determination and validation of the protection scheme was performed in the simulation software DIgSILENT PowerFactory for an illustrative example of a medium voltage cell with distributed energy resources based on the CIGRÉ European medium voltage benchmark network. A scheme of protection units widely used today in the medium voltage level of distribution systems was taken as a basis and advanced with the implementation of an adaptive functionality. The adaptivity of the protection system was based on an assumed centralized supervisory control termed as "Cell Central Controller" (CCC) and pre-defined setting groups between which can be switched according to the cell operating state. The CCC as well as its communication with the IEDs was represented by a programmed script in the used software. Its functionality enclosed the estimation of the cell's short-circuit level and the automatically adaptation of the IED settings in order to match with this level. The setting groups of IEDs' overcurrent units were pre-calculated and coordinated based on a short-circuit analysis for different short-circuit levels. For the recording of these setting groups an additional function unit was created in the used IED relay model that enabled the adaptive functionality.

The validation of the proposed protection scheme combined an analysis of the necessity for adaptive protection and an examination of selective fault isolation by the IEDs with adapted protection settings according to different cell operation conditions. The results showed that the CCC represented by a programmed script enabled a proper automatic adaption of IED settings according to the short-circuit level within the cell. The proposed protection scheme with its adaptive capability indicated an appropriate response and selectivity in case of disturbed grid conditions coping with different cell operating states.

Figure 1: The exchange activity was performed at TECNALIA (Bilbao, Spain) through the engagement of J. Merino and J. E. Rodríguez Seco

ACKNOWLEDGMENT

The research leading to these results has received funding from the European Union Seventh Framework Programme ([FP7/2007-2013] under grant agreement n°609687 (ELECTRA project), as part of the ELECTRA REX Researcher Exchange Programme.