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The Effect of Distributed Generation in Distribution Network on Coordination of Protective Devices

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Abstract – *DGs are being introduced to power systems to secure the electric power supply. The increasing penetration of DG added to the distribution power system creates new technical and economic challenges. It would be essential to inquire into many issues involving these challenges. In connection with physical integration, protection is one significant subject of those challenges. In this paper, the interconnection of DG units with power systems from protection point of view is discussed. The overcurrent protection of radial line using fuses and autoreclosers before and after merging a DG source is examined. Simulation is accomplished in PSCAD/EMTDC. Since there is not any component in PSCAD/EMTDC to depict the fuse or recloser, two models are designed for simulating the operation of both fuse and recloser. These models can be utilized for any other implementation. Simulations are carried out in detail to study the effect of DG integration to the system from the prospective of protection devices coordination. Also, the suitability of the classical protection for the system after DG integration is examined. This study demonstrates that coordination among fuses and reclosers in a distribution system can be interrupted with substantial penetration of DG. The impact of DG on protective device coordination is sensitive to distribution system formation, DG place and size.*

Keywords: *Distribution Network, Distributed Generation, Protection, Recloser and Fuse Coordination*

Nomenclature

Re	Recloser
Fu	Fuse
L	Load
T	Transformer
F	Fault
f	frequency
TCC	Time Current Curves
V	Voltage
I	Current

I. Introduction

Rising public awareness for environmental protection, increasing energy consumption, lack of power generation, steady growth in power deregulation and utility restructuring lead to increasing usage of DG systems. DG systems installed near load centers due to tight constraints imposed on the construction of new transmission lines for long-power transmission [1].

DG has many explanations because it is a new trend in electric power system. Generally speaking, it can be defined as "the development of small, modular electric generation close to the point of consumption" [2].

DG is currently attracting both distribution utilities and electricity users.

DG can provide meaningful advantages for not only its owner, but also the utility to which it is connected. The advantages of DG are of both engineering and economic viewpoints. The advantageous applications of DG can be summarized as follows: backup generation, loss reduction, power quality improvement, grid expansion postponement, environmental concerns, peak load service, rural and remote application, combined heat and power generation, and financial and trading purposes [3]-[6].

The increasing penetration of DG in the power system creates new challenges and problems for network operators. It will be essential to investigate many issues involving technical, economic and regulatory problems.

Integration of DG in distribution networks may impact the network protection system [7]-[16]. The overall problem when integrating DG in existing networks is that distribution systems is a unidirectional system from the central generation downstream to the consumer. The conventional protection systems were designed in common Medium Voltage (MV) and Low Voltage level (LV) distribution networks for a passive paradigm, i.e. no generation are expected in the distribution network. For future distribution system, the networks get active and the conventional protection turns out to be unsuitable [7]. As a result, the additional fault current supplied by DG can cause relays to under-reach or overreach.

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