Model-Based Adaptive Protection Scheme for Isolated Microgrids

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Introduction

Isolated microgrids have received much attention in recent years due to their ability for electrifying zones typically disconnected from the main grid. Among the most important challenges of isolated microgrids is the **design and operation of the protection scheme**, in order to recognize system **abnormalities** and **faults.**

AC low voltage isolated microgrid in Huatacondo, Chile

Problem Statement

It is necessary to **rethink** protection schemes to adequately respond to the requirements of isolated microgrids.

Features of isolated microgrids

- Absence of the interconnected system
- Intensive use of inverter-based DGs
- Variability of the renewable energy sources

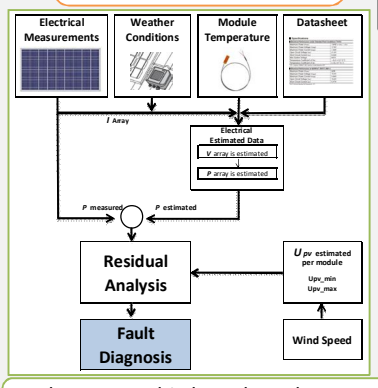
With these features fault currents will have the following behavior:

DC-Side: ***i)*** location and impedance fault; ***ii)*** weather conditions; ***iii)*** arrangement and configurations of devices.

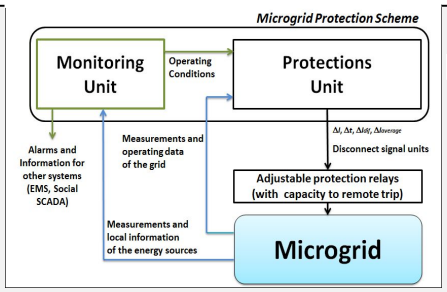
AC-Side: ***i)*** Low level limited by power electronics; ***ii)*** bidirectional flows may occur; ***iii)*** similar values along the grid; ***iv)*** depends on DG´s operating conditions.

Proposal

PV Plant Monitoring Unit



The proposed method combines monitoring with protection strategies in an **Adaptive Protection Scheme** in order to coordinate the response of the protections accordingly.



Protections Unit

Functions:

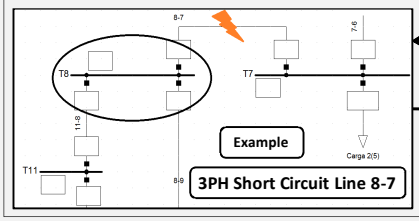
i) Adjust the protective relays deployed in the microgrid (overcurrent, directional and differential relays).

ii) Disconnect equipment if thresholds are exceeded.

The proposal is based on the use of ***digital protection relays***, which have the potential of using several settings groups. The settings will be updated online as changes occur, to ensure operation with: ***sensitivity, selectivity and speed.***

Case Study: An example

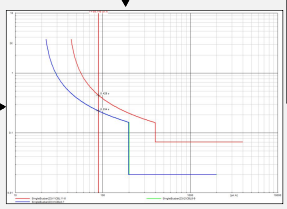
This methodology is being implemented in the **ESUSCON Microgrid** in Huatacondo

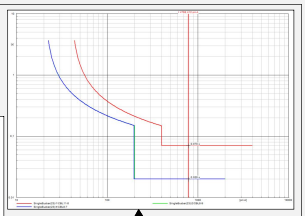


Currently, the microgrid has a protection system based on **circuit breakers** with fixed setting for overload and short circuit protections.

PV Plant includes **fuses** in the DC-side for the protection of the modules.

PV Plant + BESS (ON):
Short circuit current (RMS): 114 A
Fault clearing time: 0.234 s





Diesel Generator + BESS (ON):
Short circuit current (RMS): 798 A
Fault clearing time: 0.020 s

Conclusions

This poster presents a method for monitoring and diagnosis of PV plant based on a model as part of an adaptive protection scheme designed for isolated grids. The experimental results showed that the proposed method is effective to diagnose the PV plant of an isolated grid. Finally, the analysis of the microgrid showed the need for an adaptive protection scheme.

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