Effect Analysis of Electric Vehicle Charging to Smart Grid with Anti-Islanding Method

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Abstract. In this paper, we present a smart grid monitoring system connected with electric vehicle charging system using anti-islanding method. The monitoring system was implemented in Local Area Monitor Module and it communicates with end modules wirelessly using Zigbee protocols. The charging of electric vehicles can be remotely controlled by the presented monitoring system more efficiently and more conveniently. It is shown by some experiments that the presented smart grid monitoring system provide useful information with electric power to electric vehicles while detecting anti-islanding in the smart grid.

Keywords: Electric Vehicles, Smart Grid, Anti-Islanding, Electric Vehicle charging.

1 Introduction

Traditional energy solutions cause unrecoverable damages to nature i.e., fossil fuel releases CO_2 in the atmosphere and nuclear power plant emits radioactive waste. Various types of vehicles are being actively developed which use electric energy in part or fully such as hybrid vehicles, fuel cell hybrid vehicles, electric vehicles, etc. We can imagine hundreds of electric vehicles are waiting for charging from electric power suppliers in the near future. Vehicle data communication and certification process are performed between EV and EV charging systems (EVSE: Electric Vehicle Supply Equipment) usually by using wired communication like CAN (Controller Area Network) protocol and power information between smart grid and the EVSE are communicated by using wireless network protocols [1]-[3].

In this paper, we propose a smart-grid remote power monitoring system using anti-islanding method. Smart grid system is connected EVSE for remote control of EV charging. Wired and wireless communication protocols are effectively used in the smart grid between devices including EVs. The basic communication between the smart grid and the EVSE use the ZigBee technology since it has low power requirements and a simple configuration and the EVSE communicates with EV using CAN protocol. The efficiency of this smart grid monitoring system was tested on an experimental system using HILS (Hardware-In-the-Loop-Simulation) of EV and EVSE.

2 Remote Monitoring System and HILS-based Experimentation

The block diagram of the proposed RMS is as shown in Figure 1 which is applied to a micro-grid. It consists of several different components, such as an End Monitor Module (EM), a Local Area Monitor Module (LAM), a Wide Area Monitor Module (WAM), and client devices.

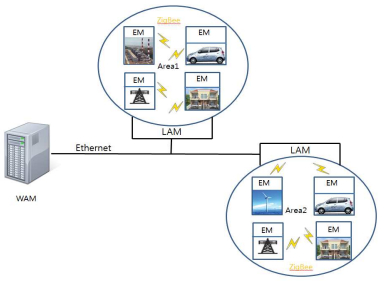

Fig. 1. The block diagram of the RMS.

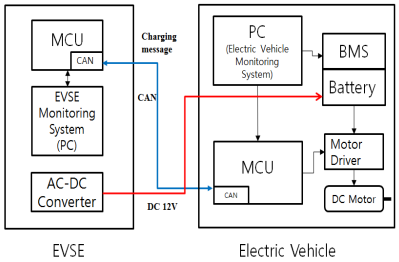

Fig. 2. HILS of EV and EVSE.

HILS developed for EV charging is composed of EVSE and EV. EVSE connected to smart grid having anti-islanding method, it is using smart grid power for EV charging. Because smart grid having Anti-islanding method, we can be expected EV charging to safety. The structure of the developed HILS is shown in Fig. 2.

Existing islanding detection methods have some problems. First, due to the conversion of the generator output signal to an arbitrary signal, the power quality is reduced. Second, existing anti-islanding methods have a NDZ (Non-Detect Zero) problem. Therefore, in this paper, to secure the above problems, EV charging through linking with smart grid having Anti-islanding method is proceeding smoothly and reliably seems to come true.

We can analyze the status of the distributed generator systems based on these waveforms and data. In addition, The EV charge using the power of the smart grid should proceed. Smart grid was use the normal household AC power for EV charge. EV charging status information can be seen of Using EV monitoring system. HILS miniature and monitoring system is shown in Fig. 3.

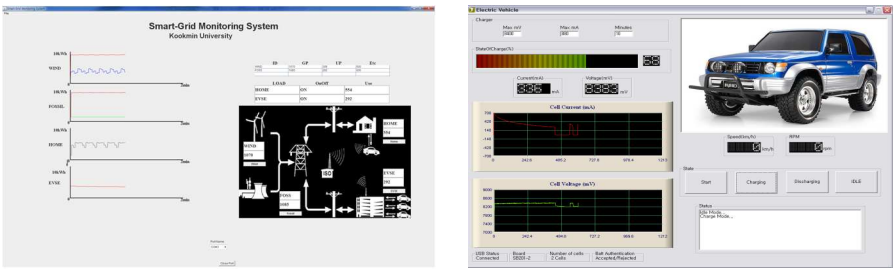

Fig. 3. The experimental End Monitor Modules and the LAM monitor program.

Experimental setup is consists of two sensor nodes and LAM. One of LAM is EVSE. EV and EVSE charging connection has been progress. EVSE by connecting one of the LAM was charge in progress. We can check the charge process of during charging of EV from monitoring system. Sensor node using the smart grid monitoring system has solved the problem. The LAM get guarantees a short cut-off time to prevent islanding in less than 1 second. The result of experiment is shown in Figure 5. Figure 5 shows the detecting time of islanding and the status of EV charging voltage. If islanding occurred, EV charging voltage is a little drop down while replaced EM.

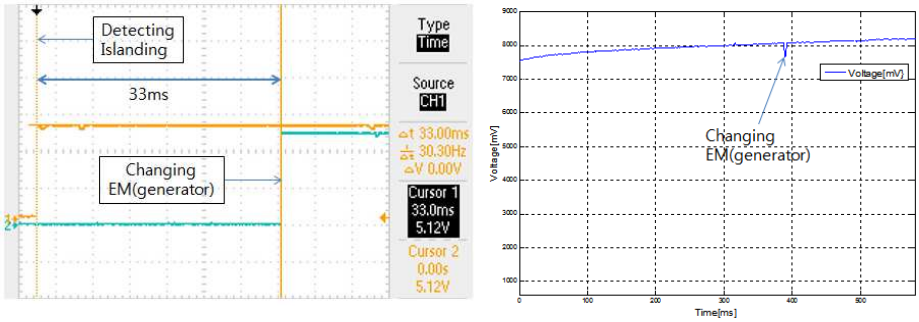

Fig. 4. The Detecting time of islanding and EV charging voltage at occurred islanding

3 Conclusions

This paper presented the smart grid monitoring system with islanding detection method using a sensor network. The smart grid system consists of a WAM, LAMs and EMs. It was illustrated that the presented monitoring system can detect islanding and redirect power flow to another power source within tolerance time.

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