CHAPTER I

INTRODUCTION

1.1 Motivation

Demands of clean energy, high reliability and power quality for sensitive loads force the demand of distributed resources to increase. Replying to the global warming and energy security, applications of distributed generation (DG) such as solar or wind powers have been extensively promoted, and are currently attracting not only distribution utilities, but also electricity users. Increasing powers from distributed generations could decrease the investment of the system upgrade. On the other hand, an addition of DG such as grid-connected photovoltaic (GCPV) systems will increase the fault current which may not have been previously envisioned in the system. As a result, the interrupting capability and setting of protective devices will also be influenced by this additional fault current contribution. Impacts on protection coordination in the presence of fault current contribution from GCPV have to be evaluated.

1.2 Research Objectives

The objectives of this research are described as follows:

1. To model grid-connected photovoltaic (GCPV).
2. To analyze fault current contribution with and without DG installation.
3. To compare the fault current level between GCPV and synchronous generator (SG)
4. To evaluate impacts on protection coordination in the presence of fault current contribution from GCPV and SG.

1.3 Scope of Study

The scope of this research can be summarized as follows:

1. To model grid-connected photovoltaic (GCPV) systems containing

photovoltaic array, boost converter with maximum power point tracking (MPPT), and PWM inverter with voltage regulator. The model will be implemented using MATLAB-SIMULINK, and also verified with the actual measurements.

2. To analyze fault current contribution with and without DG installation by simulation in MATLAB-SIMULINK. Firstly, the GCPV systems or SG are connected to some buses in the system. Then, various fault positions are assumed. Finally, fault current comparison between the GCPV systems and SG installation in the system is analyzed and discussed.

3. To evaluate impacts on protection coordination in the presence of fault current contribution based on IEEE standard inverse-time characteristic equations for overcurrent relay, IEEE Std C37.112-1996.

1.4 Research Methodology

1. Literature reviews on background knowledge relevant to photovoltaic model, power electronic components and controls in GCPV systems, synchronous generator, fault current analysis, and protection relaying standard.
2. Modeling the photovoltaic system.
3. Verifying photovoltaic model with actual measurements.
4. System testing by connecting GCPV systems and SG with a test system using MATLAB-SIMULINK.
5. Assuming various fault positions to assess the fault current contribution from the GCPV systems and SG to the main grid.
6. Analyzing the fault current comparison between GCPV systems and SG installation in the system.
7. Considering impacts on protection coordination in the presence of fault current contribution based on IEEE Std C37.112-1996.

1.5 Research Outcomes

This research can be expected some benefits as follows:

The model of grid-connected photovoltaic systems using MATLAB-SIMULINK will be available and verified. Researchers who want to conduct on the photovoltaic research can take this model as the reference. Understand impacts on fault current and protection coordination in the presence of GCPV systems. This would lead to proper protective device setting and measures.