

Combined Operation of Unified Power-Quality Conditioner With Distributed Generation

B. Han, *Senior Member, IEEE*, B. Bae, H. Kim, and S. Baek

Abstract—This paper describes analysis results of a combined operation of the unified power quality conditioner with the distributed generation. The proposed system consists of a series inverter, a shunt inverter, and a distributed generator connected in the dc link through rectifier. The proposed system can compensate voltage sag and swell, voltage interruption, harmonics, and reactive power in both interconnected mode and islanding mode. The performance of proposed system was analyzed using simulations with power system computer aided design/electromagnetic transients dc analysis program, and experimental results with the hardware prototype. The proposed system can improve the power quality at the point of installation on power distribution systems or industrial power systems.

Index Terms—Distributed generation (DG), power system computer-aided design/electromagnetic transients dc analysis program (PSCAD/EMTDC), unified power-quality conditioner (UPQC).

I. INTRODUCTION

UNIFIED power-quality control was widely studied by many researchers as an ultimate method to improve power quality [1]–[5]. The function of unified power-quality conditioner (UPQC) is to mitigate the disturbance that affects the performance of the critical load. The UPQC, which has two inverters that share one dc link capacitor, can compensate the voltage sag and swell, the harmonic current and voltage, and control the power flow and voltage stability. However, UPQC cannot compensate the voltage interruption because it has no energy storage in the dc link.

The interest in distributed generation (DG) has been increasing rapidly because DG might play an important role in the future power system [6]–[8]. DG can solve many typical problems that the conventional ac power system has. For example, an energy security problem occurs in the large-scale power system because a few transmission facilities are responsible for serving electric power to a great number of customers. This security problem caused by some transmission-line trip can be alleviated if a large number of DGs are installed in the power system. Moreover, DG can yield economic benefits, such as reducing the loss of transmission line and the cost of high-voltage equipment. However, a small DG has some significant problems of frequency and voltage variation when it

is operated in stand-alone mode. Therefore, a small DG should be interconnected with the power system in order to maintain the frequency and the voltage. Several studies proposed an interconnection system for DG with the power system through the inverter because the inverter gives versatile functions improving the ability of DG [9], [10].

This paper proposes a combined operation system of UPQC and DG, which is connected to the dc link through a rectifier. The advantage of the proposed system over the UPQC in [4] is to compensate the voltage interruption, as well as the voltage sag, voltage swell, harmonics, and reactive power. The operation of the proposed system was verified through simulations with power system computer-aided design/electromagnetic transients dc analysis program (PSCAD/EMTDC). The feasibility of hardware development was confirmed through experimental works with a prototype.

II. PROPOSED SYSTEM

Normally, UPQC has two voltage-source inverters in three-phase four-wire or three-phase three-wire configuration. One inverter called the series inverter is connected through transformers between the source and the common connection point. The other inverter called the shunt inverter is connected in parallel with the common connection point through transformers. The series inverter operates as a voltage source, while the shunt inverter operates as a current source.

UPQC has compensation capabilities for the harmonic current, the reactive power compensation, the voltage disturbances, and the power-flow control. But UPQC has no capability in compensating the voltage interruption because there is no energy storage.

This paper proposes a new configuration of UPQC that has a DG connected to the dc link through the rectifier as shown in Fig. 1. The UPQC can compensate the voltage interruption in the source, while the DG supplies power to the source and load or the load only. There are two operation modes in the proposed system. One is called the interconnected mode, in which the DG provides power to the source and the load. The other is called the islanding mode, in which the DG provides power to the load only within its power rating.

III. CONTROLLER DESIGN

The control structure of proposed system is shown in Fig. 2. Three major elements are the positive sequence detector, the series inverter control, and the shunt inverter control. The control strategy was designed for implementing the interconnected

Manuscript received July 27, 2004; revised March 14, 2005. This work was supported by the Next-Generation Power Technology Center, Myongji University, Seoul, Korea. Paper no. TPWRD-00344-2004.

B. Han, B. Bae, and S. Baek are with the Department of Electrical Engineering, Myongji University, Seoul 449-728, Korea (e-mail: erichan@mju.ac.kr; baekst@mju.ac.kr).

H. Kim is with LSIS R&D Center, LS Industrial Systems Company, Anyang 431-081, Korea (e-mail: hjkim3@lgis.com).

Digital Object Identifier 10.1109/TPWRD.2005.852843

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات