Chapter 1

Electric Power Converters

ABSTRACT

In this book, we discuss reliability in electrical energy converters. The first step is introducing these devices and recognizing their main functions as well as their importance. Electrical energy conversion systems consist of two main parts: Electrical machines and Power electronic converters. Electrical machines are used for converting electrical energy to mechanical one in the generator state and vice-versa in the motor state. To emphasize the importance of these devices, it may be noted that electrical motors consume about half of the total generated electrical energy in the world. On the other hand, power electronic converters are essential equipments which are used for electrical energy conditioning. These equipments have observed considerable growth in modern industries in recent years. Because energy conditioning allows us to use energy with higher efficiency and better performance, in this chapter, importance of electric power converters in modern industries is presented. The aim of this presentation is showing the dependence of various industrial functions to conversion of electric power. Basic relations of various electrical machines as well as power electronic converters are presented. In each section, some typical industrial examples are presented. This background will be used in the next chapters for reliability calculation and improvement. In fact, this chapter is an introduction on reasons of writing an individual book about reliability of electric power converters.

INTRODUCTION: IMPORTANCE OF RELIABLE POWER CONVERTERS

This book is about reliability in the field of power electronic converters and electrical machines which are named “electric power converters”. Why reliability? and why in electric power converters? The main goal of this chapter is clarifying the importance of the title of this book. So we start the first chapter of the book with some essential questions:

- What is the importance of reliability in the field of electric power converters?
- Why must they work reliable?
- Which parts of the world are affected if electric power converters are unreliable?

DOI: 10.4018/978-1-4666-9429-3.ch001
In this chapter, we answer to these questions by presenting enormous applications of electric power converters in modern industries. In this chapter, terms of “power converter” or “converter” mean “electric power converter” for summary. Power electronic converters and electrical machines are two main parts of electric power conversion field and consume considerable amount of energy. Regarding to the fast and wide usage of electrical energy, it is obvious that these two parts have a key role in normal operation of industries. Thus, the uninterrupted operation of these power converters is very important. Many problems in electric equipments are due to neglecting reliability considerations in design process of their power converter (Song, & Wang 2013). As a senior researcher, we saw many electric systems with unsafe operation because of lack of reliability. Unsafe operation means:

- Damaging in equipment without pre-alarm
- Consecutive shutdowns of equipment
- Interference with other devices

In this book, we talk about reliability in electrical energy converters. Therefore, the first step is introducing these devices and recognizing their main functions as well as their importance. Figure 1 shows the state of this chapter in the book.

*Figure 1. State of chapter 1 in flowchart of the book*