ELECTRICAL POWER ENGINEERING

Introduction

This trainer has been designed to provide students with a fully comprehensive knowledge in Electrical Power Engineering systems.
The trainer is composed of a set of modules for the simulation of the various subsystems forming a complete electrical power system, from power generation to energy utilization.
High voltage components have been scaled down for obvious reasons: a real 380 kV power transmission line is represented by a 380 V line in the laboratory. However, the same low voltage industrial equipment which is normally used in real systems has been used also in this laboratory, whenever this was feasible.

The trainer can be subdivided into four major study areas:

- Power Generation
- Power Transmission and Distribution
- Protection Techniques
- Energy Utilization

In the Power Generation section a two-pole alternator is investigated. A dc shunt wound machine performs the drive function. To determine some of the characteristics of the synchronous machine, the so called isolated operation situation is reproduced.
This is an operating mode in which the generator supplies only one single consumer.
Then, various synchronization circuits are assembled and the response of the machine is investigated in a constant-voltage constant-frequency system. In this situation, voltage and frequency are predetermined by the system and have constant values. Problems related to the protection of the generation are also dealt with.

In the Power Transmission and Distribution section a three-winding transformer is investigated. Then, a model of an overhead high voltage power line is used to investigate its performance characteristics under various load conditions.
Circuit configurations are connected for the demonstration of different neutral point connections in three-phase mains systems. Asymmetrical short-circuits are also simulated and reactive power compensation analyzed.

In the Protection Techniques section instrument transformers, to reduce the high current and voltage values so that they can be measured safely and economically, are studied. Then, the procedures which are most commonly used in protective technology are introduced and the most frequently used relays (under/over voltage relays, definite and inverse time over-current relays, earth-fault relays, etc.) are investigated.
Finally, over-voltage, under-voltage and earth fault monitoring and short-circuit protection of high voltage lines are analyzed.
Special attention is given to the issue of protection of the generation, of the transmission and of transformers.

In the Energy Utilization section the problems related to reactive power compensation are discussed as well as the methods and the equipment relevant to measuring the electrical energy in ac current and in three-phase networks: active and reactive energy induction meters and maximum demand meters.