CHAPTER 3

LOAD MODEL DEVELOPMENT

In this chapter, general approaches to load model development are presented. They are measurement-based method and component-based method. The models used in this work and assumptions are also described.

3.1 Basic consideration

In general, two main methods for building load models [9,21] are as following :

- measurement-based method
- component-based method

The measurement-based method use measurement results to develop load models. It involves placing monitors at load buses to record active and reactive power of loads due to voltage and frequency variations.

The advantage of this method is that it can derive load model parameters directly from the measurement results. Its disadvantages are due to the cost of measurement equipment and the need to repeat the measurements when loads change.

The component-based method involves building load models from information of the combination of fundamental components (e.g. fluorescent lamps, incandescent lamps, heaters, etc.) at load buses. The purpose of this method is to develop load models without concerning field tests. However, it requires laboratory tests of load components, but these tests only have to be performed once, or one can resort to the previous published results [6].

The component-based method has the advantage of not requiring system measurements and therefore making it more convenient put into use [8].

The difficulty is how to know the composition of loads in the actual system (how many motors, lamps, etc.).

Special investigations are needed in power systems in order to find the composition of loads.

3.2 Assumptions

In this thesis, the following assumptions are made :

1. All load components are connected directly in parallel at the bus.
2. Single-phase loads are assumed to be balanced three-phase loads.
3. None of the load changes during the observed period.

3.3 Modelling methods

In this work, load models are developed based on component-based method because it is a much more practical approach [20].

To develop load models, the following requirements should be met :

- Models should have simple forms as possible.
- Models must be sufficient to represent both steady state and dynamic characteristics of loads.

As mentioned earlier, electric loads may be divided into two classes, static and rotating. Most static loads have small time constants whereas rotating loads which consist of motors can have large time constants due

to their inertias. Because of the different characteristics of the loads, it seems to be better to model them separately, and when composite loads are considered, just group them together to one equivalent model.

The model selected to represent static loads is exponential model. Previous works [1,4-7,18] have shown that this model is sufficient for representing loads. It has the simple form which can be easily put into computer programme. However, it is not easy to find the parameters of the model. Exponential model is described in detail in chapter 4.

Exponential model may be used to represent induction motor loads. However, in some cases such as when large disturbances occur, or when induction motors constitute a substantial of loads (i.e. industrial loads), the model may be insufficient to represent dynamic behavior of the loads. This is because induction motors can have non-negligible time constants.

Due to the above reason, in this work induction motors are modelled using either exponential model or induction motor model depend on suitable conditions. For example, when industrial plants are considered, motors loads should be modelled by induction motor model with the necessary differential equations. The detail of induction motor model is presented in chapter 5.