Chapter 4

Model of the reduced network for dynamic studies

4.1 Introduction

The purposes of this chapter are to provide the methodology to compose model of the reduced network for dynamic studies and to describe the computer programs for calculating the dynamic equivalent.

4.2 Methodology to compose the models

In this section the various factors will be described to compose the model of the network.

4.2.1 Definition of the studied system

The studied system of the reduced network for dynamic equivalent studies is defined as area of the system which is retained in details and the parts of the network in which fault occures. In general, the definition of the studied system will be determined by requirements of the user.

If loads are modelled as constant impedances, all load buses can be reduced, except those buses which are involved in switching operation.

On the other hand, if load models include non-linear components, a more conservative approach to defining the studied system is needed. It is necessary to retain an area which sorrounds the fault in order to avoid reducing non-linear load buses which large voltage changes. The method to tackle this problem is to divide the studied system into sub-studied systems which are roughly coherent and the tie lines between the sub-studied systems are retained. In the EGAT power system, for example, it can be suitable to reduce the power system into 6 sub-studied systems. A more accurate representation of the actual system is also retained by reducing the sub-studied systems individually. Figure 4.1 shows the example of how the overall studied may be divided up into sub-studied system.

4.2.2 Accounting for different of faults

The coherency-based equivalents can be computed to handle the different of faults location in two different ways. A separate equivalent can either be computed for each fault location, or an equivalent which is generally valid for faults in an area can be computed. An equivalent which is valid for faults in an area will tend to be larger than one which is derived for specific fault location since a greater number of coherent groups will be required. However, the computation effort which would other be required for recomputing multiple equivalent, would be reduced. The seconed way is selected for using in the tests which are described in the chapter 5.

Figure 4.1 The sub-studied system of EGAT

4.2.3 Coherent generators

An important task is to decide which generators in the studied system are coherent. The most reliable method is to perform a stability of the actual system on to compare the rotor angles of all generators, if the maximum change in angle difference falls within a specified tolerence. The coherency test may also be applied to several sets of rotor angles for various faults in order to determine an equivalent which is applicable to a range of faults. However, this method is particularly time-consuming. The other methods which used for identifying the coherent generators are described in [2,3].

There are 5 test cases of transient stability simulation of EGAT power system. The objective of the tests are to specify the coherent generators in the EGAT power system.

By the test cases, we can divide the group of generator into 6 coherent groups. The swing curves of these coherent groups are illustrated in appendix 3.

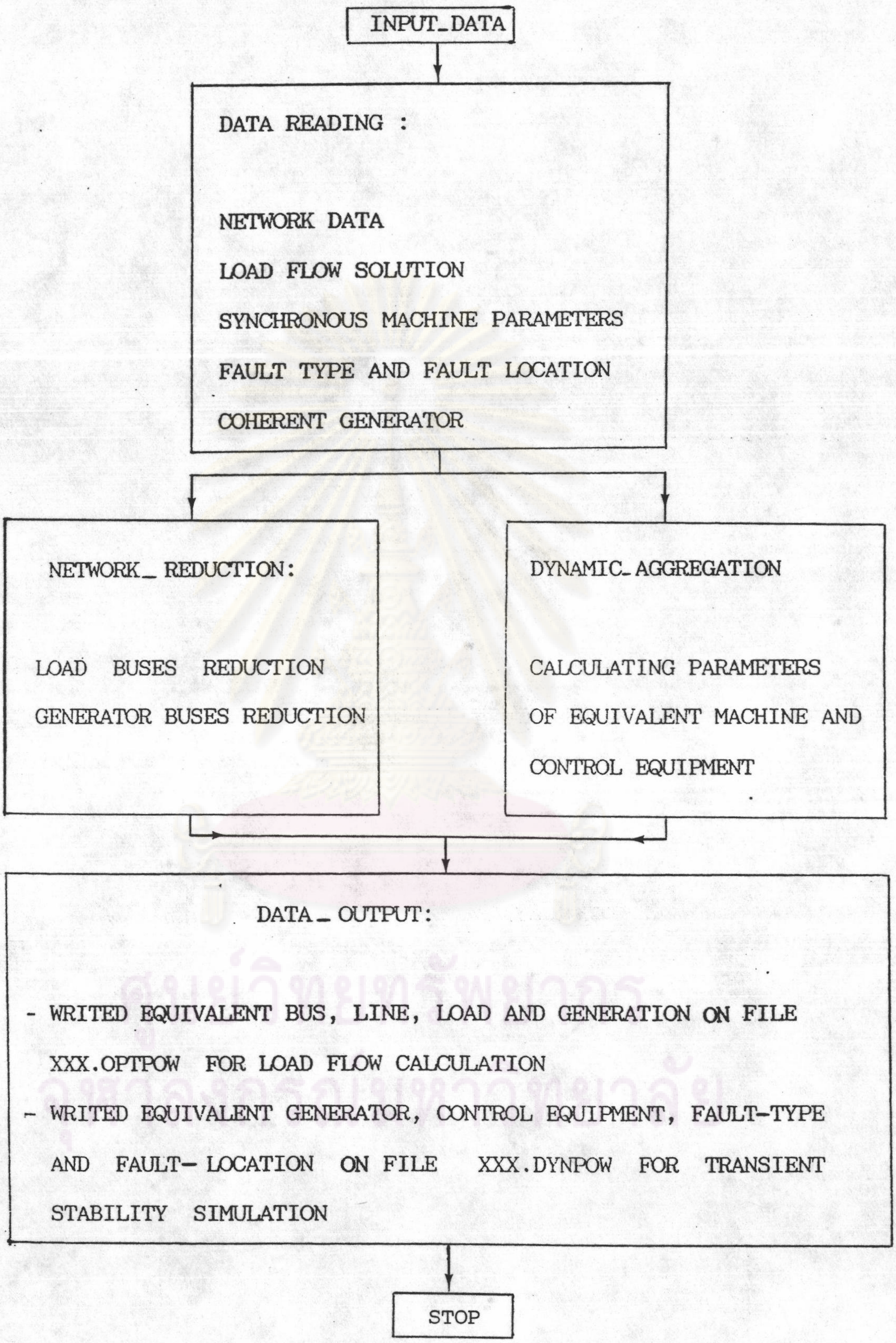
4.3 Program description

The method of calculating dynamic equivalents described here has been realised in computer programs. The programs perform the four basis steps as outlined below:

- Data_Reading : This program is used for reading the data of network, load flow solution, synchronous machine parameters, coherent group of generator, fault type and fault location

- Network_Reduction : This program is used for load buses reduction and generator buses reduction which are described in the chapter 2.
- Dynamic_Aggregation: This program is used for calculating the parameters of synchronous machine and control equipment which are described in chapter 3.
- Data_output: The output data from network reduction and dynamic aggregation are written on files by this program.

The programs are written in Fortran-77 and have been executed on a Vax-Station 2000. The source programs are given in appendix 1. Input and output **data** of these programs can be used with the SIMPOW (Power System Simulation) package. An overall flow diagram showing co-ordination of the program is shown in Figure 4.2



XXX = Job Name

Figure 4.2 Flow chart of Dynamic Equivalent Program