CHAPTER V

PROCEDURES IN PROGRAMMING

5.1. Equipment and Facilities.

The programs have been tested and the short circuit analyses of the Y.E.A. system have been done on the I.B.M. 1620 Model 1 computer installed at the Statistical Computer Centre, Chulalongkorn University. The computer contains 20,000 positions of core storage. The input and output operations of the computer are done by the console typewriter and the card read-punch machine. The machine cycle of the computer is 20 microseconds.

The processor used is the PDQ Fortran C 1 7/63. The subroutine is the PDQ free form subroutines 10/63. The PDQ subroutine consists of two parts which have to be loaded separately. The free form subroutine enables a data on a card to begin at any position in its field. There must be at least one blank spacing between two adjacent data. The first instruction statement of an object program compiled by the PDQ processor begins at address 6700.

5.2. Assumptions.

(a) Current injected into a busbar is positive.

(b) Reactive power is positive when lagging.

(c) Generation is positive.

(d) Loads and motors consume negative power.

(e) Current at one end of a branch flows from the busbar that end connected to.

(f) All groundings are solid.

(g) Fictitious node of a three-winding transformer in a zero sequence network is treated as a busbar in case of a one-phase short circuit study.

5.3. Method of Formulating Problem.

The following step-by-step procedure outlines the method of preparing a short circuit problem in a form for solution by a digital computer.

(a) Draw single-line diagrams to represent the sequence network. Only a positive network is needed in a three-phase short circuit problem.

(b) Assign numbers to busbars and branches, including generators and loads. Busbar numbers must start with 1 and proceed consecutively. Branch numbers may be any ones not exceeding three digits. For the two busbar numbers of a wye-delta transformer, the smaller number is at the wye side. The positive and negative sequence networks are numbered in the same manner; but the zero sequence network may be numbered differently. However, the branch numbers are the same in the three networks.

(c) Assume or determine from a load flow balance the active and reactive power generations which will meet the given loads and system loss, transformer tap settings and prefault voltage magnitude and angle.

(d) Fill in data sheets.

5.4. Data Preparation.

5.4.1. Types of Data.

Data to be processed by the programs may be divided into two types

(a) Primary Data.

They are the system data that are filled in various forms of sheets and manually punched on cards. They may be, according to their formats, put into four types

(i) Control data.

(ii) Branch data.

(iii) Generation and load data, and

(iv) Prefault voltage data.

(b) Secondary data.

They are those obtained from the outputs of some previous programs and punched out by the computer.

The data are:-

(i) Nodal admittance matrices.

(ii) Nodal impedance matrices.

(iii) Prefault voltages in rectangular form.

(iv) Equivalent load admittances, and

(v) Equivalent current sources and internal shunt admittances of generators.

5.4.2. Data Sheets.

Primary data should preferably be presented on a set of data sheets. Sample data sheets are shown in Appendices G-J. They are:-

(a) Master data sheets.

Each program has a master sheet on which sequence of data and control data are shown on it. Control data are fixed point numbers not exceeding three digits.

(b) Branch data sheets.

The entries of each branch data and their formats with maximum number of digits are:-

(i) Busbar number, a smaller one; three digit, fixed point.

(ii) Another busbar number, a bigger one; three digit, fixed point.

(iii) Branch number, three digit, fixed point.

(iv) Base KV of busbar in entry (i), four digit, floating point.

(v) Base KV of busbar in entry (ii), four digit, floating point.

(vi) Tap of transformer in percent, four digit, floating point. If there is neither tap setting on the transformer nor transformer in the branch, the entry is a floating point zero.

(vii) A fixed point 1 if there is a tap setting on the end connected to busbar in entry (i); otherwise the entry is a fixed point zero.

(viii) A fixed point 1 if there is a tap setting on the end connected to busbar in entry (ii), otherwise the entry is a fixed point zero.

(ix) Per unit resistance, thirteen digit, floating point.

(x) Per unit reactance, thirteen digit, floating point.

(xi) Per unit shunt susceptance, thirteen digit, floating point.

(xii) Sequence number, 1 for positive sequence, 2 for negative sequence and 3 for zero sequence. All are fixed point.

(c) Generator/Load data sheet.

The entries, with their maximum formats, of either a load or a generator are:-

(i) Busbar number, three digit, fixed point.

(ii) Generator or load number, three digit, fixed point.

(iii) Base KV of the busbar in entry (a), four digit, floating point.

(iv) Active power in MW, thirteen digit, floating point.

(v) Reactive power in MV R, thirteen digit, floating point.

(vi) Per unit generator internal resistance, thirteen digit, floating point. The entry is zero for a load.

(vii) Per unit generator internal rectance, thirteen digit, floating point. The entry is zero for a load.

(viii) Sequence number; one digit, fixed point.

(d) Prefault data sheet.

The entries of each prefault voltage are:-

(i) Busbar number, three digit, fixed point.

(ii) Per unit voltage magnitude, thirteen digit, floating point.

(iii) Argument of voltage in degrees, thirteen digit, floating point.

In filling in the data sheet, the entries of each line within the heavy lines must be completed.

5.5 Processing on the I.B.M. 1620 computer.

The program switches on the console of the computer are set according to the program to be loaded. Normally all the switches are off. For programs No. 1, No. 2, No. 3 and No. 4, switch 1 is on if outputs will be listed by the typewriter. Other switches are set according to that indicated in Chapter IV. An object deck and a subroutine deck are loaded, data are

fed in and the outputs are obtained on punched cards and/or typed paper.