CHAPTER III

LOAD FLOW STUDIES PROGRAMME

3.1 Brief description of the method to approach system solution.

Specified elements;

Line constant at nominal-ratio transformers.

Slack busbar voltage.

Generators and load values.

Limits of synchronous condenser.

Limits of voltages.

Results;

Busbar voltages.

Off-nominal ratio transformer.

Solution;

The previous system will be taken as an example.

1. At nominal-ratio transformer, the first approximation

$$\begin{bmatrix} I_{m2} \\ I_{m3} \\ I_{m4} \end{bmatrix} = \begin{bmatrix} A_{22} & A_{23} & A_{24} \\ A_{32} & A_{33} & A_{34} \\ A_{42} & A_{43} & A_{44} \end{bmatrix} \begin{bmatrix} V_2 \\ V_3 \\ V_4 \end{bmatrix}$$

Busbar voltages are found from the known I_{mn} and admittance matrix by means of matrix multiplication between I_{mn} and the impedance matrix inverted from the admittance matrix.

2. Power determined at a certain busbar is

$$S_n = I_{sn} . V_n^*$$

The variation of S_n from the defined value is

$$S_n = P_n - S_n$$

In the case of an itteration method, it can be assumed that

$$\Delta S_n = V_n^* \Delta I_n$$

Hence

$$\Delta I_n = \Delta S_n / V_n^*$$

ΔI_n is added to I_{sn}, and the final result would be

$$\begin{pmatrix} I_{m2} \\ -I_{s3} + I_{m3} \\ I_{s4} + I_{m4} \end{pmatrix} = \begin{pmatrix} A_{22} & A_{23} & A_{24} \\ A_{32} & A_{33} & A_{34} \\ A_{42} & A_{43} & A_{44} \end{pmatrix} \begin{pmatrix} V_2' \\ V_3' \\ V_4' \end{pmatrix}$$

The procedure in 1 and 2 will be repeated until the results are obtained with the required accuracy.

3. The tap of the transformers are changed to adjust the busbar voltages to be in the required limits. This tap change is performed in certain cycles of iteration, it may be performed every cycle. ΔI_A and ΔI_B are calculated and added to the current injection at their busbar every cycle of iteration.

$$\begin{pmatrix} I_{m2} \\ -I_{s2} + I_{m3} + I_B \\ I_{s5} + I_{m4} - I_A \end{pmatrix} = \begin{pmatrix} A_{22} & A_{23} & A_{24} \\ A_{32} & A_{33} & A_{34} \\ A_{42} & A_{43} & A_{44} \end{pmatrix} \begin{pmatrix} V_2'' \\ V_3'' \\ V_4'' \end{pmatrix}$$

The actual matrix used in this method is an impedance matrix, and is kept constant throughout the computation.

$$\begin{pmatrix} Z_{22} & Z_{23} & Z_{24} \\ Z_{32} & Z_{33} & Z_{34} \\ Z_{42} & Z_{43} & Z_{44} \end{pmatrix} \begin{pmatrix} I_{m2} \\ -I_{s3} + I_{m3} + I_B \\ I_{s4} + I_{m4} - I_A \end{pmatrix} = \begin{pmatrix} V_2'' \\ V_3'' \\ V_4'' \end{pmatrix}$$

Admittance matrix is used in the description because it is easier to understand the logic in nodal current form.

3.2. Load-Flow Studies Programme.

Load studies programme must be devided into 4 parts separately. The facts of this difficulty is due to the computer system used and the limitation of the computer size. It comprises of

1. Input Programme.
2. Complex Number Matrix Inversion Programme.
3. Voltage Computation Programme.
4. Output Programme.