A COMPARATIVE TECHNICAL STUDY ON LOCAL GENERATION VERSUS POWER IMPORT IN BANGLADESH PERSPECTIVES

A project submitted to the Department of Electrical and Electronic Engineering, Bangladesh University of Engineering and Technology in partial fulfillment of the requirements for the Degree of Master in Engineering (Electrical and Electronic)

by

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OCTOBER 2005

DECLARATION

This is to certify that I have done this work and it has not been submitted elsewhere for the award of any degree or diploma.

Signature of the Student

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The Project titled "A Comparative Technical Study on local Generation Versus Power Import in Bangladesh Perspectives" Submitted by Md. Abul Bashar, Roll: 100106106P; has been accepted as satisfactory in partial fulfillment of the requirements for the degree of Master in Engineering (Electrical and Electronic) on 27th October 2005.

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ABSTRACT

Electricity, the most convenient form of energy, is an indispensable ingredient for the development of a country. The per capita consumption or generation of electricity is a reliable indicator of a country's socio-economic status. From the point of view of energy usage, Bangladesh is one of the least developed countries of the world with a low per capita energy consumption.

The short as well as the long term demands for electricity in Bangladesh have made either of the two options worth consideration. These are (i) escalation in local generation of electricity using indigenous primary energy resource (i.e. gas and coal reserves) with export of the occasional surplus power to or (ii) reduction in generation with import of power from neighboring countries through regional interconnections. In this study, the BPDB (Bangladesh Power Development Board) – PGCB (Power Grid Company of Bangladesh) system with scenarios as of 2004 and 2015 (planned) are modeled. Three points of export or import are considered for Bangladesh power system under the two modes of operation. The points are Ishurdi, Thakurgaon and Sreemongal but at a time only one point is considered. A comprehensive comparison of the steady state and the dynamic performance of Bangladesh power system when local power generation is enhanced for inland consumption as well as occasional export abroad, is made with that when power is imported from neighboring countries. This research is expected to serve as decision support tools for the policy makers in Bangladesh in opting out whether to import power from the neighboring countries or locally generate utilizing the proven and potential indigenous gas and coal reserves to meet the own demand and export excess power (if any) to the neighbors.

CONTENTS

Chapter 1

INTRODUCTION

1.1 Background

In present days electrical energy has become an essential element for the development of a country in every sector. The living standard and prosperity of a nation vary directly with increase in the use of electricity. The per capita consumption of electrical energy is a reliable indicator of a country's socio-economic status. An electric power utility is committed to ensuring uninterrupted, economic and reliable supply. Generating stations, transmission lines and distribution system are the main components which when interconnected constitute what is termed a grid or a power system. In the developed countries power systems are normally organized in the form of electrically connected areas. Each area can operate independently from economic as well as technical points of view. But those are eventually interconnected with another area or neighboring country to form a super grid so that each area is contractually tied to other areas in respect of certain generation and scheduling features aimed at more economy and security.

Interconnection in developing countries generally provides potential benefits through closer co-operation on regional power transfer, resource sharing and taking advantage of the diversities in demand. This usually results in system reliability, economic efficiency in system operation, reduced environmental impact, and lower costs to consumers.

The generation system in Bangladesh is owned and operated primarily by the Bangladesh Power Development Board (BPDB). However, there is private sector participation in the generation sector by the Independent Power Producers (IPP) which own about 25% of the total installed capacity and sell electricity to the BPDB. The ownership and operating responsibility for the transmission system rest with the Power Grid Corporation of Bangladesh (PGCB). The present (2004) generation capability of BPDB and IPPs is about 4300 MW against an approximate peak demand of 3800 MW, though their combined installed capacity is about 4470 MW.

It has been projected that the peak demand [1] in Bangladesh would be of about 7600 MW by 2015 taking into account the effects of certain power sector reforms such as higher tariffs and energy conservation measures. To cater to this demand approximately 4000 MW of capacity additions are required from the end of 2004 through 2015. This can be done either through full utilization of the proven gas and coal reserves in the country or import from Nepal, Bhutan or India. Notably Nepal and Bhutan have huge untapped hydro power potentials outweighing their demands in the foreseeable future. The surplus power can be exported to India and Bangladesh. The export to Bangladesh can take place through 132kV or 230kV interconnecting transmission lines that may or may not be tapped in the intervening Indian corridor as may be agreed upon by the all concerned.

1.2 Review of Previous Work

A study [2] done by Nexant, a consultant to USAID (United states Agency for International Development) which also looks after the interests of US investors in the South Asia region) mainly focused on the economic aspects of power import by Bangladesh from neighbors i.e. Nepal and Bhutan through the Indian power system. The only technical aspect included in Nexant study was steady state performance i.e. a load flow analysis. It was not clear how it modeled the neighboring power systems from which Bangladesh would import power. Furthermore, the Nexant study completely ignored a comparison of the operational impacts [3-5] of import versus escalated local generation by Bangladesh.

1.3 Purpose and Scope of the Present Study

The main objectives and scope of the present study are as follows:

(i) To conduct an analysis of the steady state and the dynamic performance of the Bangladesh power system when local power generation is enhanced for inland consumption as well as occasional export. To this end respectively the Newton-Raphson fast decoupled load flow analysis [3, 4] and multi machine stability analysis through numerical solution of the swing equations [4] will be used.

(ii) To determine the steady state and the dynamic performance of the Bangladesh power system also when power is imported from neighboring countries.

(iii) To investigate into the use of the Thevenin's equivalent for the neighboring system at the point of interconnection with the Bangladesh system. This is because the main difficulty for such a regional system study is inaccessibility to data.

iv) To investigate into three points of export or import for the Bangladesh power system. The points are Ishurdi, Thakurgaon and Sreemongal but at a time only one point is considered. Power export/import ranging from 50 MW to 500 MW at 50 MW step is considered in this study. Such a choice is mainly based on the engineering judgment, needs, and the geographical context of Bangladesh and its neighbors. The results obtained in (i) and (ii) above will be compared with each other for the scenarios corresponding to the three points of transactions modeled as in (iii).

1.4 Thesis Organization

The presentation of the material studied in the present study is organized as follows.

Chapter 1 presents the background of this study, objectives and scope of the thesis along with the thesis organization.

Chapter 2 gives an overview of mathematical models for power flow and stability analysis used respectively to determine the steady state and the dynamic performance of a power system.

Chapter 3 presents the single line diagram, load flow and stability data of Bangladesh power system and assumes Thevenin's equivalent data for the neighboring country's system together with a justification.

Chapter 4 compares the results from load flow and stability analysis for the demand scenarios of the year 2004 as well as the year 2015 in Bangladesh considering local generation versus import.

Chapter 5 presents the main conclusion on the basis of the results and discussions in Chapter 4. Recommendations for further research work are also made in this chapter.

The appendixes provide supporting data and sample results in tabular and graphical forms.

Chapter 2

MATHMATICAL MODELS USED IN THE STUDY

2.1 Introduction

Load flow (also termed Power flow) is the study conducted to determine from a given steady operating condition (generation and load powers specified) of a system the unknown voltages and phase angles at the buses by solving a set of simultaneous quadratic equations. The main information obtained from load flow studies are flow of MW and MVAR in the network, and the bus voltage magnitudes and phase angles. These are then checked for violation against set thresholds.

Of equal concern is the need to preserve the stability of the system under abnormal conditions (e.g. a fault) when the acceleration or deceleration of a generator may result in loss of synchronism of all or a number of generators in the system. Stability is the property of a power system which ensures that it will remain in operating equilibrium in abnormal operating conditions if it is corrected or cleared in a reasonable time. There are two types of stability namely "steady state stability" and "transient stability". Small and gradual changes in load/generation constitute a problem of steady-state stability while large and sudden changes like faults pose problems of transient stability. However; the latter one i.e. transient stability deserves more concern.

The first step in the transient stability study is to develop a mathematical model of the system components which influence the electrical and mechanical torques of the synchronous machines, and hence acceleration or deceleration of the machine rotors. This model comprises a set of nonlinear differential equations called swing equations. Their solution requires the knowledge of the power transferability from each machine, and hence the network condition before, during and after the fault. In the simplest mathematical model, also termed the classical model, each synchronous machine is represented by a constant voltage source behind its transient reactance with negligible damping, and a load is represented by constant shunt admittance determined from the pre-fault load flow solution. In the classical stability study the period of interest is the first swing of the rotor angle i.e. a period of time during which the system dynamic response is dependent largely upon the kinetic energy in the rotating masses of the generators.

2.2. Power Flow Model

For a balanced three phase system the transmission network can be represented by its positive sequence network. The elements of the network are therefore not mutually coupled and hence the nodal admittance matrix Y_{BUS} can be written [4] by inspection.

$$I_{BUS} = Y_{BUS} V_{BUS} \tag{2.1}$$

Again, equation (2.1) in an expanded form is as follows.

$$I_p = \sum_{q=1}^{n} Y_{pq} V_q, \quad p = 1,2,\dots\dots, N \tag{2.2}$$

Conjugating equation (2.2) and multiplying by V_p

$$V_p I_p{}^* = S_p = V_p \sum_{q=1}^{n} Y_{pq}^* V_q^* \tag{2.3}$$

Separating into real and imaginary parts

$$P_p = R_e\left[V_p \sum_{q=1}^{n} Y_{pq}{}^* V_q{}^*\right], \quad p = 1,2,\dots\dots, N \tag{2.4}$$

$$Q_p = I_m\left[V_p \sum_{q=1}^{n} Y_{pq}{}^* V_q{}^*\right], \quad q = 1,2\dots\dots, N \tag{2.5}$$

when

$$V_p = |V_p| \angle \theta_r ; \theta_{pq} = \theta_p - \theta_q \text{ and } Y_{pq} = G_{pq} + jB_{pq}$$

Equations (2.4) and (2.5) can be expressed in terms of the polar coordinates as

$$P_p - |V_p| \sum_{q=1}^{n} ((G_{pq} \cos\theta_{pq} + B_{pq} \sin\theta_{pq})|V_q|) = 0 \tag{2.6}$$

where, p=1, 2, 3, ...N_1+N_2

q=1, 2, 3,.................................N

$$Q_p - |V_p| \sum_{q=1}^{n} ((G_{pq} \sin\theta_{pq} - B_{pq} \cos\theta_{pq})|V_q|) = 0 \tag{2.7}$$

where, p= 1, 2, ...N_2

q = 1, 2, ... N

Let X be the vector of all unknown $|V|$ and θ, and Y the vector of all specified variables. The dimension of X is $N_1 + 2N_2$ and that of Y is $2N_1 + 2N_2 + 2$ i.e.

$$X = \begin{bmatrix} \left.\begin{matrix} |V| \\ \theta \end{matrix}\right\} \begin{matrix} on \ each \\ P-Q \ node \end{matrix} \\ \left.\theta \right\} \begin{matrix} on \ each \\ P-V \ node \end{matrix} \end{bmatrix} \tag{2.8}$$

$$Y = \begin{bmatrix} \left.\begin{matrix} V_s \\ \theta_S \end{matrix}\right\} on \ slack \ node \\ \left.\begin{matrix} P_p^{sp} \\ Q_p^{pp} \end{matrix}\right\} on \ each \ P-Q \ node \\ \left.\begin{matrix} P_p^{sp} \\ |V|_p^{sp} \end{matrix}\right\} on \ each \ P-V \ node \end{bmatrix} \tag{2.9}$$

such that N_1 is number of P-V buses, N_2 is number of P-Q buses and $N=N_1+N_2+1$ is total number of buses including slack.

From the set of equations (2.6) and (2.7) a number of equations equal to the number of unknowns evolve as follows:

$$F(X)=\begin{bmatrix} Eq.(2.6) for\ each\ P-Q\ and\ P-V\ node\ with\ P_p=P_p^{sp} \\ Eq.(2.7)\ For\ each\ P-Q\ node\ with\ Q_p=Q_p^{sp} \end{bmatrix}=0 \qquad (2.10)$$

Thus there will be N_1+2N_2 equations, and this number is clearly equal to the number of unknowns in X. These equations can be written as.

$$\begin{bmatrix} \Delta P \\ \Delta Q \end{bmatrix}=0 \qquad (2.11)$$

$$\text{where, } \Delta P_p=P_p^{sp}-|V_p|\left(\sum_{q=1}^{n}(G_{pq}\cos\theta_{pq}+B_{pq}\sin\theta_{pq}\right)|V_q| \qquad (2.12)$$

where, p = 1, 2, ..., N_1+N_2

$p \neq Slack\ \ bus$

$p \neq q$, q=1,2,.....................N

$$\Delta Q_p=Q_p^{sp}-|V_p|\left(\sum_{q=1}^{n}(G_{pq}\sin\theta_{pq}-B_{pq}\cos\theta_{pq})|V_q|\right) \qquad (2.13)$$

where, p = 1, 2, ..., N_2

q = 1, 2, ..., N

$p \neq q,\ p \neq P-V\ \ node,\ p \neq Slack\ \ bus$

The linear equation appearing in each iteration K of Newton's method is given by

$$\begin{bmatrix} \Delta P \\ \Delta Q \end{bmatrix}^{(K)}=\begin{bmatrix} H & G \\ M & L \end{bmatrix}^{(K)}\begin{bmatrix} \Delta\theta \\ \dfrac{\Delta|V|}{|V|} \end{bmatrix}^{(K)} \qquad (2.14)$$

$\Delta\theta$ is the sub vector of incremental phase angles at P -Q and P - V buses and $\Delta|V|$ is the sub vector of incremental voltage magnitudes at P-Q bus. In equation.(2.14) the elements to be neglected are sub matrices G and M because these represent the weak coupling between the P - V and Q - θ variables.

The resulting linear equations then become

$$[\Delta p]^{(K)} = [H]^{(K)}[\Delta\theta]^{(K)} \tag{2.15}$$

$$[\Delta Q]^{(K)} = [L]^{(K)}\left[\frac{\Delta|V|}{|V|}\right]^{(K)} \tag{2.16}$$

where, for $p \neq q$,

$$H_{pq} = L_{pq} = |V_p||V_q|(G_{pq}\sin\theta_{pq} - B_{pq}\cos\theta_{pq}) \tag{2.17}$$

and for p = q

$$H_{PP} = -B_{PP}|V_p|^2 - Q_p \tag{2.18}$$

$$L_{pp} = -B_{PP}|V_p|^2 + Q_p \tag{2.19}$$

The decoupled model (2.15 and 2.16) can be further simplified to obtain fast decoupled version by making few physically justifiable simplifications without much loss in accuracy of solution. In practical power systems the following assumptions are valid.

$$\cos\theta_{pq} \approx 1;\ G_{pq}\sin\theta_{pp} << B_{pq}; Q_p << B_{pp}|V_p|^2 \tag{2.20}$$

With this the expressions (2.17) to (2.19) become

For $p \neq q$ $\quad H_{pq} = L_{pq} = -|V_p||V_q|B_{pq}$ (2.21)

For $p = q$ $\quad H_{pp} = L_{pp} = -B_{pp}|V_p|^2$ (2.22)

Matrices H and L are square matrices with order of $(N_1 + N_2)$ and N_2 respectively.

With this (2.15) and (2.16) become

$$[\Delta P]^{(K)} = \left[|V_p||V_q|B'_{pq}\right]\ [\Delta\theta]^{(K)} \tag{2.23}$$

$$[\Delta Q]^{(K)} = \left[|V_p||V_q|B''_{pq}\right]\left[\frac{\Delta|V|}{|V|}\right]^{(K)} \tag{2.24}$$

where, B'_{pq}, B''_{pq} are elements of bus susceptance [B] matrix.

Further refinement of the fast decoupled load flow algorithm is achieved by

(a) Omitting from $[B']$ the representation of those network elements that predominantly effect MVAR flows, i. e. shunt susceptance and off nominal in - phase transformer taps.

(b) Omitting from $[B']$ the angle shifting effects of phase shifters,

(c) Dividing each of the equations.(2.23) and (2.24) by $|V_p|$ and setting $|V_q| = 1$ p.u. in the equations, and

(d) Neglecting series resistance in calculating the elements of $[B']$.

With these modifications the final expressions for the fast decoupled load flow equation becomes

$$\left[\frac{\Delta P}{|V|}\right]^{(K)} = [B'][\Delta\theta]^{(K)} \tag{2.25}$$

$$\left[\frac{\Delta Q}{|V|}\right]^{(K)} = [B''][\Delta|V|]^{(K)} \tag{2.26}$$

Both $[B']$ and $[B'']$ are real and sparse and have structures of $[H]$ and $[L]$ respectively, and as they contain only network admittances they are constant they need to be evaluated and inverted once only at the beginning of the study.

2.3 Model for Transient Stability Analysis

The swing equation [3, 6] governs the motion of a synchronous machine (generator) rotor relating the inertia torque to the accelerating or decelerating torque i.e. the resultant of the mechanical and electrical torques on the rotor. The following equation shows this.

$$J\frac{d^2\theta_m}{dt^2} = T_m - T_e \tag{2.27}$$

where,

J: the moment of inertia in consistent unit.

θ_m : instantaneous angular position of the rotor shaft in mechanical radians with respect to a stationary reference axis on the stator.

T_m: mechanical (driving) torque in consistent unit.

T_e: electrical (load) torque in consistent unit.

Since in stability studies the rotor speed relative to the synchronous speed is of interest it is more convenient to measure the rotor angular position with respect to a reference axis, which rotates at a constant speed i.e. the synchronous speed ω_{sm} (mechanical radians/second).

$$\theta_m = \omega_{sm} t + \delta_m \tag{2.28}$$

Where δ_m is the angular displacement (in mechanical radians) of the rotor from the synchronously rotating axis. Figure 2.1 shows θ_m and δ_m relative to two reference axes.

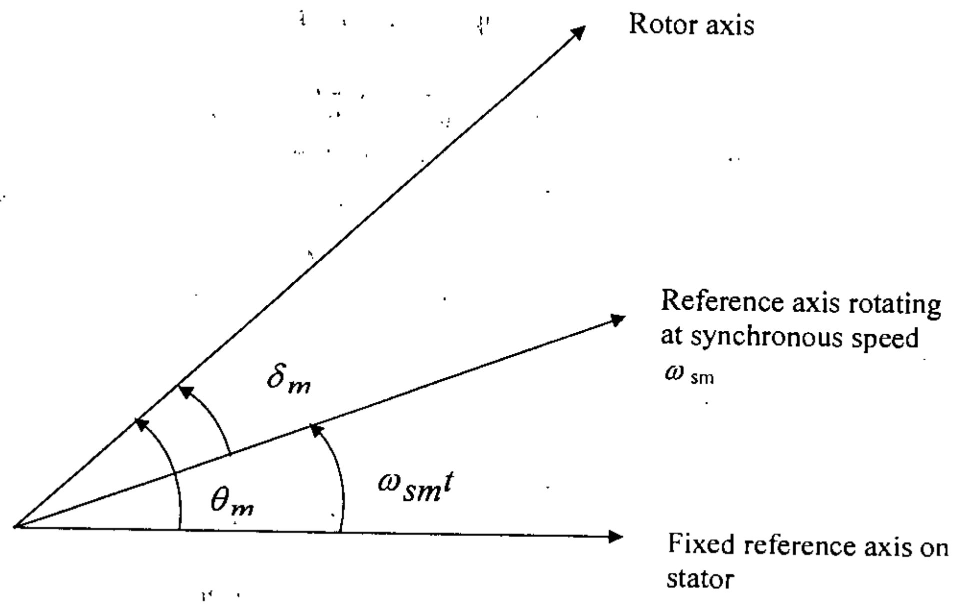

Fig 2.1 Machine rotor angle with respect to two reference axes

The derivative of equation (2.28) with respect to time is

$$\frac{d\theta_m}{dt} = \omega_{sm} + \frac{d\delta_m}{dt} \tag{2.29}$$

and

$$\frac{d^2\theta_m}{dt^2} = \frac{d^2\delta_m}{dt^2} \tag{2.30}$$

The derivative $\frac{d\theta_m}{dt}$ can be denoted as

$$\omega_m = \frac{d\theta_m}{dt} \tag{2.31}$$

The quantity ω_m (also in mechanical radians/second) differs from ω_{sm} in that while the latter denotes the synchronous angular velocity of the machine or the reference frame the former denotes the angular velocity of the rotor shaft. Also ω_m does not equal ω_{sm} under all conditions especially when the machine undergoes an oscillatory disturbance, rather differs by an amount $\omega' = d\delta_m / dt$ as in equation (2.29). This difference is insignificant or zero when the machine remains stable under a disturbance.

Substituting equation (2.30) into equation (2.27) provides

$$J\frac{d^2\delta_m}{dt^2} = T_m - T_e \tag{2.32}$$

As power equals torque times angular velocity, multiplying equation (2.32) by ω_m gives

$$J\omega_m\frac{d^2\delta_m}{dt^2} = P_m - P_e \tag{2.33}$$

where P_m is the mechanical power i.e. power supplied to the generator by the prime mover and P_e is the electrical power output of the machine when the rotational and armature losses are neglected.

In equation (2.33) J is in units of $kg-m^2$, ω_m in mechanical radians/second, P_m and P_e in watts, ω_m in mechanical radian and the product Jω_m is in unit of Joules-sec/mechanical radian. The quantity $J\omega_m$ is termed as the inertia constant M of the machine at synchronous speed ω_{sm} though ω_m differs from ω_{sm} under a disturbance. Equation (2.33) is then written as

$$M\frac{d^2\delta_m}{dt^2} = P_m - P_e \quad \text{Watts} \tag{2.34}$$

Equation (2.34) can be rewritten as follows replacing M by another constant called H_o-constant because the data on machine inertias are supplied by the manufacturers usually in the form of H_o.

$$(\frac{2H_0}{\omega_{sm}}S_{mach})\frac{d^2\delta_m}{dt^2} = P_m - P_e \text{ Watts} \tag{2.35}$$

where,

$$H_o = \frac{Stored\ kinetic\ energy\ at\ synchronous\ speed(Mega\ Joules)}{Three\ phase\ rating\ of\ machine\ (in\ MVA)}$$

or $$H_o = \frac{\frac{1}{2}j\omega^2{}_{sm}}{S_{mach}}$$

or $$H_o = \frac{\frac{1}{2}M\omega_{sm}}{S_{mach}} \quad \text{MJ-S/ mech. rad}$$

or $$M = (\frac{2H_o}{\omega_{sm}}S_{mach}) \quad MJ - S/mech.\ rad \tag{2.36}$$

when, S_{mach} is the three phase rating of the machine in MVA. Equation (2.35) can be modified as

$$\frac{2H_a}{\omega_{sm}}\frac{d^2\delta_m}{dt^2} = \frac{P_m - P_e}{S_{mach}} \quad \text{MW / MVA} \tag{2.37}$$

The right side of equation (2.37) is in second or per unit because of its normalization due to division by the machine rating i.e. a base value. If δ_m and δ_{sm} are expressed in terms of electrical radians (equal to the number of machine pole pairs times the mechanical radians) then the subscript m can be omitted resulting in the following equation, called the swing equation.

$$\frac{2H_0}{\omega_s}\frac{d^2\delta}{dt^2} = P_m - P_e \quad \text{Per unit} \tag{2.38}$$

In equation (2.38) H_0 is also in per unit because the base quantity i.e. the machine rating S_{mach} has also been used in the definition of H_0.

In the stability study of power system with multiple synchronous machines, only one MVA base common to all parts of the system is to be chosen so that the right as well as the left sides of all the swing equations, one for each machine, can be expressed in per unit on this common system base S_{system}. This requires that equation (2.37) be multiplied on each side by the ration (S_{mach} / S_{system}) so that the new per unit value of H_0-constant is given by

$$H = H_o \frac{S_{mach}}{S_{system}} \tag{2.39}$$

Then equation (2.38) becomes as follows and its right side is still in per unit but on system base S_{system}

$$\frac{2H}{\omega_s}\frac{d^2\delta}{dt^2} = P_m - P_e \tag{2.40}$$

2.3.1 Multimachine System Modeling

The electrical network [6] for an n-machine system is shown in Figure 2.2 with node 0 as the reference node (neutral). Nodes 1, 2, ...n are the internal machine buses, or the buses to which the voltages behind transient reactances E_i are applied. Passive constant impedances connect the remaining nodes (r) to the reference at load buses. The initial values of $\bar{E}_1$ $\bar{E}_2$ ------------ $\bar{E}_n$ are determined from the pre-transient conditions. The magnitudes E_i, i = 1, 2 ....n are held constant during the transient in classical stability studies.

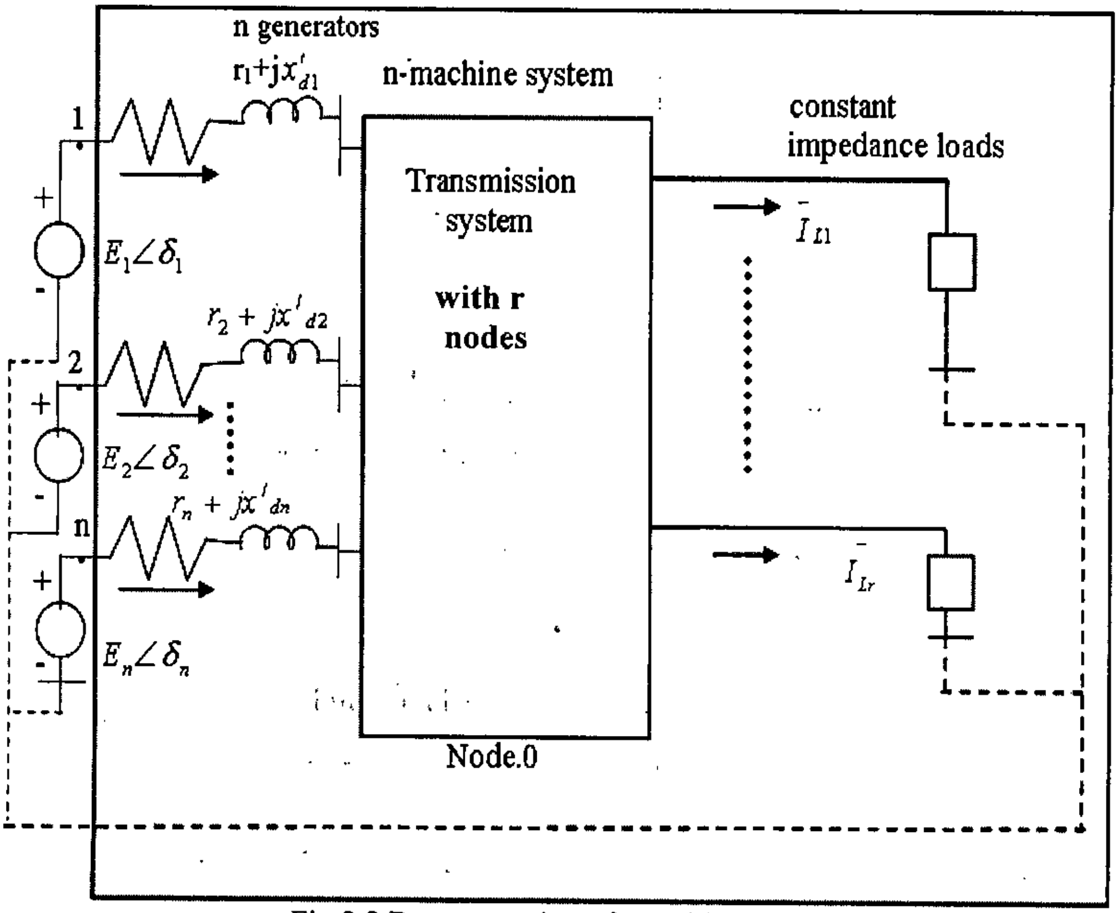

Fig 2.2 Representation of a multimachine system

The electrical network shown in Figure 2.2 has n nodes with active sources. The admittance matrix of the n-port network, looking into the network from the terminals of the generators is defined by

$$[I] = [Y]\,[E] \tag{2.41}$$

where, [Y] has the diagonal elements $\bar{Y}_{ii}$ and the off-diagonal elements $\bar{Y}_{ij}$. By definition,

$$\bar{Y}_{ii} = Y_{ii}\angle\theta_{ii} = \text{Driving point admittance for node i}$$

$$= G_{ii} + jB_{ii}$$

$$\bar{Y}_{ij} = Y_{ij}\angle\theta_{ij} = \text{Negative of the transfer admittance between nodes i and j}$$

$$= G_{ij} + jB_{ij} \tag{2.42}$$

The power into the network at node i, which is the electrical power output of machine i, is given by

$$P_{ei} = \text{Re}\left(\bar{E}_i \bar{I}_i^*\right)$$

$$P_{ei} = E^2{}_i G_{ii} + \sum_{\substack{j=1 \\ j\neq i}}^{n} E_i E_j Y_{ij} \cos(\theta_{ij} - \delta_i + \delta_j), \quad i = 1,2 \ldots\ldots\ldots\ldots n$$

$$= E^2{}_i G_{ii} + \sum_{\substack{j=1 \\ j\neq i}}^{n} E_i E_j [B_{ij} \sin(\delta_i - \delta_j)] + G_{ij} \cos(\delta_i - \delta_j)]$$

$$i = 1, 2, \ldots\ldots\ldots\ldots\ldots\ldots\ldots n \tag{2. 43}$$

The swing equation (2.40) for each machine is then given by

$$\frac{2H_i}{\omega_s}\frac{d^2\delta_i}{dt^2} = P_{mi} - [E_i^2 G_{ii} + \sum_{\substack{j=1 \\ j\neq 0}}^{n} E_i E_j Y_{ij} \cos(\theta_{ij} - \delta_i + \delta_j)]$$

$$i = 1, 2, \ldots\ldots\ldots\ldots\ldots\ldots\ldots, n \tag{2.44}$$

A load flow study of the network in pre-transient steady state condition is done to determine the mechanical power P_m equal to electrical power output of the generators neglecting losses and to calculate the internal emf values of $E_i\angle\delta_{io}$ for all the generators. The equivalent admittance of the loads is obtained from the load bus data.

The subscript o is used to indicate the pre-transient condition i.e. the condition prior to the disturbance or fault.

If a certain load bus has a voltage V_L, power P_L, reactive power Q_L and current I_L flowing into load admittance $Y_L = G_L + jB_L$, then

$$P_L + jQ_L = \bar{V}_L \bar{I}_L{}^* = \bar{V}_L[\bar{V}_L{}^*(G_L - jB_L)] = V_L{}^2(G_L - jB_L)$$

The equivalent shunt admittance at the bus is given by

$$\bar{Y}_L = P_L / V_L{}^2 - j(Q_L / V_L{}^2) \qquad (2.45)$$

The internal voltages of the generators $E_i\angle\delta_{io}$ are calculated from the pretransient terminal voltages $V\angle\alpha$ as follows. Let the terminal voltage be used temporarily as a reference, as shown in Figure 2.3. If we define $\bar{I} = I_1 + jI_2$ then from the relation P + jQ = $\bar{V}\bar{I}^*$ we have $I_1 + jI_2 = (P - jQ)/V$. But since $E\angle\delta' = \bar{V} + jx'_d\bar{I}$, x'_d being the direct axis transient reactance, it can be written that

$$E\angle\delta' = (V + QX'_d / V) + j(Px'_d / V) \qquad (2.46)$$

The initial generator angle δ_o is then obtained by adding the pretransient voltage angle α to δ'

$$\delta_o = \delta' + \alpha \qquad (2.47)$$

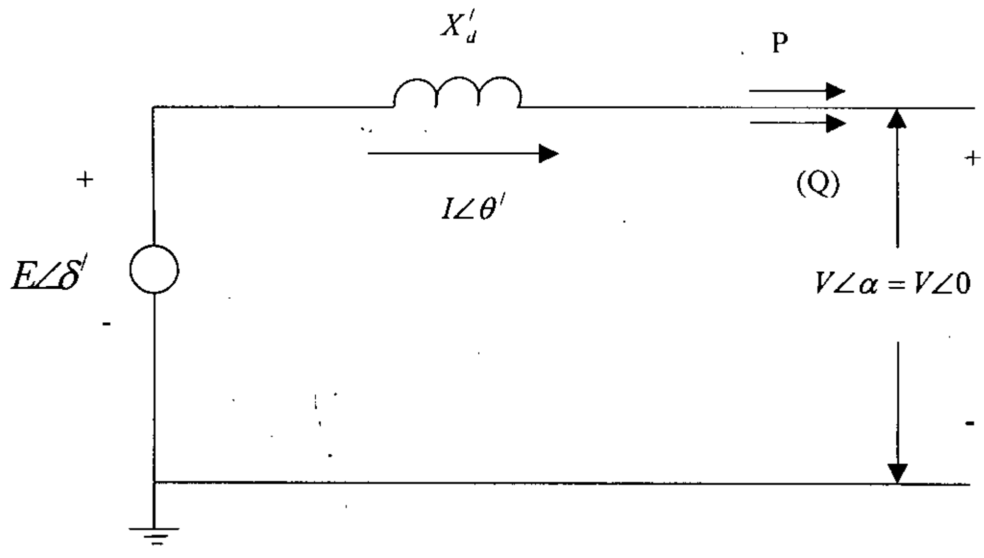

Fig 2.3 Generator representations for computing δ_o

Before obtaining the [Y]matrix of equation (2.41) the system admittance $[Y_s]$ matrix considering all the nodes including internal machine buses i.e. (n+r) of the network is formed. Then all the nodes except the internal generator nodes are eliminated to obtain the [Y] matrix for the reduced network. The reduction can be achieved by matrix operation as all the nodes have zero injection currents except for the internal generator nodes. This property is used to obtain the network reduction as shown below.

Let $[I] = [Y_s][V]$ (2.48)

where,

$$[I] = \left[\frac{I_n}{0}\right] \tag{2.49}$$

Now the matrices $[Y_s]$ and [V] are partitioned to get

$$\left[\frac{I_n}{0}\right] = \left[\frac{Y_{nn} \quad Y_{nr}}{Y_{rn} \quad Y_{rr}}\right] \left[\frac{V_n}{V_r}\right] \tag{2.50}$$

where the subscript n is used to denote generator nodes and the subscript r is used for the remaining nodes. Thus for the network in Figure 2.2, $[V_n]$ has the dimension (n x 1) and $[V_r]$ has the dimension (r x 1).

Expanding (2.50)

$$[I_n] = [Y_{nn}][V_n] + [Y_{nr}][V_r]$$

$$[0] = [Y_{rn}][V_n] + [Y_{rr}][V_r]$$

for which $[V_r]$ is eliminated to find

$$[I_n] = [(Y_{nn} - Y_{nr} Y_{rr}^{-1} Y_{rn})][V_n] \tag{2.51}$$

The matrix $[(Y_{nn} - Y_{nr} Y_{rr}^{-1} Y_{rn})]$ is the desired reduced matrix [Y]. It has the dimensions (n x n) where n is the number of the generators.

It should be noted that two separate reduced admittance matrices are to be formed by equation (2.51) considering respectively during fault and after clearing fault network conditions. These matrices are used to compute the corresponding electrical power output of the generators by equations (2.43).

2.3.2 Step-by-Step Method for Solving Swing Equations

In the step-by-step method [3] used for solving each of the swing equations (2.44) the change in the angular position of the rotor from the synchronously rotating reference axis during a short interval of time Δt is computed by making the following assumptions.

1. The accelerating power $P_a = P_m - P_e$ computed at the beginning of an interval is constant from the middle of the preceding interval to the middle of the interval considered.

2. The angular velocity is constant throughout any interval at the value computed for the middle of the interval.

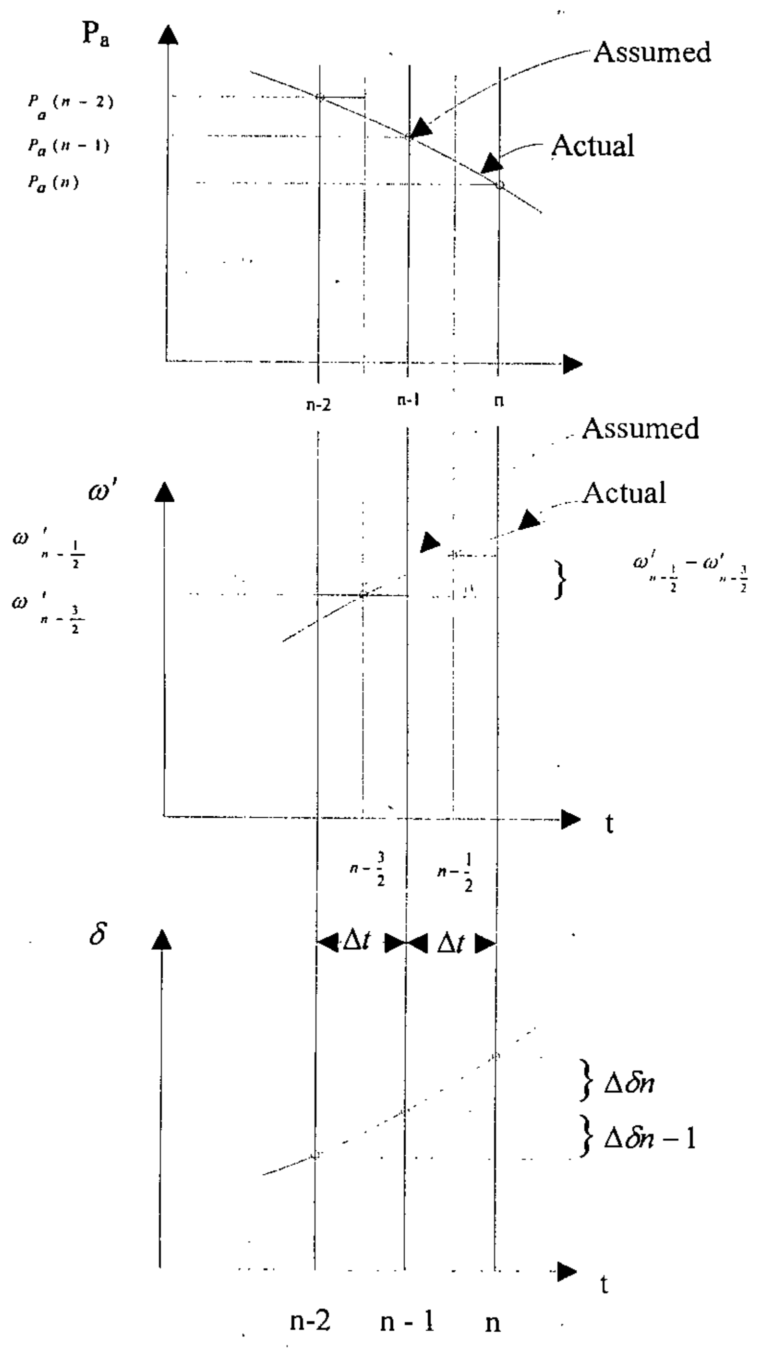

Fig 2.4 Actual and assumed values of P_a, ω' and as function for time, and δ as function for time

Figure 2.4 will help in visualizing the assumptions. The accelerating power is computed for the points enclosed in circles at the ends of the n-2, n-1, and n intervals, which are the beginnings of the n - 1, and n + 1 intervals. The step curve of P_a in Figure 2.4 results from the assumption that P_a is constant between midpoints of the intervals. Similarly, ω' the excess of the angular velocity ω over the synchronous angular velocity ω_s i.e., $\omega' = d\delta / dt$, is shown as a step curve that is constant throughout the interval at the value computed for the midpoint. Between the ordinates n-3/2 and n-1/2 there is change of speed caused by the constant accelerating power. The change in speed is the product of the acceleration and the time interval. Combining this fact with equation (2.40) it can be written that

$$\omega'_{n-\frac{1}{2}} - \omega'_{n-\frac{3}{2}} = \frac{d^2\delta}{dt^2}\Delta t = \frac{P_{a(n-1)}}{\frac{2H}{\omega_s}} \qquad (2.52)$$

The change in δ over any interval is the product of ω' for the interval and the time of the interval. Thus, the change in δ during the n - 1 interval is

$$\Delta\delta_{n-1} = \delta_{n-1} - \delta_{n-2} = \Delta t \omega'_{n-3/2} \qquad (2.53)$$

and during the nth interval

$$\Delta\delta_n = \delta_n - \delta_{n-1} = \Delta t \omega'_{n-1/2} \qquad (2.54)$$

Subtracting equation (2.54) from equation (2.53) and substituting equation (2.52) in the resulting equation to eliminate all values of ω' yield

$$\Delta\delta_n = \Delta\delta_{n-1} + \frac{P_{a(n-1)}}{\frac{2H}{\omega_s}}(\Delta t)^2 \qquad (2.55)$$

$$\delta_n = \delta_{n-1} + \Delta\delta_n \qquad (2.56)$$

Equation (2.55) shows that, subject to the stated assumptions, the change in δ during a given interval is equal to the change in δ during the preceding interval plus the accelerating power at the beginning of the interval times $(\Delta t)^2/(2H/\omega_s)$. The accelerating power is calculated at the beginning of each new interval, Equation (2.56) shows how to calculate δ during an interval if the δ for the previous interval and the change in δ for the interval in question are known. The solution progresses through enough steps to obtain points for plotting the swing curve. Greater accuracy is obtained when the length of the time interval is small.

The occurrence of a fault causes a discontinuity in the accelerating power P_a which is zero before the fault and a definite amount immediately following the fault. The discontinuity occurs at the beginning of the interval, when t = 0 Figure 2.4 shows that the step-by-step method of calculation assumes that the accelerating power computed at the beginning of and interval is constant from the middle of the preceding interval to the middle of the interval considered. When the fault occurs, there are two values of P_a at the beginning of an interval, and the average of these two values should be taken as constant accelerating power. Also discontinuity results when a fault is cleared at the beginning of an interval and hence average P_a should be used in a similar way.

2.4 Summary

The mathematical models available in the literature to determine the steady state and the dynamic performance of a power system have been reviewed. This study has considered fast decoupled load flow method of solving for unknown voltages and flows of power. The transient stability analysis of a multi-machine system can be done effectively as well as quickly using a classical model based on a number of justified assumptions. The classical model comprises a set of second order nonlinear differential equations termed swing equations, one for each synchronous generator. These are solved usually by a step-by-step numerical integration method, which provides accuracy inversely proportional to the step size i.e. length of the time interval. With a digital computer, to obtain a satisfactory level of accuracy in a reasonable execution a step size of 0.01 seconds can be chosen.

Chapter 3

SYSTEM OF STUDY

3.1 Introduction

The very objective of the present work requires that the Bangladesh power generation and transmission system be studied in stand alone mode (base case) and then considering it to be interconnected with the neighboring countries' systems. As Bangladesh is flanked on all the viable sides by the Indian territories, it is implied that power import from Nepal or Bhutan having large hydro potentials will either take place through India by direct tie lines over the Indian corridor or through the Indian power system. In either case the point of interconnection can be represented by an 'Indian' bus. There are three such potential sites for interconnection to be considered one at a time. These are (i) 'India'-Ishurdi, (ii) 'India'-Thakurgaon and (iii) 'India'-Sreemongal. Notably the first two were also considered in Nexant study [2]. The problems in obtaining Indian or neighbouring countries' system data have prompted this study to use Thevenin's equivalent representation at the point of interconnection for stability studies. For load flow studies the 'Indian' bus will be modeled simply as a P-V (specified voltage and generation) bus.

3.2. Bangladesh System

Bangladesh Power Development Board (BPDB) and its subsidiary Power Grid Company of Bangladesh (PGCB) are the state owned utilities in Bangladesh respectively responsible for generation and transmission of electricity which is distributed through BPDB itself and three other public utilities viz. Dhaka Electric Supply Authority (DESA), Dhaka Electric Supply Company (DESCO) limited and Rural Electrification Board (REB). The BPDB-PGCB grid comprises a transmission network operating at 132 kV and some lines at 230 kV. The grid area consists of two

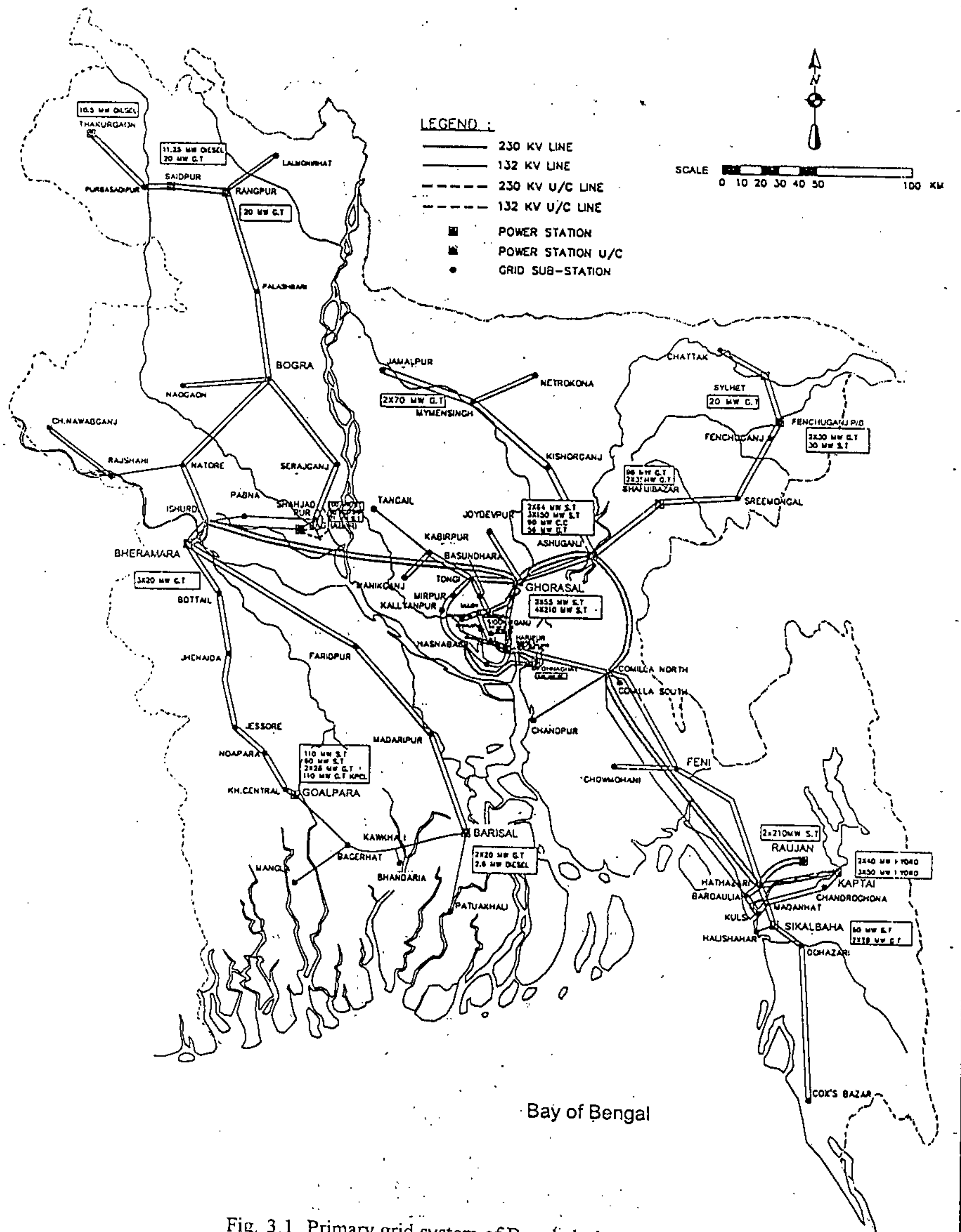

Fig. 3.1 Primary grid system of Bangladesh.

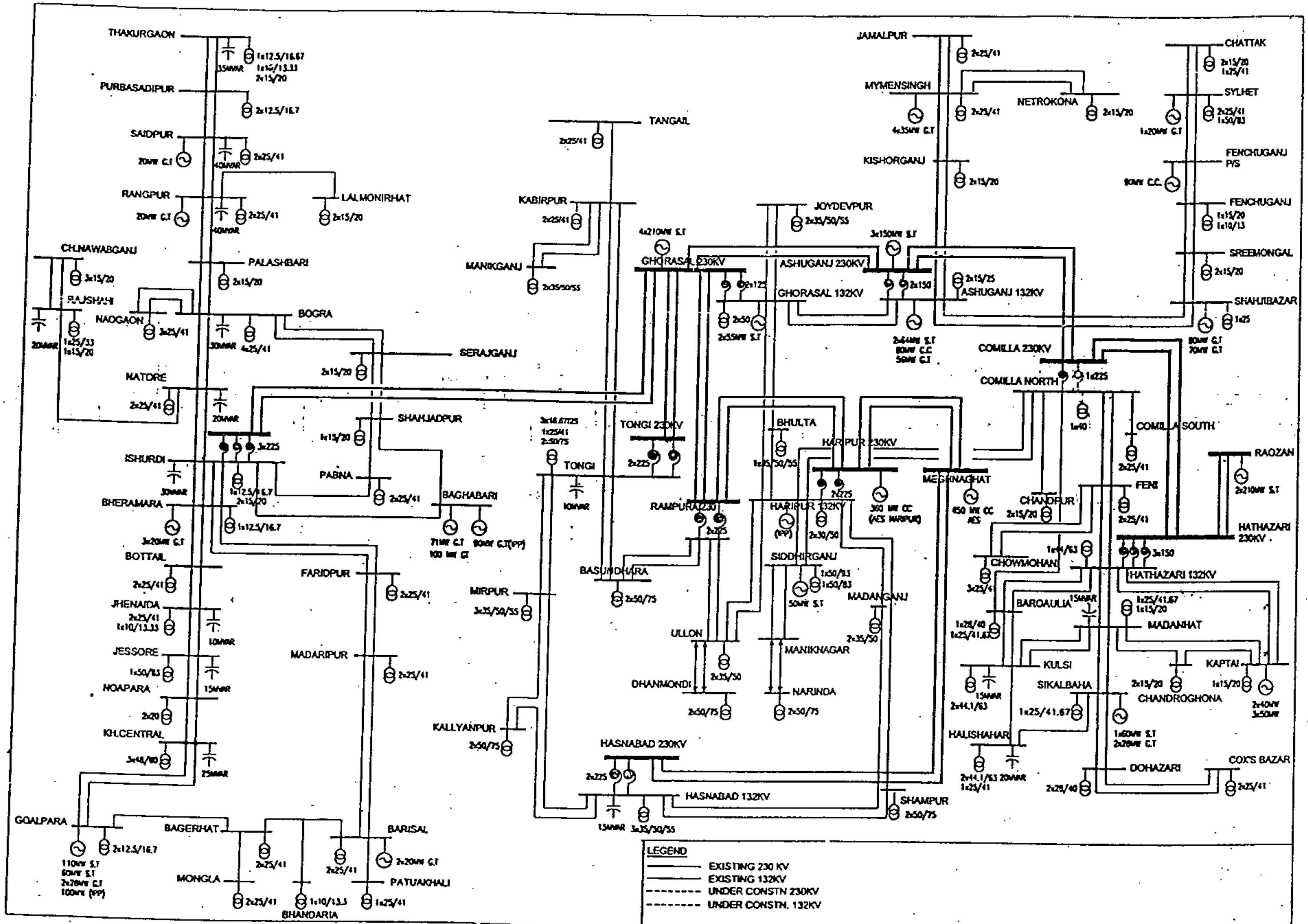

Fig 3.2 Single line diagram of 132 and 230 kV system of BPDB as of 2004

geographical zones: East zone and West zone, interconnected by a 230kV double circuit line as shown in Figure 3.1 and Figure 3.2.

Due to availability of natural gas and hydro reserves, most of the power plants are located in the east zone. Demand wise also the East zone consumes more electricity and almost 50% of the country's total demand is in the Greater Dhaka (DESA and DESCO) portion.

Figure 3.2 shows the single line diagram of the whole grid system of BPDB-PGCB as exists in the year 2004.The East zone and the West zone are connected by two 230 kV circuits (each 179 km long) termed the East-West interconnector (EWI). Due to the nonhomogeneous location of generation and load centers in the West zone, transmission lines there are radial. The BPDB Grid system comprises 1144 km 230 kV lines (total 25 No. of circuits), 4562 km 132 kV lines (total 157 No. of circuits). The present installed generation capacity is around 4600 MW being owned by the BPDB and few independent power producers (IPPs) with whom BPDB has power purchase agreement.

3.3 Model of Neighboring Country's Power System

Figure 3.3 shows the schematic diagram for the load flow model of Bangladesh system being interconnected with the nearest 'Indian' bus through

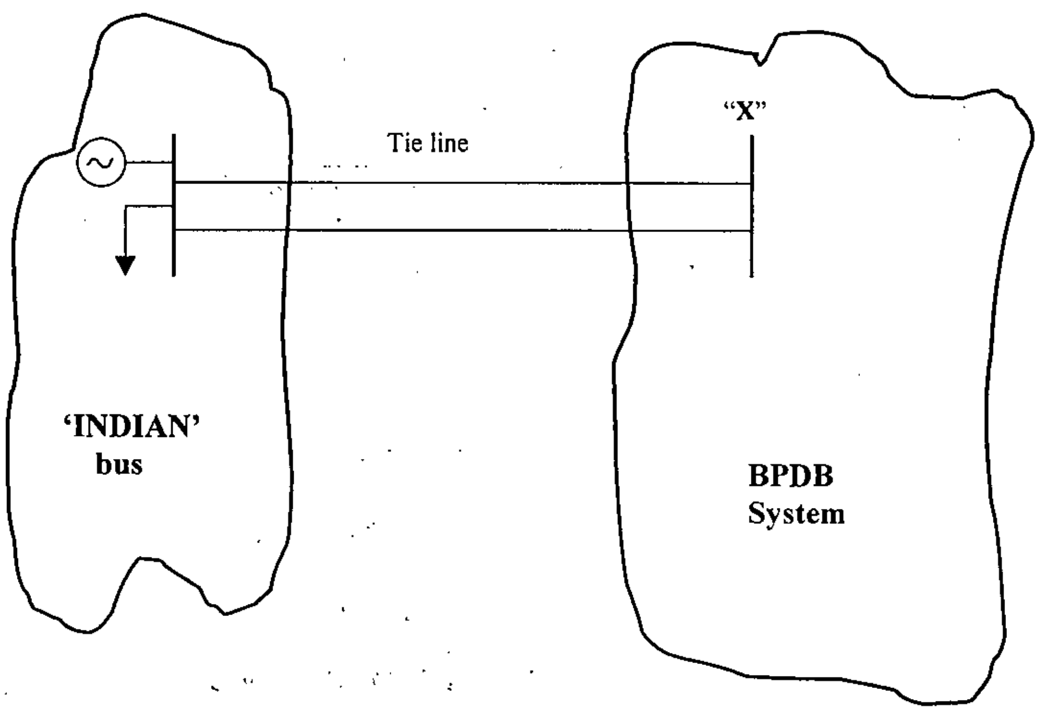

Fig 3.3: Load flow model considering interconnection between BPDB system and Indian system.

suggested tie lines that correspond to respectively the three locations in Bangladesh as mentioned in Table 3.1. The 'Indian' bus would be considered as a P-V bus.

Table 3.1: Interconnection scenario between India and Bangladesh

Option	Bangladesh location (X)	Tie line voltage (kV)	Tie line length (km)
I	Ishurdi	230	380
II	Thakurgaon	132	90
III	Sreemongal	132	90

Data necessary for load flow and stability studies for Bangladesh power system are available from the Directorate of System Planning of BPDB. But due to non-availability of data from India or other neighbouring country, the neighbouring power system is represented for stability study by a Thevenin's equivalent network with respect to the point of interconnection between Bangladesh and the neighbouring system.

With resistance and shunt capacitance neglected, the single-phase Thevenin equivalent circuit [3] which represents a system with respect to the bus is an emf equal to the nominal line voltage divided by $\sqrt{3}$ in series with an inductive reactance of X_{th} given as follows.

$$X_{th} = \frac{(\text{nominal} \quad kV / \sqrt{3})x1000}{I_{SC}} \quad \Omega. \tag{3.1}$$

Usually the short - circuit mega volt-amperes for a three phase fault at a bus is

$$\text{Short circuit MVA} = \sqrt{3} \times (\text{nominal kV}) \times I_{sc} \times 10^{-3} \tag{3.2}$$

Solving (3.2) for I_{sc} and substituting in (3.1) yields

$$X_{th} = \frac{(\text{nominal} \quad kV)^2}{Short \quad circuit \quad MVA} \quad \Omega.. \tag{3.3}$$

If base kilovolts is equal to the nominal kilovolts, converting to per unit (p u) yields.

$$X_{th} = \frac{base \quad MVA}{Short \quad circuit \quad MVA} \; p \quad u \tag{3.4}$$

Figure.3.4 shows the Thevenin's model for the neighbouring system

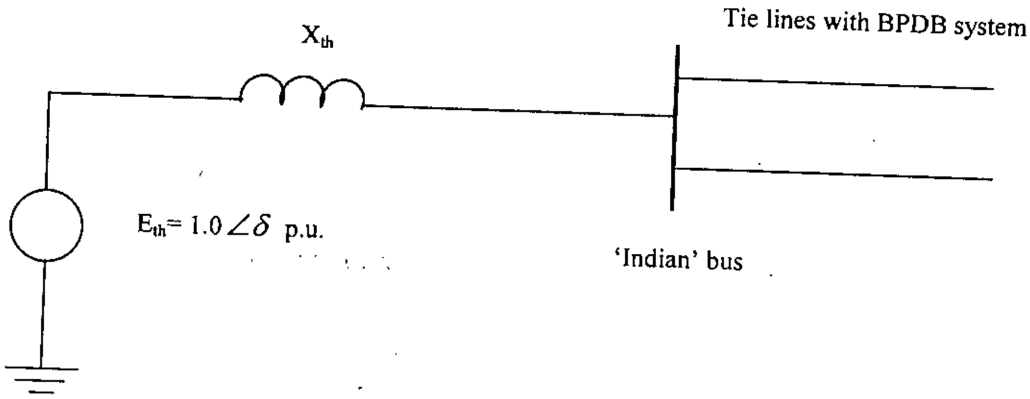

Fig 3.4 Thevenin's representation of the neighboring system for stability study.

3.4 Summary

The technical study of an interconnected system becomes complicated especially when requisite data are unavailable. This is far more true in the context of Bangladesh and its neighbors that can be electrically connected. However, fairly accurate results are expected by using P-V bus representation of the immediately neighboring 'Indian' bus for load flow studies while Thevenin's equivalent of the same for the transient stability study. This is because these will require the minimum amount of data on the neighbouring system that can also be assumed applying engineering judgments.

Chapter 4

RESULTS AND DISCUSSION

4.1 Introduction

The study made in the present work focuses on two base cases and their extensions viz. i) the supply, peak demand and system configuration as of year 2004(base case) and considering with it power import from or export to the neighboring country; ii) forecasted supply, peak demand and planned system configuration as of year 2015 (base case) and considering with it power import from or export to the neighboring country. In both the system configurations three geographical locations Ishurdi, Thakurgaon and Sreemongal are assigned in turn (i.e. one point at a time) as the points for power transfer. The Ishurdi bus due to its robust position in the grid system is investigated for large power transfer i.e. from 150 MW to 500 MW in both configurations and the other two buses are investigated for limited power transfer i.e. from 50 MW to 150 MW. In all the cases studies were made in steps of 50 MW increase in power transfer.

The grid system of Bangladesh i.e. BPDB-PGCB system as mentioned in Section 3.2, has two distinct zones respectively termed the East zone and the West zone interconnected by a 230 kV double circuit line i.e. East West Interconnector (EWI). In the present study, the neighboring power system is considered to be interconnected with Bangladesh system by tie line circuits at 230 kV when the power transfer point is at Ishurdi. The tie lines are considered at 132kV when the power transfer point is either Sreemongal or Thakurgaon.

The steady state impact of power generation with export to or import from the neighboring system has been evaluated by a load flow analysis for each of the scenarios. A number of indices such as bus voltage magnitude, bus angle differences from the slack, power factor at each generation bus, total real power (MW) loss etc have been considered in this evaluation. The impact of faults assumed at critical locations such as on the EWI or the tie line between Bangladesh system and neighboring power system, has been evaluated by a transient stability analysis to obtain swing curves for each of the synchronous machines. In the limited space the results have mainly been presented in the form of general comments and representative tables and swing curves for typical scenarios.

The results presented in the chapter have been obtained through developing a FORTRAN77 code for the models and algorithms presented in Section 2.2 and 2.3. The FORTRAN77 computer code has been compiled and executed using 'Microsoft FORTRAN Power Station version 1.0, on a 2.4 GHz Pentiun-4 PC under Windows98 operating system. The Microsoft Excel package has been used to construct graphical plots from the obtained output data files. The computer simulation have been made faster and less memory occupant by exploiting [7] sparse structures of the Jacobean matrices in load flow analysis and the bus admittance matrices in the post fault transient stability analysis.

4.2 Load flow and Stability Data

The load flow and transient stability studies require various data that are not always available especially when the interconnected system like the one considered in the present study is yet to come into existence. Some of the data and assumptions based on engineering judgments are as follows.

I. All the generating units are available for operation.

II. As mentioned in section 3.3, the length of the tie line circuit is considered 380 km for the India-23 bus to Ishurdi-23 bus line, and 90 km for the India-131 bus to Thakurgaon bus line or the India-138 bus to Sreemongal bus line. Notably the Indian bus name has been coded arbitrarily.

III. For the system of year 2004, loads on various buses are according to the data supplied by the System Planning Directorate of BPDB. But for the year of 2015 loads on various bus (as of the year 2004) are increased proportionately [1].

IV. For the case of 2015, some new generating units are considered in this study whose data (necessary for load flow and transient stability study) are assumed based on those for similar generating units available in the present power system. It should be noted that the expected generation capacity in Bangladesh 2015 system would be around 8200 MW with 64 No. of 230kV circuits and 165 No. of 132kV circuits in the base case configuration.

V. All the new transformer (step-up and step-down) data are assumed to be close to those available for the same type of transformers with other units.

VI. Per unit resistance, reactance and susceptances are considered to be equal to those of the EWI or a typical 132 kV line respectively for the considered 230 kV and 132 kV tie lines between Bangladesh and India.

VII. For both the year 2004 and the year 2015 power systems, the maximum power transfer capacity considered for 132 kV line is 150 MW per circuit and for 230kV line is 250 MW per circuit from thermal limit point of view.

VIII. For the year 2015 system, direct axis transient reactances (x'_d) of new generating units are considered equal to those for corresponding sized units in the 2004 power system.

IX. Inertia constants (H) of various generating units for the 2004 system are made available by the System Planning Directorate of BPDB. But for the 2015(planned) system the inertia constants of the new generating units are considered equal to those of the same or near sized units present in the 2004 power system.

X. Direct axis transient reactance (x_d') of the equivalent generator at the Indian (neighboring) bus was considered to be same as X_{th} that was calculated using equation 3.4. For this the short circuit MVA at Indian bus was considered to be equal to the short circuit MVA at the corresponding bus in the Bangladesh system with which the Indian system is tied. Notably the short circuit MVA of Ishurdi, Thakurgaon and Sreemongal buses are respectively 2584, 331 and 1799 MVA as given by the System Planning Directorate of BPDB. It should also be noted that the inertia constant (H) of the equivalent generator of the Indian bus was considered to be equal to that of the nearest sized generation unit (around 450 MW) connected in Bangladesh system.

Appendix - A and B shows the load flow and stability data of the Bangladesh power system respectively as of 2004 and 2015(planned). Appendix - C shows the load flow and stability performance respectively through tables and typical swing curves of selected generation units for various cases in the BPDB systems of 2004 and 2015.

4.3 Performance of the year 2004 Power System

Load flow analysis was done for the base case configuration of the Bangladesh power system as of 2004 and no violation of any constraints was found. It was repeated for import or export of various levels of power when interconnected with Indian system at Ishurdi bus. Tables C.1 and C.2 compare the steady state performances under import or export condition with the base case using various criteria. It should be noted that to avoid line flow limit constraints two more EWI circuits than that in base case configuration are required to be added in the

Bangladesh system for power export. It is evident from Tables C.1 and C.2 show that without violating the load flow constraints, 500 MW power can be imported from or 450 MW exported to the neighboring system through tie line connected at Ishurdi bus.

Stability analysis was made for the 2004 system base case peak demand considering a 3-phase fault at Ishurdi end of one of the EWI circuits. The fault was considered to be cleared in 4 cycles (at t=0.08 seconds on 50 Hz basis) by tripping only the faulty circuit. Figures C.1a and C.1b show the swing curves of selected machines relative to KPT--123 machine. The system as a whole is found stable. Considering the same fault the stability analysis was repeated for import or export through Ishurdi bus considering the highest level of power feasible from load flow point of view i.e. 500 MW and 450 MW respectively. Figure C.2 shows that the system will be stable if 500 MW is imported. Similarly, an export of 450 MW power through Ishurdi bus is possible without losing stability as evident from the swing curves of Figure C .3.

The stability analysis was repeated considering a fault at the Ishurdi end of the tie line between Bangladesh and India, and only the faulty circuit was considered to be tripped. The swing curves of Figure C.4 show that the system will be unstable if 500 MW is imported under this fault condition and the number of tie line circuits is 3. However, if 400 MW is imported the system is found stable. The swing curves of Figure C.5 show that the system will remain stable if 450 MW is exported and the number of tie line circuits is 4.

The load flow analysis and the stability analysis have been made for import or export through Thakurgaon or Sreemongal in a fashion similar to that as done for Ishurdi bus. An analysis of the corresponding Tables C.3 and C .4 and the swing curves of the Figures C.6 to C.11 show that a maximum of 150 MW power can be imported through Thakurgaon from load flow point of view but 100 MW from stability point of view. However, no power can be exported through Thakurgaon bus even from load flow point of view. The most probable reason for this is that the Thakurgaon bus is a radial-fed bus being at longer distances from the nearest larger sized power stations in the Bangladesh system of year 2004. On the other hand, a maximum of 150 MW power can be exported or imported from load flow as well as stability point of view through Sreemongal bus.

Table 4.1 shows a summary of the generation, peak load, EWI circuits and tie line circuits scenario for the 2004 system under the steady state base case, import and export conditions. It should be noted that the generation in Bangladesh system was reduced / increased uniformly all over the system respectively during import / export of power. This uniformity helped in maintaining the voltage limit and ensured transient stability.

Table 4.1: Generation and peak load in the east zone and the west zone of the 2004 Bangladesh grid system.

	Base case	Power Import through			Power export through		
		Ishurdi	Thakurgaon	Sreemongal	Ishurdi	Thakurgaon	Sreemongal
Maximum feasible level of power import or export (MW) without violating load flow constraints		500	150	150	450	Export not possible	150
East Zone generation	3190.049	2792.1	3027.7	3053.7	3676.31		3338.8
East Zone load	2887.50	2906	2906	2906	2906		2905
West Zone generation	681	611	681	681	721		696
West Zone load	912.50	894	894	894	894		895
EWI Line flow per circuit	134.423	61.642	55.681	134.435	185.385		126.502
Number of EWI circuit	2	2	2	2	4		2
Number of Tie line circuit	--	3	2	2	4		2

4.4 Performance of the year 2015 Power System

Load flow analysis was done for the base case configuration of the Bangladesh power system as of 2015(planned) and no violation of any constraints was found. It was repeated for import or export of various levels of power when interconnected with Indian system at Ishurdi bus. Tables C.5 and C.6 compare the steady state performances under import or export condition with the base case using various criteria. It should be noted that to avoid line flow limit constraints four more EWI circuits than that in base case configuration are required to be added in the Bangladesh system for power export. It is evident from Tables C.5 and C.6 show that without violating the load flow constraints, 500 MW power can be imported from or exported to the neighboring system through tie line connected at Ishurdi bus.

Stability analysis was made for the 2015(planned) system base case peak demand considering a 3-phase fault at Ishurdi end of one of the EWI circuits. The fault was considered to be cleared in 4 cycles (at t=0.08 seconds on 50 Hz basis) by tripping only the faulty circuit. Figures C.12a and C.12b show the swing curves of selected machines relative to KPT--123 machine. The system as a whole is found stable. Considering the same fault the stability analysis was repeated for import or export through Ishurdi bus considering the highest level of power feasible from load flow point of view i.e. 500 MW both export or import. Figure C.13 shows that the system will be stable if 500 MW is imported. Similarly, an export of 500 MW power through Ishurdi bus is possible without losing stability as evident from the swing curves of Figure C .14.

The stability analysis was repeated considering a fault at the Ishurdi end of the tie line between Bangladesh and India, and only the faulty circuit was considered to be tripped. Analysis shows that the system will be unstable for 500 MW (Figure C.15) import but will remain stable if 450 MW is imported under this fault condition and the number of tie line circuits is 3. The swing curves of Figure C.16 show that the system will remain stable if 500 MW is exported and the number of tie line circuits is 3.

The load flow analysis and the stability analysis have been made for import or export through Thakurgaon or Sreemongal in a fashion similar to that as done for Ishurdi bus. An analysis of the corresponding Tables C.7 and C .8 and the swing curves of Figures C.17 to C.24 show that a maximum of 150 MW power can be imported or exported through Thakurgaon from both load flow and stability point of view. The analysis also shows that a maximum of 150 MW power can be exported or imported from stability as well load flow point of view through Sreemongal bus.

Table 4.2 shows a summary of the generation, peak load, EWI circuits and tie line circuits scenario for the 2015(planned) system under the steady state base case, import and export conditions. It should be noted that the generation in Bangladesh system was reduced / increased uniformly all over the system respectively during import / export of power. This uniformity helped in maintaining the voltage limit and ensured transient stability.

Table 4.2: Generation and peak load in the east zone and the west zone of the 2015 Bangladesh grid system.

	Base case	Power Import through			Power export through		
		Ishurdi	Thakurgaon	Sreemongal	Ishurdi	Thakurgaon	Sreemongal
Maximum feasible level of power import or export (MW) without violating load flow constraints		500	150	150	500	150	150
East Zone generation	6768.752	6349.48	6612.8	6624.14	7275.9	6921.99	6921.99
East Zone load	5890.56	5928.9	5924.9	5924.9	5924.9	5924.9	5924.9
West Zone generation	875	825	875	875	950	925	925
West Zone load	1641.34	1603	1607	1607	1607	1607	1607
EWI Line flow per circuit	164.228	134.028	135.646	164.237	165.37	194.465	194.465
Number of EWI circuit	4	4	4	4	8	5	5
Number of Tie line circuit	--	3	2	2	3	2	2

4.5 Comparative Performance of Year 2004 and 2015 Power Systems

Table 4.3 shows a comparison of the steady state and transient stability performance of the year 2004 and the year 2015 systems under various conditions. It is evident that in both the systems same amount of power can be imported from the neighboring system without violating the load flow constraints i.e. 500 MW through Ishurdi bus, 150 MW through Thakurgaon bus and 150 MW through Sreemongal bus. However, the highest level of power that can be exported to the neighboring system from the 2004 system through Ishurdi bus is 50 MW less than that from the 2015 system from load flow point of view. However, no power can be exported through Thakurgaon bus from the 2004 system. It should be noted that from transient stability point of view the highest level of power that can be imported or exported in 2004 system is around 50 MW less than that from load flow point of view. In the 2015 system the highest level of power exchange from transient stability point of view is almost same as that from load flow point of view. This is because Bangladesh system would be more robust in the year 2015 than 2004 due to augmented generation capacity with greater uniformity in their locations and higher number of transmission lines.

4.6 Summary

The detailed load flow and stability studies reveal that for import or export made through Thakurgaon and Sreemongal in both 2004 and 2015 base case systems, no reinforcement is required in terms of transmission lines excepting a double circuit tie line between Bangladesh and the neighboring system. However, only 100 to 150 MW power can be exported or imported safely through these two buses.

Table 4.3: Comparison of the steady state and the transient stability performance in 2004 and 2015(planned) systems under various conditions.

Scenario	Fault condition	Bangladesh system as of 2004		Bangladesh system as planned in 2015	
Base case	Fault considered at Ishurdi end of EWI and only one circuit of EWI tripped	Load flow constraints not violated; Transient stability retained		Load flow constraints not violated; Transient stability retained	
Power Import	Fault considered at Ishurdi end of EWI for stability analysis and only one circuit of EWI tripped	Through Ishurdi	L=500 MW T=500 MW	Through Ishurdi	L=500 MW T=500 MW
		Through Thakurgaon	L=150 MW T=150 MW	Through Thakurgaon	L=150 MW T=150 MW
		Through Sreemongal.	L=150 MW T=150 MW	Through Sreemongal	L=150 MW T=150 MW
	Fault at Bangladesh end of a tie line circuits and only one circuit tripped	Through Ishurdi	L=500 MW T=400 MW	Through Ishurdi	L=500 MW T=450 MW
		Through Thakurgaon	L=150 MW T=100 MW	Through Thakurgaon	L=150 MW T=150 MW
		Through Sreemongal	L=150 MW T=150 MW	Through Sreemongal	L=150 MW T=150 MW
Power Export	Fault at Ishurdi end of EWI and only one circuit of EWI tripped	Through Ishurdi	L=450 MW T=450 MW	Through Ishurdi	L=500 MW T=500 MW
		Through Thakurgaon	Export not possible even due to load flow constraints violation	Through Thakurgaon	L=150 MW T=150 MW
		Through Sreemongal	L=150 MW T=150 MW	Through Sreemongal	L=150 MW T=150 MW
	Fault at Bangladesh end of a tie line circuits and only one circuit tripped	Through Ishurdi	L=450 MW T=450 MW	Through Ishurdi	L=500 MW T=500 MW
		Through Thakurgaon	Export not possible even due to load flow constraints violation	Through Thakurgaon	L=150 MW T=150 MW
		Through Sreemongal	L=150 MW T=150 MW	Through Sreemongal	L=150 MW T=150 MW

L= Maximum power exchange without violating steady state (load flow) constraints; T= Maximum power exchange without violating transient stability.

The power that can be exported through Ishurdi bus in the 2004 system is 450 MW from stability point of view and this will require addition of 2 more EWI circuits and 4 tie line circuits. The power that can be imported through Ishurdi bus from stability point of view is maximum 400 MW and this will require 3 tie line circuits but no more EWI circuits. The import in the 2004 system will result in higher transmission loss (83 MW) than that in base case (71 MW).

The power that can be exported through Ishurdi bus in the 2015 (planned) system is 500 MW from stability point of view and this will require addition of 4 more EWI circuits and 3 tie line circuits. The power that can be imported through Ishurdi bus from stability point of view is maximum 450 MW and this will require 3 tie line circuits but no more EWI circuits. The import in the 2015 system will result in higher transmission loss (136 MW) than that in base case (111 MW).

An important point that should be noted is that the stability analysis in the present investigation is made considering only the faulty circuit to be tripped while other circuits of the faulted line kept in operation. Otherwise, the system would not retain stability in the base case as well as interconnected modes regardless of export or import level. Therefore, this requires that the protection systems be designed for selective (only the faulty circuit) tripping specially for the EWI and tie lines in the 2004 or 2015 systems

Chapter 5

CONCLUSION

5.1 General Conclusion

With the present pace of gas and coal field development and exploring new ones in Bangladesh, it has become necessary to make a comparative study between local generation versus import of hydro power from Nepal and Bhutan through tie lines over Indian corridor. The present study has made a detailed load flow and transient stability analysis considering the Bangladesh power system as of now (2004) and of 2015 (planned). It has been found that 400 to 450 MW power can be exported or imported under peak load condition through a 3 or 4 circuit tie line between Ishurdi bus and the neighboring (Indian) system without violating system security. Export is possible if all the developed/ discovered gas fields and the Barapukuria coal mine are ready to be utilized for power generation purposes from now on until 2015. For export from 2004 system additional requirement is that the total generation capacity should be committable.

The important technical requirement for local generation or import is that a protection system with selective tripping (only the faulty circuit) be introduced for the EWI and tie lines to avert system instability. Furthermore, if export be desired the number of EWI circuits need to be increased by 2 and 4 from that in the base case respectively in 2004 and 2015.

5.2 Suggestions for Further Research

A detailed financial study to compare the gains from local generation with occasional export against the gains from power import (considering energy purchase, tariff, wheeling charge and the cost of extra transmission loss incurred) is worthy of investigation.

The technical studies made in the present investigation can be extended considering the load growth as well as local resource (gas, coal) development scenarios in Bangladesh up to the year 2030.

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APPENDIX - A

BPDB 2004 SYSTEM DATA AND BASE CASE LOAD FLOW OUTPUT DATA

BPDB 2004 BASE CASE

MVA BASE= 100.0
CONVERGENCE TOLERANCE= .00100
MAXIMUM NUMBER OF ITERATIONS=100
SLACK BUS IS=GH--3210

BUSBAR DATA

NODE	VOLTAGE P.U.	P.GEN MW	Q.GEN MVAR	P.LOAD MW	Q.LOAD MVAR	NOM.VOLTAGE.
KPT--123	1.000	90.00	45.00	1.50	.75	11.00
KPT---45	1.000	100.00	50.00	2.00	1.00	11.00
RAZ2x210	1.050	360.00	180.00	28.00	14.00	15.00
SK--1X60	1.000	60.00	35.00	4.00	2.00	11.00
SK--2X28	1.000	56.00	28.00	1.00	.50	11.00
HRP---CC	1.000	100.00	50.00	1.00	.50	11.00
HARI-360	1.050	360.00	180.00	8.00	4.00	15.00
SD----50	1.000	50.00	25.00	3.00	1.50	11.00
AES--450	1.050	400.00	200.00	12.00	6.00	15.00
GH--2X55	1.000	80.00	40.00	30.00	15.00	11.00
GH--3210	1.050	610.00	360.00	40.00	20.00	15.00
GH--1210	1.050	200.00	100.00	12.00	6.00	15.00
AS--2X64	1.050	50.00	25.00	4.00	2.00	13.00
AS--1X90	1.050	80.00	40.00	2.00	1.00	13.00
AS--1X60	1.050	50.00	25.00	4.00	2.00	13.00
AS--3150	1.050	300.00	200.00	24.00	12.00	15.00
MYM--070	1.000	70.00	35.00	2.00	1.00	11.00
SHZ---80	1.000	60.00	30.00	3.00	1.50	11.00
SHZ---70	1.000	70.00	35.00	1.00	.50	11.00
FNC--090	1.000	90.00	45.00	2.00	1.00	11.00
SY--1X20	1.000	20.00	10.00	1.00	.50	11.00
KL--1X60	1.000	60.00	30.00	.00	.00	11.00
KL--1110	1.000	110.00	55.00	4.00	2.00	11.00
KPC----L	1.000	60.00	30.00	2.00	1.00	11.00
KL--2X28	1.000	56.00	28.00	1.00	.50	11.00
BR---140	1.000	40.00	20.00	2.00	1.00	11.00
BH--3X20	1.000	54.00	36.00	.50	.25	11.00
BG----71	1.000	71.00	35.00	1.00	.50	11.00
IPP--090	1.000	90.00	50.00	3.00	1.50	11.00
BG---100	1.000	100.00	50.00	1.00	.50	11.00
RP--1X20	1.000	20.00	10.00	2.00	1.00	11.00
SP--1X20	1.000	20.00	10.00	2.00	1.00	11.00
KAPTA--I	.000	.00	.00	5.00	2.50	132.00
CHNDR--O	.000	.00	.00	22.00	11.00	132.00
HATHA--Z	.000	.00	.00	61.00	30.50	132.00
MADNH--T	.000	.00	.00	49.00	24.50	132.00
SIKLB--A	.000	.00	.00	15.00	7.50	132.00
DOHZR--I	.000	.00	.00	44.00	22.00	132.00
COXBZ--R	.000	.00	.00	26.00	13.00	132.00
HLSHA--R	.000	.00	.00	100.00	50.00	132.00
KULSH--I	.000	.00	.00	50.00	25.00	132.00
BARLI--A	.000	.00	.00	60.00	30.00	132.00
FEN----I	.000	.00	.00	37.00	18.00	132.00
CHOWM--U	.000	.00	.00	37.00	18.00	132.00
COMI---N	.000	.00	.00	49.00	24.00	132.00

NODE	VOLTAGE P.U.	P.GEN MW	Q.GEN MVAR	P.LOAD MW	Q.LOAD MVAR	NOM.VOLTAGE.
COMI---S	.000	.00	.00	74.00	37.00	132.00
CHNDP--R	.000	.00	.00	36.00	18.00	132.00
HARIP--R	.000	.00	.00	65.00	32.50	132.00
SIDDG--J	.000	.00	.00	160.00	80.00	132.00
MANIK--N	.000	.00	.00	35.00	17.50	132.00
ULLOO--N	.000	.00	.00	120.00	60.00	132.00
DHANM--O	.000	.00	.00	120.00	60.00	132.00
RAMPR--A	.000	.00	.00	80.00	40.00	132.00
NARIN--D	.000	.00	.00	60.00	30.00	132.00
SHAMP--R	.000	.00	.00	110.00	55.00	132.00
MADNG--J	.000	.00	.00	78.00	39.00	132.00
HASNB--D	.000	.00	.00	115.00	58.00	132.00
MIRPU--R	.000	.00	.00	98.00	49.00	132.00
KALLY--N	.000	.00	.00	115.00	58.00	132.00
BASHU--N	.000	.00	.00	110.00	56.00	132.00
TONGG--I	.000	.00	.00	100.00	50.00	132.00
KABRP--R	.000	.00	.00	64.00	33.00	132.00
MANIK--G	.000	.00	.00	32.00	16.00	132.00
TANGA--L	.000	.00	.00	45.00	22.00	132.00
GHRAS--L	.000	.00	.00	100.00	50.00	132.00
JYDVP--R	.000	.00	.00	80.00	40.00	132.00
BHULT--A	.000	.00	.00	40.00	20.00	132.00
ASHUG--J	.000	.00	.00	50.00	25.00	132.00
KISHG--J	.000	.00	.00	25.00	12.00	132.00
MYMNS--G	.000	.00	.00	20.00	10.00	132.00
JAMLP--R	.000	.00	.00	35.00	17.00	132.00
NETRO--K	.000	.00	.00	15.00	7.50	132.00
SHJIB--Z	.000	.00	.00	25.00	12.50	132.00
SRMNG--L	.000	.00	.00	25.00	12.50	132.00
FENCG--J	.000	.00	.00	20.00	10.00	132.00
FNCHP--S	.000	.00	.00	.00	.00	132.00
SYLHE--T	.000	.00	.00	75.00	37.50	132.00
CHATA--K	.000	.00	.00	20.00	10.00	132.00
GOLPR--A	.000	.00	.00	6.00	3.00	132.00
KLCEN--T	.000	.00	.00	105.00	52.50	132.00
NOAPR--A	.000	.00	.00	12.00	6.00	132.00
JESOR--E	.000	.00	.00	72.00	36.00	132.00
JHNDA--H	.000	.00	.00	43.00	21.00	132.00
BOTAI--L	.000	.00	.00	43.00	21.00	132.00
BHRMR--A	.000	.00	.00	25.00	12.50	132.00
FRIDP--R	.000	.00	.00	33.00	16.50	132.00
MADAP--R	.000	.00	.00	25.00	12.50	132.00
BRISA--L	.000	.00	.00	30.00	15.00	132.00
KAUKH--L	.000	.00	.00	5.00	2.50	132.00
BNDRI--A	.000	.00	.00	10.00	5.00	132.00
BAGRH--T	.000	.00	.00	26.00	13.00	132.00
MANGL--A	.000	.00	.00	14.00	7.00	132.00
PATUA--K	.000	.00	.00	10.00	5.00	132.00
ISHRD--I	.000	.00	.00	20.00	10.00	132.00
NATOR--E	.000	.00	.00	28.00	14.00	132.00
RAJSH--I	.000	.00	.00	48.00	24.00	132.00
NWBGN--G	.000	.00	.00	29.00	14.50	132.00
PABAN--A	.000	.00	.00	33.00	16.50	132.00
SHJDP--R	.000	.00	.00	17.00	8.50	132.00
BAGBR--I	.000	.00	.00	10.00	5.00	132.00
SRJGN--J	.000	.00	.00	24.00	12.00	132.00
BOGUR--A	.000	.00	.00	51.00	25.50	132.00
NAOGO--A	.000	.00	.00	36.00	18.00	132.00
PLSBR--I	.000	.00	.00	28.00	14.00	132.00

NODE	VOLTAGE P.U.	P.GEN MW	Q.GEN MVAR	P.LOAD MW	Q.LOAD MVAR	NOM.VOLTAGE.
RANGP--R	.000	.00	.00	20.00	10.00	132.00
LALMO--N	.000	.00	.00	20.00	10.00	132.00
SAIDP--R	.000	.00	.00	20.00	10.50	132.00
PRBSD--P	.000	.00	.00	25.00	12.00	132.00
THAKU--R	.000	.00	.00	26.00	13.00	132.00
RAJN--23	.000	.00	.00	.00	.00	230.00
HATZ--23	.000	.00	.00	.00	.00	230.00
COMI--23	.000	.00	.00	.00	.00	230.00
ASHU--23	.000	.00	.00	.00	.00	230.00
GRSL--23	.000	.00	.00	.00	.00	230.00
TONG--23	.000	.00	.00	.00	.00	230.00
HARI--23	.000	.00	.00	.00	.00	230.00
HASN--23	.000	.00	.00	.00	.00	230.00
MEGH--23	.000	.00	.00	.00	.00	230.00
HAR--360	.000	.00	.00	.00	.00	230.00
RAMP--23	.000	.00	.00	.00	.00	230.00
ISHR--23	.000	.00	.00	.00	.00	230.00

NETWORK DATA

NODE TO	NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
KAPTA--I	CHNDR--O	.00460	.01770	.00420	.00000	.00000	.00000	.00000	.00000
KAPTA--I	MADNH--T	.02250	.08570	.02020	.00000	.00000	.00000	.00000	.00000
KAPTA--I	HATHA--Z	.02200	.08400	.01980	.00000	.00000	.00000	.00000	.00000
KAPTA--I	HATHA--Z	.02200	.08400	.01980	.00000	.00000	.00000	.00000	.00000
CHNDR--O	MADNH--T	.01790	.06810	.01600	.00000	.00000	.00000	.00000	.00000
HATHA--Z	MADNH--T	.00520	.01990	.00470	.00000	.00000	.00000	.00000	.00000
HATHA--Z	MADNH--T	.00520	.01990	.00470	.00000	.00000	.00000	.00000	.00000
HATHA--Z	FEN----I	.05160	.19670	.04640	.00000	.00000	.00000	.00000	.00000
HATHA--Z	FEN----I	.05160	.19670	.04640	.00000	.00000	.00000	.00000	.00000
MADNH--T	SIKLB--A	.00930	.03560	.00640	.00000	.00000	.00000	.00000	.00000
MADNH--T	SIKLB--A	.00930	.03560	.00640	.00000	.00000	.00000	.00000	.00000
MADNH--T	KULSH--I	.00740	.03000	.00620	.00000	.00000	.00000	.00000	.00000
MADNH--T	KULSH--I	.00740	.03000	.00620	.00000	.00000	.00000	.00000	.00000
SIKLB--A	HLSHA--R	.00750	.02850	.00670	.00000	.00000	.00000	.00000	.00000
SIKLB--A	DOHZR--I	.01870	.07120	.01680	.00000	.00000	.00000	.00000	.00000
SIKLB--A	DOHZR--I	.01870	.07120	.01680	.00000	.00000	.00000	.00000	.00000
DOHZR--I	COXBZ--R	.04480	.17060	.04020	.00000	.00000	.00000	.00000	.00000
DOHZR--I	COXBZ--R	.04480	.17060	.04020	.00000	.00000	.00000	.00000	.00000
HATHA--Z	BARLI--A	.00700	.02650	.00630	.00000	.00000	.00000	.00000	.00000
HATHA--Z	BARLI--A	.00700	.02650	.00630	.00000	.00000	.00000	.00000	.00000
HATHA--Z	HLSHA--R	.00780	.03190	.00660	.00000	.00000	.00000	.00000	.00000
KULSH--I	BARLI--A	.00750	.02850	.00670	.00000	.00000	.00000	.00000	.00000
KULSH--I	BARLI--A	.00750	.02850	.00670	.00000	.00000	.00000	.00000	.00000
BARLI--A	COMI---N	.08120	.30940	.07290	.00000	.00000	.00000	.00000	.00000
FEN----I	COMI---N	.03680	.14030	.03310	.00000	.00000	.00000	.00000	.00000
FEN----I	COMI---N	.03680	.14030	.03310	.00000	.00000	.00000	.00000	.00000
FEN----I	CHOWM--U	.01860	.07040	.01670	.00000	.00000	.00000	.00000	.00000
FEN----I	CHOWM--U	.01860	.07040	.01670	.00000	.00000	.00000	.00000	.00000
COMI---N	HARIP--R	.04200	.16000	.03770	.00000	.00000	.00000	.00000	.00000
COMI---N	HARIP--R	.04200	.16000	.03770	.00000	.00000	.00000	.00000	.00000
COMI---N	COMI---S	.00920	.03510	.00830	.00000	.00000	.00000	.00000	.00000
COMI---N	CHNDP--R	.04460	.17010	.04010	.00000	.00000	.00000	.00000	.00000
COMI---N	CHNDP--R	.04460	.17010	.04010	.00000	.00000	.00000	.00000	.00000
HARIP--R	SIDDG--J	.00030	.00110	.00030	.00000	.00000	.00000	.00000	.00000
HARIP--R	SIDDG--J	.00030	.00110	.00030	.00000	.00000	.00000	.00000	.00000
HARIP--R	SIDDG--J	.00090	.00330	.00080	.00000	.00000	.00000	.00000	.00000
HARIP--R	SIDDG--J	.00090	.00330	.00080	.00000	.00000	.00000	.00000	.00000
HARIP--R	SHAMP--R	.01860	.07090	.01670	.00000	.00000	.00000	.00000	.00000
HARIP--R	MADNG--J	.00750	.02850	.00670	.00000	.00000	.00000	.00000	.00000
SIDDG--J	MANIK--G	.00730	.02760	.00650	.00000	.00000	.00000	.00000	.00000
SIDDG--J	MANIK--G	.00670	.02560	.00600	.00000	.00000	.00000	.00000	.00000
HARIP--R	ULLOO--N	.01030	.03910	.00920	.00000	.00000	.00000	.00000	.00000
HARIP--R	ULLOO--N	.01030	.03910	.00920	.00000	.00000	.00000	.00000	.00000
MANIK--N	NARIN--D	.00170	.00660	.00170	.00000	.00000	.00000	.00000	.00000

NODE TO	NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
MANIK--N	NARIN--D	.00170	.00660	.00170	.00000	.00000	.00000	.00000	.00000
HARIP--R	GHRAS--L	.02570	.09680	.02310	.00000	.00000	.00000	.00000	.00000
HARIP--R	BHULT--A	.01400	.05280	.01260	.00000	.00000	.00000	.00000	.00000
BHULT--A	GHRAS--L	.01170	.04400	.01050	.00000	.00000	.00000	.00000	.00000
SHAMP--R	MADNG--J	.00580	.02200	.00520	.00000	.00000	.00000	.00000	.00000
SHAMP--R	MADNG--J	.00580	.02200	.00520	.00000	.00000	.00000	.00000	.00000
MADNG--J	HASNB--D	.00900	.03450	.00810	.00000	.00000	.00000	.00000	.00000
MADNG--J	HASNB--D	.00820	.03090	.00730	.00000	.00000	.00000	.00000	.00000
SHAMP--R	HASNB--D	.01110	.04240	.01000	.00000	.00000	.00000	.00000	.00000
ULLOO--N	DHANM--O	.00320	.01220	.00290	.00000	.00000	.00000	.00000	.00000
ULLOO--N	DHANM--O	.00320	.01220	.00290	.00000	.00000	.00000	.00000	.00000
ULLOO--N	RAMPR--A	.00230	.00880	.00210	.00000	.00000	.00000	.00000	.00000
ULLOO--N	RAMPR--A	.00230	.00880	.00210	.00000	.00000	.00000	.00000	.00000
BASHU--N	TONGG--I	.00720	.02710	.00640	.00000	.00000	.00000	.00000	.00000
BASHU--N	TONGG--I	.00720	.02710	.00640	.00000	.00000	.00000	.00000	.00000
RAMPR--A	BASHU--N	.00640	.02420	.00570	.00000	.00000	.00000	.00000	.00000
RAMPR--A	BASHU--N	.00640	.02420	.00570	.00000	.00000	.00000	.00000	.00000
TONGG--I	MIRPU--R	.00840	.03200	.00760	.00000	.00000	.00000	.00000	.00000
TONGG--I	MIRPU--R	.00840	.03200	.00760	.00000	.00000	.00000	.00000	.00000
MIRPU--R	KALLY--N	.00870	.03320	.00780	.00000	.00000	.00000	.00000	.00000
MIRPU--R	KALLY--N	.00870	.03320	.00780	.00000	.00000	.00000	.00000	.00000
KALLY--N	HASNB--D	.01040	.03980	.00940	.00000	.00000	.00000	.00000	.00000
KALLY--N	HASNB--D	.01040	.03980	.00940	.00000	.00000	.00000	.00000	.00000
TONGG--I	KABRP--R	.01220	.04620	.01100	.00000	.00000	.00000	.00000	.00000
TONGG--I	KABRP--R	.01220	.04620	.01100	.00000	.00000	.00000	.00000	.00000
KABRP--R	MANIK--N	.01520	.05720	.01360	.00000	.00000	.00000	.00000	.00000
KABRP--R	MANIK--N	.01520	.05720	.01360	.00000	.00000	.00000	.00000	.00000
KABRP--R	TANGA--L	.02970	.11260	.02670	.00000	.00000	.00000	.00000	.00000
KABRP--R	TANGA--L	.02970	.11260	.02670	.00000	.00000	.00000	.00000	.00000
GHRAS--L	ASHUG--J	.02520	.09550	.02270	.00000	.00000	.00000	.00000	.00000
GHRAS--L	ASHUG--J	.02520	.09550	.02270	.00000	.00000	.00000	.00000	.00000
GHRAS--L	JYDVP--R	.01750	.06600	.01570	.00000	.00000	.00000	.00000	.00000
GHRAS--L	JYDVP--R	.01750	.06600	.01570	.00000	.00000	.00000	.00000	.00000
JYDVP--R	KABRP--R	.00870	.03320	.00780	.00000	.00000	.00000	.00000	.00000
JYDVP--R	KABRP--R	.00870	.03320	.00780	.00000	.00000	.00000	.00000	.00000
ASHUG--J	SHJIB--Z	.03020	.11120	.02270	.00000	.00000	.00000	.00000	.00000
ASHUG--J	SHJIB--Z	.03020	.11120	.02270	.00000	.00000	.00000	.00000	.00000
SHJIB--Z	SRMNG--L	.02120	.08060	.01880	.00000	.00000	.00000	.00000	.00000
SHJIB--Z	SRMNG--L	.02120	.08060	.01880	.00000	.00000	.00000	.00000	.00000
SRMNG--L	FNCHP--S	.02860	.10870	.02540	.00000	.00000	.00000	.00000	.00000
SRMNG--L	FNCHP--S	.02860	.10870	.02540	.00000	.00000	.00000	.00000	.00000
FENCG--J	FNCHP--S	.00290	.01100	.00260	.00000	.00000	.00000	.00000	.00000
FENCG--J	FNCHP--S	.00290	.01100	.00260	.00000	.00000	.00000	.00000	.00000
FNCHP--S	SYLHE--T	.01430	.05440	.01270	.00000	.00000	.00000	.00000	.00000
FNCHP--S	SYLHE--T	.01430	.05440	.01270	.00000	.00000	.00000	.00000	.00000
SYLHE--T	CHATA--K	.01870	.07200	.01660	.00000	.00000	.00000	.00000	.00000

NODE TO	NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
SYLHE--T	CHATA--K	.01870	.07200	.01660	.00000	.00000	.00000	.00000	.00000
ASHUG--J	KISHG--J	.03000	.11400	.02700	.00000	.00000	.00000	.00000	.00000
ASHUG--J	KISHG--J	.03000	.11400	.02700	.00000	.00000	.00000	.00000	.00000
KISHG--J	MYMNS--G	.03420	.12960	.03070	.00000	.00000	.00000	.00000	.00000
KISHG--J	MYMNS--G	.03420	.12960	.03070	.00000	.00000	.00000	.00000	.00000
MYMNS--G	JAMLP--R	.03180	.12080	.02870	.00000	.00000	.00000	.00000	.00000
MYMNS--G	JAMLP--R	.03180	.12080	.02870	.00000	.00000	.00000	.00000	.00000
MYMNS--G	NETRO--K	.01970	.07480	.01770	.00000	.00000	.00000	.00000	.00000
JAMLP--R	TANGA--L	.05800	.22100	.05210	.00000	.00000	.00000	.00000	.00000
JAMLP--R	TANGA--L	.05800	.22100	.05210	.00000	.00000	.00000	.00000	.00000
GOLPR--A	KLCEN--T	.00060	.00180	.00910	.00000	.00000	.00000	.00000	.00000
GOLPR--A	KLCEN--T	.00060	.00180	.00910	.00000	.00000	.00000	.00000	.00000
GOLPR--A	KLCEN--T	.00060	.00180	.00910	.00000	.00000	.00000	.00000	.00000
GOLPR--A	KLCEN--T	.00060	.00180	.00910	.00000	.00000	.00000	.00000	.00000
KLCEN--T	NOAPR--A	.01680	.04910	.01090	.00000	.00000	.00000	.00000	.00000
KLCEN--T	NOAPR--A	.01680	.04910	.01090	.00000	.00000	.00000	.00000	.00000
NOAPR--A	JESOR--E	.01930	.05620	.01280	.00000	.00000	.00000	.00000	.00000
NOAPR--A	JESOR--E	.01930	.05620	.01280	.00000	.00000	.00000	.00000	.00000
JESOR--E	JHNDA--H	.03470	.10120	.02300	.00000	.00000	.00000	.00000	.00000
JESOR--E	JHNDA--H	.03470	.10120	.02300	.00000	.00000	.00000	.00000	.00000
JHNDA--H	BOTAI--L	.03340	.09760	.02210	.00000	.00000	.00000	.00000	.00000
JHNDA--H	BOTAI--L	.03340	.09760	.02210	.00000	.00000	.00000	.00000	.00000
BOTAI--L	BHRMR--A	.01730	.05060	.01150	.00000	.00000	.00000	.00000	.00000
BOTAI--L	BHRMR--A	.01730	.05060	.01150	.00000	.00000	.00000	.00000	.00000
BHRMR--A	ISHRD--I	.00740	.02160	.00490	.00000	.00000	.00000	.00000	.00000
BHRMR--A	ISHRD--I	.00740	.02160	.00490	.00000	.00000	.00000	.00000	.00000
BHRMR--A	ISHRD--I	.00370	.01880	.00350	.00000	.00000	.00000	.00000	.00000
BHRMR--A	ISHRD--I	.00370	.01880	.00350	.00000	.00000	.00000	.00000	.00000
GOLPR--A	BAGRH--T	.03030	.09920	.02170	.00000	.00000	.00000	.00000	.00000
BAGRH--T	KAUKH--L	.02800	.09160	.02000	.00000	.00000	.00000	.00000	.00000
BAGRH--T	MANGL--A	.02440	.07620	.01480	.00000	.00000	.00000	.00000	.00000
KAUKH--L	BNDRI--A	.00600	.01950	.00430	.00000	.00000	.00000	.00000	.00000
BRISA--L	KAUKH--L	.01850	.06050	.01320	.00000	.00000	.00000	.00000	.00000
BRISA--L	PATUA--K	.02610	.09950	.02350	.00000	.00000	.00000	.00000	.00000
BRISA--L	MADAP--R	.02590	.12880	.01850	.00000	.00000	.00000	.00000	.00000
BRISA--L	MADAP--R	.02590	.12880	.01850	.00000	.00000	.00000	.00000	.00000
MADAP--R	FRIDP--R	.04990	.14800	.03200	.00000	.00000	.00000	.00000	.00000
MADAP--R	FRIDP--R	.04990	.14800	.03200	.00000	.00000	.00000	.00000	.00000
FRIDP--R	BHRMR--A	.08090	.24000	.05210	.00000	.00000	.00000	.00000	.00000
FRIDP--R	BHRMR--A	.08090	.24000	.05210	.00000	.00000	.00000	.00000	.00000
NATOR--E	BOGUR--A	.04550	.14890	.03260	.00000	.00000	.00000	.00000	.00000
NATOR--E	BOGUR--A	.04550	.14890	.03260	.00000	.00000	.00000	.00000	.00000
ISHRD--I	NATOR--E	.02100	.06870	.01510	.00000	.00000	.00000	.00000	.00000
ISHRD--I	NATOR--E	.02100	.06870	.01510	.00000	.00000	.00000	.00000	.00000
NATOR--E	RAJSH--I	.02320	.08800	.02090	.00000	.00000	.00000	.00000	.00000
NATOR--E	RAJSH--I	.02320	.08000	.02090	.00000	.00000	.00000	.00000	.00000

NODE TO	NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
RAJSH--I	NWBGN--G	.02750	.10380	.02440	.00000	.00000	.00000	.00000	.00000
BOGUR--A	NAOGO--A	.02610	.09900	.02350	.00000	.00000	.00000	.00000	.00000
BOGUR--A	PLSBR--I	.03890	.11340	.02540	.00000	.00000	.00000	.00000	.00000
BOGUR--A	PLSBR--I	.03890	.11340	.02540	.00000	.00000	.00000	.00000	.00000
PLSBR--I	RANGP--R	.03670	.12000	.02630	.00000	.00000	.00000	.00000	.00000
PLSBR--I	RANGP--R	.03670	.12000	.02630	.00000	.00000	.00000	.00000	.00000
RANGP--R	SAIDP--R	.02870	.09390	.02080	.00000	.00000	.00000	.00000	.00000
RANGP--R	SAIDP--R	.02870	.09390	.02080	.00000	.00000	.00000	.00000	.00000
RANGP--R	LALMO--N	.02220	.08390	.01970	.00000	.00000	.00000	.00000	.00000
SAIDP--R	PRBSD--P	.02300	.04830	.01050	.00000	.00000	.00000	.00000	.00000
SAIDP--R	PRBSD--P	.02300	.04830	.01050	.00000	.00000	.00000	.00000	.00000
PRBSD--P	THAKU--R	.04990	.10030	.02150	.00000	.00000	.00000	.00000	.00000
PRBSD--P	THAKU--R	.04990	.10030	.02150	.00000	.00000	.00000	.00000	.00000
ISHRD--I	BAGBR--I	.03250	.12320	.02930	.00000	.00000	.00000	.00000	.00000
ISHRD--I	PABAN--A	.00930	.03520	.00840	.00000	.00000	.00000	.00000	.00000
PABAN--A	SHJDP--R	.02600	.09900	.02350	.00000	.00000	.00000	.00000	.00000
BAGBR--I	SRJGN--J	.01970	.07480	.01780	.00000	.00000	.00000	.00000	.00000
BAGBR--I	SRJGN--J	.01970	.07480	.01780	.00000	.00000	.00000	.00000	.00000
SHJDP--R	BAGBR--I	.00460	.01350	.00310	.00000	.00000	.00000	.00000	.00000
SRJGN--J	BOGUR--A	.03830	.14520	.03450	.00000	.00000	.00000	.00000	.00000
SRJGN--J	BOGUR--A	.03830	.14520	.03450	.00000	.00000	.00000	.00000	.00000
RAJN--23	HATZ--23	.00180	.01240	.04700	.00000	.00000	.00000	.00000	.00000
RAJN--23	HATZ--23	.00180	.01240	.04700	.00000	.00000	.00000	.00000	.00000
RAJN--23	HATZ--23	.00180	.01240	.04700	.00000	.00000	.00000	.00000	.00000
HATZ--23	COMI--23	.01160	.07970	.30300	.00000	.00000	.00000	.00000	.00000
HATZ--23	COMI--23	.01160	.07970	.30300	.00000	.00000	.00000	.00000	.00000
COMI--23	ASHU--23	.00870	.06000	.12090	.00000	.00000	.00000	.00000	.00000
COMI--23	ASHU--23	.00870	.06000	.12090	.00000	.00000	.00000	.00000	.00000
ASHU--23	GRSL--23	.00660	.03480	.06520	.00000	.00000	.00000	.00000	.00000
ASHU--23	GRSL--23	.00660	.03480	.06520	.00000	.00000	.00000	.00000	.00000
GRSL--23	TONG--23	.00410	.02080	.04020	.00000	.00000	.00000	.00000	.00000
GRSL--23	TONG--23	.00410	.02080	.04020	.00000	.00000	.00000	.00000	.00000
GRSL--23	RAMP--23	.00290	.01980	.07590	.00000	.00000	.00000	.00000	.00000
GRSL--23	RAMP--23	.00290	.01980	.07590	.00000	.00000	.00000	.00000	.00000
RAMP--23	HARI--23	.00240	.02100	.04460	.00000	.00000	.00000	.00000	.00000
RAMP--23	HARI--23	.00240	.02100	.04460	.00000	.00000	.00000	.00000	.00000
MEGH--23	HASN--23	.00300	.02090	.07980	.00000	.00000	.00000	.00000	.00000
MEGH--23	HASN--23	.00300	.02090	.07980	.00000	.00000	.00000	.00000	.00000
COMI--23	MEGH--23	.00500	.03300	.12650	.00000	.00000	.00000	.00000	.00000
COMI--23	MEGH--23	.00500	.03300	.12650	.00000	.00000	.00000	.00000	.00000
MEGH--23	HARI--23	.00160	.01100	.04180	.00000	.00000	.00000	.00000	.00000
MEGH--23	HARI--23	.00160	.01100	.04180	.00000	.00000	.00000	.00000	.00000
HAR--360	HARI--23	.00020	.00110	.00420	.00000	.00000	.00000	.00000	.00000
HAR--360	HARI--23	.00020	.00110	.00420	.00000	.00000	.00000	.00000	.00000
GRSL--23	ISHR--23	.02670	.13710	.26490	.00000	.00000	.00000	.00000	.00000
GRSL--23	ISHR--23	.02670	.13710	.26490	.00000	.00000	.00000	.00000	.00000

NODE TO	NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
THAKU--R	THAKU--R	.00000	-2.85710	.00000	.00000	.00000	.00000	.00000	.00000
SAIDP--R	SAIDP--R	.00000	-2.50000	.00000	.00000	.00000	.00000	.00000	.00000
RANGP--R	RANGP--R	.00000	-2.50000	.00000	.00000	.00000	.00000	.00000	.00000
RAJSH--I	RAJSH--I	.00000	-5.00000	.00000	.00000	.00000	.00000	.00000	.00000
BOGUR--A	BOGUR--A	.00000	-3.33330	.00000	.00000	.00000	.00000	.00000	.00000
NATOR--E	NATOR--E	.00000	-5.00000	.00000	.00000	.00000	.00000	.00000	.00000
ISHRD--I	ISHRD--I	.00000	-3.33330	.00000	.00000	.00000	.00000	.00000	.00000
JHNDA--H	JHNDA--H	.00000	-10.00000	.00000	.00000	.00000	.00000	.00000	.00000
JESOR--E	JESOR--E	.00000	-6.66670	.00000	.00000	.00000	.00000	.00000	.00000
KLCEN--T	KLCEN--T	.00000	-3.00000	.00000	.00000	.00000	.00000	.00000	.00000
PATUA--K	PATUA--K	.00000	-1.50000	.00000	.00000	.00000	.00000	.00000	.00000
TONGG--I	TONGG--I	.00000	-10.00000	.00000	.00000	.00000	.00000	.00000	.00000
DHANM--O	DHANM--O	.00000	-2.40000	.00000	.00000	.00000	.00000	.00000	.00000
ULLOO--N	ULLOO--N	.00000	-2.40000	.00000	.00000	.00000	.00000	.00000	.00000
RAMPR--A	RAMPR--A	.00000	-2.40000	.00000	.00000	.00000	.00000	.00000	.00000
SHAMP--R	SHAMP--R	.00000	-2.40000	.00000	.00000	.00000	.00000	.00000	.00000
TONGG--I	TONGG--I	.00000	-4.66670	.00000	.00000	.00000	.00000	.00000	.00000
MADNH--T	MADNH--T	.00000	-6.66670	.00000	.00000	.00000	.00000	.00000	.00000
KULSH--I	KULSH--I	.00000	-6.66670	.00000	.00000	.00000	.00000	.00000	.00000
HLSHA--R	HLSHA--R	.00000	-5.00000	.00000	.00000	.00000	.00000	.00000	.00000
KPT--123	KAPTA--I	.00000	.22220	.00000	.00000	.00000	.00000	.00000	.00000
KPT--123	KAPTA--I	.00000	.22220	.00000	.00000	.00000	.00000	.00000	.00000
KPT--123	KAPTA--I	.00000	.22600	.00000	.00000	.00000	.00000	.00000	.00000
KPT---45	KAPTA--I	.00000	.17600	.00000	.00000	.00000	.00000	.00000	.00000
KPT---45	KAPTA--I	.00000	.17600	.00000	.00000	.00000	.00000	.00000	.00000
RAZ2x210	RAJN--23	.00000	.04330	.00000	.00000	.00000	.00000	.00000	.00000
RAZ2x210	RAJN--23	.00000	.04330	.00000	.00000	.00000	.00000	.00000	.00000
SK--1X60	SIKLB--A	.00000	.14600	.00000	.00000	.00000	.00000	.00000	.00000
SK--2X28	SIKLB--A	.00000	.14600	.00000	.00000	.00000	.00000	.00000	.00000
HRP---CC	HARIP--R	.00000	.16970	.00000	.00000	.00000	.00000	.00000	.00000
HARI-360	HAR--360	.00000	.07430	.00000	.00000	.00000	.00000	.00000	.00000
HARI-360	HAR--360	.00000	.07430	.00000	.00000	.00000	.00000	.00000	.00000
SD----50	SIDDG--J	.00000	.14600	.00000	.00000	.00000	.00000	.00000	.00000
AES--450	MEGH--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
AES--450	MEGH--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
AES--450	MEGH--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
AS--2X64	RAJN--23	.00000	.11000	.00000	.00000	.00000	.00000	.00000	.00000
AS--1X90	RAJN--23	.00000	.16970	.00000	.00000	.00000	.00000	.00000	.00000
AS--1X90	RAJN--23	.00000	.35550	.00000	.00000	.00000	.00000	.00000	.00000
AS--1X60	RAJN--23	.00000	.16970	.00000	.00000	.00000	.00000	.00000	.00000
AS--3150	ASHU--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
AS--3150	ASHU--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
AS--3150	ASHU--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
MYM--070	MYMNS--G	.00000	.10000	.00000	.00000	.00000	.00000	.00000	.00000
GH--2X55	GHRAS--L	.00000	.19630	.00000	.00000	.00000	.00000	.00000	.00000
GH--2X55	GHRAS--L	.00000	.19630	.00000	.00000	.00000	.00000	.00000	.00000

NODE TO	NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
GH--3210	GRSL--23	.00000	.04480	.00000	.00000	.00000	.00000	.00000	.00000
GH--3210	GRSL--23	.00000	.04480	.00000	.00000	.00000	.00000	.00000	.00000
GH--3210	GRSL--23	.00000	.04480	.00000	.00000	.00000	.00000	.00000	.00000
GH--1210	GRSL--23	.00000	.04480	.00000	.00000	.00000	.00000	.00000	.00000
SY--1X20	SYLHE--T	.00000	.44280	.00000	.00000	.00000	.00000	.00000	.00000
SHZ---80	SHJIB--Z	.00000	.10000	.00000	.00000	.00000	.00000	.00000	.00000
SHZ---70	SHJIB--Z	.00000	.10000	.00000	.00000	.00000	.00000	.00000	.00000
FNC--090	FNCHP--S	.00000	.09500	.00000	.00000	.00000	.00000	.00000	.00000
KL--1110	GOLPR--A	.00000	.09500	.00000	.00000	.00000	.00000	.00000	.00000
KL--1X60	GOLPR--A	.00000	.14900	.00000	.00000	.00000	.00000	.00000	.00000
KPC----L	GOLPR--A	.00000	.09500	.00000	.00000	.00000	.00000	.00000	.00000
KL--2X28	GOLPR--A	.00000	.14600	.00000	.00000	.00000	.00000	.00000	.00000
BR---140	BRISA--L	.00000	.54280	.00000	.00000	.00000	.00000	.00000	.00000
BH--3X20	BHRMR--A	.00000	.43120	.00000	.00000	.00000	.00000	.00000	.00000
BH--3X20	BHRMR--A	.00000	.43120	.00000	.00000	.00000	.00000	.00000	.00000
BH--3X20	BHRMR--A	.00000	.43120	.00000	.00000	.00000	.00000	.00000	.00000
SP--1X20	SAIDP--R	.00000	.44280	.00000	.00000	.00000	.00000	.00000	.00000
RP--1X20	RANGP--R	.00000	.53570	.00000	.00000	.00000	.00000	.00000	.00000
BG----71	BAGBR--I	.00000	.10000	.00000	.00000	.00000	.00000	.00000	.00000
IPP--090	BAGBR--I	.00000	.10000	.00000	.00000	.00000	.00000	.00000	.00000
BG---100	BAGBR--I	.00000	.10000	.00000	.00000	.00000	.00000	.00000	.00000
HATZ--23	HATHA--Z	.00000	.10660	.00000	.00000	.00000	.00000	.00000	.00000
HATZ--23	HATHA--Z	.00000	.10660	.00000	.00000	.00000	.00000	.00000	.00000
HATZ--23	HATHA--Z	.00000	.10660	.00000	.00000	.00000	.00000	.00000	.00000
ASHU--23	ASHUG--J	.00000	.10660	.00000	.00000	.00000	.00000	.00000	.00000
ASHU--23	ASHUG--J	.00000	.10660	.00000	.00000	.00000	.00000	.00000	.00000
GRSL--23	GHRAS--L	.00000	.07700	.00000	.00000	.00000	.00000	.00000	.00000
GRSL--23	GHRAS--L	.00000	.07700	.00000	.00000	.00000	.00000	.00000	.00000
TONG--23	TONGG--I	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
TONG--23	TONGG--I	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
COMI--23	COMI---N	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
COMI--23	COMI---N	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
HARI--23	HARIP--R	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
HARI--23	HARIP--R	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
HASN--23	HASNB--D	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
HASN--23	HASNB--D	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
RAMP--23	RAMPR--A	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
RAMP--23	RAMPR--A	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
ISHR--23	ISHRD--I	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
ISHR--23	ISHRD--I	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
ISHR--23	ISHRD--I	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000

MACHINES' DATA

	Installed Capacity(MW)	x'_d	H
KPT--123	130	.2150	6.36
KPT---45	100	.1760	4.79
RAZ2x210	420	.0810	24.70
SK--1X60	60	.2920	3.64
SK--2X28	56	.3710	1.64
HRP---CC	99	.1910	1.15
HARI-360	360	.0510	8.75
SD----50	50	.4640	2.88
AES--450	450	.0410	11.34
GH--2X55	110	.1460	8.75
GH--3210	630	.0430	37.05
GH--1210	210	.1300	12.35
AS--2X64	128	.1030	7.84
AS--1X90	90	.1360	6.92
AS--1X60	60	.2010	5.46
AS--3150	450	.0460	11.34
MYM--070	70	.2160	4.29
SHZ---80	80	.1810	4.29
SHZ---70	70	.2160	4.29
FNC--090	90	.1290	0.37
SY--1X20	20	.9230	1.99
KL--1X60	60	.2920	3.64
KL--1110	110	.2000	1.44
KPC----L	110	.3430	4.87
KL--2X28	56	.2760	4.87
BR---140	40	.4680	3.85
BH--3X20	60	.2530	5.92
BG----71	71	.2170	4.29
IPP--090	90	.1750	0.37
BG---100	100	.1790	1.44
RP--1X20	20	.9680	1.93
SP--1X20	20	.9680	1.93

FAULT AT BUS= 121
SL.NO.OF FAULTY LINES TRIPPED = 181
FAULT CLEARING TIME= .0800

LOAD FLOW OUTPUT

TOTAL NUMBER OF ELECTRICAL NODES = 121
TOTAL NUMBER OF LINES INCLUDING TRANSFORMERS = 249
TOTAL NO. OF IN-PHASE TRANSFORMERS = 0
NO.OF CONTROLLABLE IN-PHASE TRANSFORMERS = 0
NO.OF FIXED TAP IN-PHASE TRANSFORMERS = 0
NO.OF REACTORS = 20

BASE CASE LOAD FLOW CONVERGED IN 6 ITERATIONS

BUS VOLTAGE AND GENERATION

BUS NO.	BUS NAME	BUS TYPE	VOLTAGE KV	VOLTAGE PU	VOLTAGE ANG	GENERATION MW	GENERATION MVAR	LOAD MW	LOAD MVAR	MISMATCH MW	MISMATCH MVAR
1	KPT--123	PV	11.0	1.00	4.6	90.0	17.0	1.5	.8	.00	.00
2	KPT---45	PV	11.0	1.00	5.8	100.0	16.5	2.0	1.0	.00	.00
3	RAZ2x210	PV	15.7	1.05	8.4	360.0	118.0	28.0	14.0	.00	.00
4	SK--1X60	PV	11.0	1.00	3.3	60.0	21.8	4.0	2.0	.00	.00
5	SK--2X28	PV	11.0	1.00	3.2	56.0	20.2	1.0	.5	.00	.00
6	HRP---CC	PV	11.0	1.00	1.6	100.0	33.3	1.0	.5	.00	.00
7	HARI-360	PV	15.7	1.05	3.8	360.0	171.5	8.0	4.0	.00	.00
8	SD----50	PV	11.0	1.00	-4.4	50.0	31.5	3.0	1.5	.00	.00
9	AES--450	PV	15.7	1.05	1.9	400.0	239.7	12.0	6.0	.00	.00
10	GH--2X55	PV	11.0	1.00	-5.1	80.0	50.1	30.0	15.0	.00	.00
11	GH--3210	SLACK	15.7	1.05	.0	544.0	341.0	40.0	20.0	.00	.00
12	GH--1210	PV	15.7	1.05	.5	200.0	114.5	12.0	6.0	.00	.00
13	AS--2X64	PV	13.6	1.05	7.3	50.0	21.4	4.0	2.0	.00	.00
14	AS--1X90	PV	13.6	1.05	9.3	80.0	21.7	2.0	1.0	.00	.00
15	AS--1X60	PV	13.6	1.05	8.7	50.0	15.5	4.0	2.0	.00	.00
16	AS--3150	PV	15.7	1.05	.9	300.0	166.4	24.0	12.0	.00	.00
17	MYM--070	PV	11.0	1.00	-4.8	70.0	40.6	2.0	1.0	.00	.00
18	SHZ---80	PV	11.0	1.00	-.4	60.0	15.3	3.0	1.5	.00	.00
19	SHZ---70	PV	11.0	1.00	.3	70.0	15.1	1.0	.5	.00	.00
20	FNC--090	PV	11.0	1.00	.4	90.0	39.4	2.0	1.0	.00	.00
21	SY--1X20	PV	11.0	1.00	-.6	20.0	12.3	1.0	.5	.00	.00
22	KL--1X60	PV	11.0	1.00	-11.3	60.0	15.6	.0	.0	.00	.00
23	KL--1110	PV	11.0	1.00	-10.6	110.0	27.7	4.0	2.0	.00	.00
24	KPC----L	PV	11.0	1.00	-13.3	60.0	22.8	2.0	1.0	.00	.00
25	KL--2X28	PV	11.0	1.00	-11.8	56.0	15.9	1.0	.5	.00	.00
26	BR---140	PV	11.0	1.00	-10.8	40.0	8.4	2.0	1.0	.00	.00
27	BH--3X20	PV	11.0	1.00	-13.3	54.0	26.7	.5	.3	.00	.00
28	BG----71	PV	11.0	1.00	-11.1	71.0	19.1	1.0	.5	.00	.00
29	IPP--090	PV	11.0	1.00	-10.1	90.0	21.5	3.0	1.5	.00	.00
30	BG---100	PV	11.0	1.00	-9.4	100.0	21.6	1.0	.5	.00	.00
31	RP--1X20	PV	11.0	1.00	-27.4	20.0	5.5	2.0	1.0	.00	.00
32	SP--1X20	PV	11.0	1.00	-30.3	20.0	3.0	2.0	1.0	.00	.00
33	KAPTA--I	PQ	130.7	.99	.8	.0	.0	5.0	2.5	.00	.00
34	CHNDR--O	PQ	130.0	.99	.2	.0	.0	22.0	11.0	.00	.00
35	HATHA--Z	PQ	129.5	.98	-1.2	.0	.0	61.0	30.5	.00	.00
36	MADNH--T	PQ	129.1	.98	-1.3	.0	.0	49.0	24.5	.00	.00
37	SIKLB--A	PQ	128.6	.97	-1.5	.0	.0	15.0	7.5	.00	.00
38	DOHZR--I	PQ	126.4	.96	-2.9	.0	.0	44.0	22.0	.00	.00
39	COXBZ--R	PQ	124.4	.94	-4.1	.0	.0	26.0	13.0	.00	.00
40	HLSHA--R	PQ	127.9	.97	-2.2	.0	.0	100.0	50.0	.00	.00
41	KULSH--I	PQ	128.7	.97	-1.8	.0	.0	50.0	25.0	.00	.00
42	BARLI--A	PQ	128.7	.98	-1.8	.0	.0	60.0	30.0	.00	.00
43	FEN----I	PQ	126.2	.96	-5.4	.0	.0	37.0	18.0	.00	.00
44	CHOWM--U	PQ	124.9	.95	-6.2	.0	.0	37.0	18.0	.00	.00
45	COMI---N	PQ	128.6	.97	-5.6	.0	.0	49.0	24.0	.00	.00
46	COMI---S	PQ	125.8	.95	-7.0	.0	.0	74.0	37.0	.00	.00
47	CHNDP--R	PQ	125.7	.95	-7.3	.0	.0	36.0	18.0	.00	.00
48	HARIP--R	PQ	126.6	.96	-8.5	.0	.0	65.0	32.5	.01	.00
49	SIDDG--J	PQ	126.5	.96	-8.5	.0	.0	160.0	80.0	.00	.00
50	MANIK--N	PQ	118.5	.90	-13.4	.0	.0	35.0	17.5	.00	.00
51	ULLOO--N	PQ	125.8	.95	-10.0	.0	.0	120.0	60.0	.00	-.01

BUS NO.	BUS NAME	BUS TYPE	VOLTAGE KV	PU	ANG	GENERATION MW	MVAR	LOAD MW	MVAR	MISMATCH MW	MVAR
52	DHANM--O	PQ	125.3	.95	-10.4	.0	.0	120.0	60.0	.00	.00
53	RAMPR--A	PQ	126.3	.96	-9.7	.0	.0	80.0	40.0	.00	.00
54	NARIN--D	PQ	118.3	.90	-13.5	.0	.0	60.0	30.0	.00	.00
55	SHAMP--R	PQ	124.2	.94	-10.2	.0	.0	110.0	55.0	.00	.00
56	MADNG--J	PQ	124.4	.94	-9.9	.0	.0	78.0	39.0	.00	.00
57	HASNB--D	PQ	124.7	.94	-9.6	.0	.0	115.0	58.0	.00	.00
58	MIRPU--R	PQ	122.6	.93	-11.2	.0	.0	98.0	49.0	.00	.00
59	KALLY--N	PQ	122.4	.93	-11.1	.0	.0	115.0	58.0	.00	.00
60	BASHU--N	PQ	124.7	.94	-10.4	.0	.0	110.0	56.0	.00	.00
61	TONGG--I	PQ	124.5	.94	-10.4	.0	.0	100.0	50.0	.00	.00
62	KABRP--R	PQ	121.5	.92	-11.8	.0	.0	64.0	33.0	.00	.00
63	MANIK--G	PQ	126.1	.96	-8.7	.0	.0	32.0	16.0	.00	.00
64	TANGA--L	PQ	120.8	.92	-12.5	.0	.0	45.0	22.0	.00	.00
65	GHRAS--L	PQ	127.6	.97	-8.0	.0	.0	100.0	50.0	.00	.00
66	JYDVP--R	PQ	122.6	.93	-11.0	.0	.0	80.0	40.0	.00	.00
67	BHULT--A	PQ	126.2	.96	-8.7	.0	.0	40.0	20.0	.00	.00
68	ASHUG--J	PQ	129.9	.98	-6.0	.0	.0	50.0	25.0	.00	.00
69	KISHG--J	PQ	128.0	.97	-7.7	.0	.0	25.0	12.0	.00	.00
70	MYMNS--G	PQ	127.1	.96	-8.8	.0	.0	20.0	10.0	.00	.00
71	JAMLP--R	PQ	123.7	.94	-10.9	.0	.0	35.0	17.0	.00	.00
72	NETRO--K	PQ	126.0	.95	-9.4	.0	.0	15.0	7.5	.00	.00
73	SHJIB--Z	PQ	130.4	.99	-3.7	.0	.0	25.0	12.5	.00	.00
74	SRMNG--L	PQ	128.8	.98	-4.4	.0	.0	25.0	12.5	.00	.00
75	FENCG--J	PQ	127.6	.97	-4.6	.0	.0	20.0	10.0	.00	.00
76	FNCHP--S	PQ	127.7	.97	-4.5	.0	.0	.0	.0	.00	.00
77	SYLHE--T	PQ	125.6	.95	-5.7	.0	.0	75.0	37.5	.00	.00
78	CHATA--K	PQ	124.9	.95	-6.1	.0	.0	20.0	10.0	.00	.00
79	GOLPR--A	PQ	129.5	.98	-16.5	.0	.0	6.0	3.0	-.02	-.01
80	KLCEN--T	PQ	129.4	.98	-16.5	.0	.0	105.0	52.5	.00	.01
81	NOAPR--A	PQ	127.3	.96	-17.9	.0	.0	12.0	6.0	.00	.00
82	JESOR--E	PQ	125.2	.95	-19.3	.0	.0	72.0	36.0	.00	.00
83	JHNDA--H	PQ	124.6	.94	-19.7	.0	.0	43.0	21.0	.00	.00
84	BOTAI--L	PQ	125.7	.95	-18.9	.0	.0	43.0	21.0	.00	.00
85	BHRMR--A	PQ	127.4	.97	-17.9	.0	.0	25.0	12.5	-.01	.00
86	FRIDP--R	PQ	125.8	.95	-21.9	.0	.0	33.0	16.5	.00	.00
87	MADAP--R	PQ	127.1	.96	-23.0	.0	.0	25.0	12.5	-.01	.00
88	BRISA--L	PQ	129.6	.98	-23.0	.0	.0	30.0	15.0	.00	.00
89	KAUKH--L	PQ	127.9	.97	-22.3	.0	.0	5.0	2.5	.00	.00
90	BNDRI--A	PQ	127.7	.97	-22.4	.0	.0	10.0	5.0	.00	.00
91	BAGRH--T	PQ	126.5	.96	-20.5	.0	.0	26.0	13.0	.00	.00
92	MANGL--A	PQ	125.4	.95	-21.1	.0	.0	14.0	7.0	.00	.00
93	PATUA--K	PQ	137.9	1.04	-24.5	.0	.0	10.0	5.0	.00	.00
94	ISHRD--I	PQ	127.6	.97	-17.6	.0	.0	20.0	10.0	.01	-.01
95	NATOR--E	PQ	125.0	.95	-21.4	.0	.0	28.0	14.0	.02	.00
96	RAJSH--I	PQ	122.5	.93	-23.3	.0	.0	48.0	24.0	-.01	.00
97	NWBGN--G	PQ	119.3	.90	-25.1	.0	.0	29.0	14.5	-.01	.00
98	PABAN--A	PQ	127.2	.96	-17.5	.0	.0	33.0	16.5	.00	.00
99	SHJDP--R	PQ	129.3	.98	-15.5	.0	.0	17.0	8.5	.00	.00
100	BAGBR--I	PQ	129.9	.98	-15.2	.0	.0	10.0	5.0	-.02	.00
101	SRJGN--J	PQ	127.3	.96	-18.7	.0	.0	24.0	12.0	.02	.00
102	BOGUR--A	PQ	124.8	.95	-24.9	.0	.0	51.0	25.5	.01	-.01
103	NAOGO--A	PQ	120.9	.92	-26.9	.0	.0	36.0	18.0	-.01	.00
104	PLSBR--I	PQ	125.9	.95	-29.4	.0	.0	28.0	14.0	-.01	.00
105	RANGP--R	PQ	129.5	.98	-33.0	.0	.0	20.0	10.0	-.02	.00
106	LALMO--N	PQ	127.8	.97	-33.9	.0	.0	20.0	10.0	-.01	.00
107	SAIDP--R	PQ	131.3	.99	-34.9	.0	.0	20.0	10.5	-.02	.00
108	PRBSD--P	PQ	130.9	.99	-35.7	.0	.0	25.0	12.0	-.01	.00
109	THAKU--R	PQ	131.6	1.00	-36.8	.0	.0	26.0	13.0	-.01	.00
110	RAJN--23	PQ	237.1	1.03	4.6	.0	.0	.0	.0	.00	.00
111	HATZ--23	PQ	235.3	1.02	3.5	.0	.0	.0	.0	.00	.00
112	COMI--23	PQ	230.5	1.00	-2.4	.0	.0	.0	.0	.00	.00
113	ASHU--23	PQ	234.0	1.02	-2.6	.0	.0	.0	.0	.00	.00
114	GRSL--23	PQ	231.6	1.01	-4.1	.0	.0	.0	.0	.02	.00
115	TONG--23	PQ	226.2	.98	-5.6	.0	.0	.0	.0	.00	.00
116	HARI--23	PQ	229.4	1.00	-3.5	.0	.0	.0	.0	.00	-.02
117	HASN--23	PQ	225.8	.98	-4.7	.0	.0	.0	.0	.00	.00

BUS NO.	BUS NAME	BUS TYPE	VOLTAGE KV	PU	ANG	GENERATION MW	MVAR	LOAD MW	MVAR	MISMATCH MW	MVAR
118	MEGH--23	PQ	230.4	1.00	-3.0	.0	.0	.0	.0	.00	.00
119	HAR--360	PQ	229.7	1.00	-3.4	.0	.0	.0	.0	.00	.00
120	RAMP--23	PQ	228.4	.99	-4.7	.0	.0	.0	.0	.00	.00
121	ISHR--23	PQ	222.3	.97	-14.7	.0	.0	.0	.0	.03	.00
						3871.0	1710.6	3800.0	1899.0	-.02	-.07

LINE FLOW

FROM BUS	TO BUS	SENT MW	SENT MVAR	RECEIVED MW	RECEIVED MVAR	LOSSES MW	LOSSES MVAR
KAPTA--I	CHNDR--O	60.055020	11.874460	-59.878900	-11.606310	.176117	.268151
KAPTA--I	MADNH--T	42.640020	2.898076	-42.219250	-3.251068	.420776	-.352992
KAPTA--I	HATHA--Z	39.402450	-.127733	-39.053880	-.465187	.348572	-.592921
KAPTA--I	HATHA--Z	39.402450	-.127733	-39.053880	-.465187	.348572	-.592921
CHNDR--O	MADNH--T	37.879200	.606788	-37.614220	-1.139918	.264977	-.533130
HATHA--Z	MADNH--T	17.603790	12.375700	-17.578420	-12.729880	.025375	-.354183
HATHA--Z	MADNH--T	17.603790	12.375700	-17.578420	-12.729880	.025375	-.354183
HATHA--Z	FEN----I	36.595890	1.959188	-35.868690	-3.542071	.727196	-1.582883
HATHA--Z	FEN----I	36.595890	1.959188	-35.868690	-3.542071	.727196	-1.582883
MADNH--T	SIKLB--A	8.497920	6.288255	-8.486697	-6.855116	.011223	-.566861
MADNH--T	SIKLB--A	8.497920	6.288255	-8.486697	-6.855116	.011223	-.566861
MADNH--T	KULSH--I	24.496890	3.556783	-24.449290	-3.954690	.047602	-.397907
MADNH--T	KULSH--I	24.496890	3.556783	-24.449290	-3.954690	.047602	-.397907
SIKLB--A	HLSHA--R	42.203850	8.055134	-42.057660	-8.132232	.146194	-.077098
SIKLB--A	DOHZR--I	35.384750	13.770070	-35.096430	-14.239930	.288326	-.469853
SIKLB--A	DOHZR--I	35.384750	13.770070	-35.096430	-14.239930	.288326	-.469853
DOHZR--I	COXBZ--R	13.096420	3.239894	-12.999960	-6.499998	.096461	-3.260104
DOHZR--I	COXBZ--R	13.096420	3.239894	-12.999960	-6.499998	.096461	-3.260104
HATHA--Z	BARLI--A	40.421290	11.907640	-40.291770	-12.019550	.129520	-.111909
HATHA--Z	BARLI--A	40.421290	11.907640	-40.291770	-12.019550	.129520	-.111909
HATHA--Z	HLSHA--R	58.264160	23.781510	-57.942100	-23.091740	.322056	.689768
*BARLI--A	KULSH--I	.550861	.782781	-.550707	-1.418988	.000154	-.636207
*BARLI--A	KULSH--I	.550861	.782781	-.550707	-1.418988	.000154	-.636207
BARLI--A	COMI---N	19.481760	-7.527909	-19.143530	1.893571	.338234	-5.634338
*COMI---N	FEN----I	1.272704	10.400130	-1.216492	-13.268960	.056212	-2.868829
*COMI---N	FEN----I	1.272704	10.400130	-1.216492	-13.268960	.056212	-2.868829
FEN----I	CHOWM--U	18.585110	7.811163	-18.499900	-8.999978	.085217	-1.188815
FEN----I	CHOWM--U	18.585110	7.811163	-18.499900	-8.999978	.085217	-1.188815
COMI---N	HARIP--R	29.587480	.201008	-29.198100	-2.239622	.389380	-2.038614
COMI---N	HARIP--R	29.587480	.201008	-29.198100	-2.239622	.389380	-2.038614
COMI---N	COMI---S	74.690080	38.863690	-73.999510	-36.999690	.690567	1.864002
COMI---N	CHNDP--R	18.184620	5.984547	-17.999890	-8.999954	.184734	-3.015408
COMI---N	CHNDP--R	18.184620	5.984547	-17.999890	-8.999954	.184734	-3.015408
HARIP--R	SIDDG--J	54.404810	26.082190	-54.392270	-26.072200	.012543	.009995
HARIP--R	SIDDG--J	54.404810	26.082190	-54.392270	-26.072200	.012543	.009995
HARIP--R	SIDDG--J	18.134940	8.663740	-18.130750	-8.721027	.004181	-.057287
HARIP--R	SIDDG--J	18.134940	8.663740	-18.130750	-8.721027	.004181	-.057287
HARIP--R	SHAMP--R	43.136020	13.350120	-42.719470	-13.269390	.416546	.080724
HARIP--R	MADNG--J	90.183200	33.833020	-89.424930	-31.557520	.758263	2.275492
SIDDG--J	MANIK--G	15.426330	7.191246	-15.403010	-7.698167	.023326	-.506921
SIDDG--J	MANIK--G	16.621920	7.848101	-16.596870	-8.302068	.025047	-.453967
HARIP--R	ULLOO--N	61.684590	-.852879	-61.258430	1.629843	.426155	.776964
HARIP--R	ULLOO--N	61.684590	-.852879	-61.258430	1.629843	.426155	.776964
MANIK--N	NARIN--D	30.022470	14.957330	-29.998940	-15.001090	.023533	-.043766
MANIK--N	NARIN--D	30.022470	14.957330	-29.998940	-15.001090	.023533	-.043766
*GHRAS--L	HARIP--R	8.540920	4.408306	-8.512558	-6.443570	.028362	-2.035264
HARIP--R	BHULT--A	9.685405	2.780137	-9.669411	-3.874865	.015994	-1.094728
*GHRAS--L	BHULT--A	30.479350	15.715710	-30.330200	-16.125220	.149155	-.409505
*MADNG--J	SHAMP--R	21.823080	.335791	-21.791930	-.678715	.031145	-.342924
*MADNG--J	SHAMP--R	21.823080	.335791	-21.791930	-.678715	.031145	-.342924

FROM BUS	TO BUS	SENT MW	SENT MVAR	RECEIVED MW	RECEIVED MVAR	LOSSES MW	LOSSES MVAR
*HASNB--D	MADNG--J	15.249580	3.280061	-15.224740	-3.905853	.024845	-.625792
*HASNB--D	MADNG--J	17.024310	3.663906	-16.996190	-4.207579	.028124	-.543673
*HASNB--D	SHAMP--R	23.767220	2.882686	-23.695680	-3.498222	.071543	-.615536
ULLOO--N	DHANM--O	60.131320	11.459090	-59.999170	-11.216800	.132156	.242292
ULLOO--N	DHANM--O	60.131320	11.459090	-59.999170	-11.216800	.132156	.242292
*RAMPR--A	ULLOO--N	58.973930	24.367420	-58.871430	-24.167850	.102501	.199574
*RAMPR--A	ULLOO--N	58.973930	24.367420	-58.871430	-24.167850	.102501	.199574
BASHU--N	TONGG--I	1.790968	4.713819	-1.788731	-5.275250	.002238	-.561431
BASHU--N	TONGG--I	1.790968	4.713819	-1.788731	-5.275250	.002238	-.561431
RAMPR--A	BASHU--N	57.097550	33.359780	-56.790560	-32.714090	.306992	.645691
RAMPR--A	BASHU--N	57.097550	33.359780	-56.790560	-32.714090	.306992	.645691
TONGG--I	MIRPU--R	44.537770	29.308310	-44.267270	-28.943490	.270493	.364815
TONGG--I	MIRPU--R	44.537770	29.308310	-44.267270	-28.943490	.270493	.364815
*KALLY--N	MIRPU--R	4.736317	-5.098403	-4.731677	4.444007	.004640	-.654396
*KALLY--N	MIRPU--R	4.736317	-5.098403	-4.731677	4.444007	.004640	-.654396
*HASNB--D	KALLY--N	62.770400	25.124320	-62.235520	-23.901210	.534878	1.223112
*HASNB--D	KALLY--N	62.770400	25.124320	-62.235520	-23.901210	.534878	1.223112
TONGG--I	KABRP--R	52.406870	31.116460	-51.892830	-30.125030	.514046	.991434
TONGG--I	KABRP--R	52.406870	31.116460	-51.892830	-30.125030	.514046	.991434
KABRP--R	MANIK--N	48.049630	24.568420	-47.522370	-23.708760	.527260	.859659
KABRP--R	MANIK--N	48.049630	24.568420	-47.522370	-23.708760	.527260	.859659
KABRP--R	TANGA--L	10.080790	.900756	-10.043770	-3.010363	.037025	-2.109607
KABRP--R	TANGA--L	10.080790	.900756	-10.043770	-3.010363	.037025	-2.109607
*ASHUG--J	GHRAS--L	37.697810	7.212693	-37.309930	-7.902545	.387890	-.689852
*ASHUG--J	GHRAS--L	37.697810	7.212693	-37.309930	-7.902545	.387890	-.689852
GHRAS--L	JYDVP--R	79.844930	35.835870	-78.401080	-31.801280	1.443855	4.034590
GHRAS--L	JYDVP--R	79.844930	35.835870	-78.401080	-31.801280	1.443855	4.034590
JYDVP--R	KABRP--R	38.401280	11.801570	-38.237550	-11.843900	.163731	-.042330
JYDVP--R	KABRP--R	38.401280	11.801570	-38.237550	-11.843900	.163731	-.042330
*SHJIB--Z	ASHUG--J	33.593130	-6.096893	-33.236140	5.205081	.356991	-.891812
*SHJIB--Z	ASHUG--J	33.593130	-6.096893	-33.236140	5.205081	.356991	-.891812
SHJIB--Z	SRMNG--L	16.907090	9.855709	-16.819770	-11.335380	.087328	-1.479667
SHJIB--Z	SRMNG--L	16.907090	9.855709	-16.819770	-11.335380	.087328	-1.479667
SRMNG--L	FNCHP--S	4.319760	5.085216	-4.302219	-7.415143	.017541	-2.329927
SRMNG--L	FNCHP--S	4.319760	5.085216	-4.302219	-7.415143	.017541	-2.329927
*FNCHP--S	FENCG--J	10.003490	4.771567	-9.999616	-4.999426	.003876	-.227859
*FNCHP--S	FENCG--J	10.003490	4.771567	-9.999616	-4.999426	.003876	-.227859
FNCHP--S	SYLHE--T	38.298470	17.440350	-38.024510	-17.567040	.273960	-.126696
FNCHP--S	SYLHE--T	38.298470	17.440350	-38.024510	-17.567040	.273960	-.126696
SYLHE--T	CHATA--K	10.024650	3.600193	-10.000010	-5.000110	.024637	-1.399918
SYLHE--T	CHATA--K	10.024650	3.600193	-10.000010	-5.000110	.024637	-1.399918
ASHUG--J	KISHG--J	26.794280	4.394783	-26.561730	-6.087295	.232559	-1.692512
ASHUG--J	KISHG--J	26.794280	4.394783	-26.561730	-6.087295	.232559	-1.692512
KISHG--J	MYMNS--G	14.061780	.087326	-13.988990	-2.677502	.072784	-2.590175
KISHG--J	MYMNS--G	14.061780	.087326	-13.988990	-2.677502	.072784	-2.590175
MYMNS--G	JAMLP--R	30.459940	11.344090	-30.086570	-12.516870	.373379	-1.172779
MYMNS--G	JAMLP--R	30.459940	11.344090	-30.086570	-12.516870	.373379	-1.172779
MYMNS--G	NETRO--K	15.058200	6.095056	-14.999850	-7.499980	.058356	-1.404924
JAMLP--R	TANGA--L	12.586630	4.017053	-12.455820	-7.989523	.130805	-3.972470
JAMLP--R	TANGA--L	12.586630	4.017053	-12.455820	-7.989523	.130805	-3.972470
GOLPR--A	KLCEN--T	51.365150	11.865210	-51.345510	-12.684150	.019638	-.818938
GOLPR--A	KLCEN--T	51.365150	11.865210	-51.345510	-12.684150	.019638	-.818938
GOLPR--A	KLCEN--T	51.365150	11.865210	-51.345510	-12.684150	.019638	-.818938
GOLPR--A	KLCEN--T	51.365150	11.865210	-51.345510	-12.684150	.019638	-.818938
KLCEN--T	NOAPR--A	50.188550	15.129690	-49.705250	-14.747390	.483299	.382305
KLCEN--T	NOAPR--A	50.188550	15.129690	-49.705250	-14.747390	.483299	.382305
NOAPR--A	JESOR--E	43.704980	11.747670	-43.276690	-11.671050	.428288	.076617
NOAPR--A	JESOR--E	43.704980	11.747670	-43.276690	-11.671050	.428288	.076617
JESOR--E	JHNDA--H	7.278934	.417597	-7.257632	-2.415327	.021301	-1.997730
JESOR--E	JHNDA--H	7.278934	.417597	-7.257632	-2.415327	.021301	-1.997730
*BOTAI--L	JHNDA--H	14.318920	1.869329	-14.240330	-3.626558	.078595	-1.757228
*BOTAI--L	JHNDA--H	14.318920	1.869329	-14.240330	-3.626558	.078595	-1.757228
*BHRMR--A	BOTAI--L	36.088920	12.106730	-35.817330	-12.369220	.271591	-.262491
*BHRMR--A	BOTAI--L	36.088920	12.106730	-35.817330	-12.369220	.271591	-.262491
*ISHRD--I	BHRMR--A	21.928020	-.899969	-21.889850	.554300	.038172	-.345669
*ISHRD--I	BHRMR--A	21.928020	-.899969	-21.889850	.554300	.038172	-.345669

FROM BUS	TO BUS	SENT MW	SENT MVAR	RECEIVED MW	RECEIVED MVAR	LOSSES MW	LOSSES MVAR
*ISHRD--I	BHRMR--A	25.997990	2.580189	-25.970910	-2.768798	.027073	-.188609
*ISHRD--I	BHRMR--A	25.997990	2.580189	-25.970910	-2.768798	.027073	-.188609
GOLPR--A	BAGRH--T	67.550800	2.616272	-66.109300	.062318	1.441498	2.678591
BAGRH--T	KAUKH--L	26.045960	-18.913140	-25.740590	18.054990	.305365	-.858150
BAGRH--T	MANGL--A	14.062900	5.851476	-13.999050	-6.999736	.063854	-1.148260
KAUKH--L	BNDRI--A	10.007000	4.622856	-9.999191	-5.000068	.007804	-.377212
*KAUKH--L	BRISA--L	10.732940	-25.178100	-10.591360	24.385530	.141576	-.792568
BRISA--L	PATUA--K	11.163280	-65.766430	-9.998886	67.789480	1.164390	2.023056
BRISA--L	MADAP--R	3.713259	12.801280	-3.659195	-14.282420	.054064	-1.481135
BRISA--L	MADAP--R	3.713259	12.801280	-3.659195	-14.282420	.054064	-1.481135
*FRIDP--R	MADAP--R	8.928645	-10.701120	-8.837922	8.032523	.090723	-2.668597
*FRIDP--R	MADAP--R	8.928645	-10.701120	-8.837922	8.032523	.090723	-2.668597
*BHRMR--A	FRIDP--R	26.023270	-5.475187	-25.426940	2.451311	.596331	-3.023876
*BHRMR--A	FRIDP--R	26.023270	-5.475187	-25.426940	2.451311	.596331	-3.023876
NATOR--E	BOGUR--A	34.121730	-9.819621	-33.495480	8.950395	.626247	-.869226
NATOR--E	BOGUR--A	34.121730	-9.819621	-33.495480	8.950395	.626247	-.869226
ISHRD--I	NATOR--E	89.004140	2.624941	-87.221080	1.825997	1.783066	4.450938
ISHRD--I	NATOR--E	89.004140	2.624941	-87.221080	1.825997	1.783066	4.450938
NATOR--E	RAJSH--I	37.229100	9.957025	-36.839790	-10.317820	.389313	-.360792
NATOR--E	RAJSH--I	40.954600	9.966059	-40.489910	-10.201000	.464687	-.234940
RAJSH--I	NWBGN--G	29.337020	13.752730	-28.992380	-14.498810	.344639	-.746079
BOGUR--A	NAOGO--A	36.481860	17.830430	-35.989150	-17.998070	.492710	-.167641
BOGUR--A	PLSBR--I	54.791100	-24.173730	-53.253600	26.365920	1.537491	2.192188
BOGUR--A	PLSBR--I	54.791100	-24.173730	-53.253600	26.365920	1.537491	2.192188
PLSBR--I	RANGP--R	39.258240	-33.365100	-38.218340	34.304680	1.039898	.939575
PLSBR--I	RANGP--R	39.258240	-33.365100	-38.218340	34.304680	1.039898	.939575
RANGP--R	SAIDP--R	27.172160	-23.030910	-26.807100	22.196060	.365051	-.834852
RANGP--R	SAIDP--R	27.172160	-23.030910	-26.807100	22.196060	.365051	-.834852
RANGP--R	LALMO--N	20.107060	8.559027	-19.992910	-9.998788	.114149	-1.439761
SAIDP--R	PRBSD--P	25.814710	-7.406737	-25.648710	6.719603	.166004	-.687134
SAIDP--R	PRBSD--P	25.814710	-7.406737	-25.648710	6.719603	.166004	-.687134
PRBSD--P	THAKU--R	13.151950	-12.718740	-12.995270	10.906640	.156672	-1.812097
PRBSD--P	THAKU--R	13.151950	-12.718740	-12.995270	10.906640	.156672	-1.812097
*BAGBR--I	ISHRD--I	33.921880	4.120454	-33.525230	-5.403628	.396645	-1.283174
*PABAN--A	ISHRD--I	1.180659	-9.365852	-1.172479	8.614498	.008180	-.751354
*SHJDP--R	PABAN--A	34.514830	6.200576	-34.177370	-7.133378	.337460	-.932801
BAGBR--I	SRJGN--J	80.214360	6.194827	-78.894720	-2.873262	1.319633	3.321565
BAGBR--I	SRJGN--J	80.214360	6.194827	-78.894720	-2.873262	1.319633	3.321565
*BAGBR--I	SHJDP--R	51.652680	14.805310	-51.515290	-14.700680	.137383	.104628
SRJGN--J	BOGUR--A	66.885730	-3.125117	-65.042030	6.968960	1.843704	3.843843
SRJGN--J	BOGUR--A	66.885730	-3.125117	-65.042030	6.968960	1.843704	3.843843
RAJN--23	HATZ--23	167.333000	40.332790	-166.827700	-41.808010	.505371	-1.475224
RAJN--23	HATZ--23	167.333000	40.332790	-166.827700	-41.808010	.505371	-1.475224
RAJN--23	HATZ--23	167.333000	40.332790	-166.827700	-41.808010	.505371	-1.475224
HATZ--23	COMI--23	135.041600	-2.065884	-132.999000	-14.972050	2.042633	-17.037930
HATZ--23	COMI--23	135.041600	-2.065884	-132.999000	-14.972050	2.042633	-17.037930
COMI--23	ASHU--23	.006647	-31.563150	.049625	19.619700	.056272	-11.943450
COMI--23	ASHU--23	.006647	-31.563150	.049625	19.619700	.056272	-11.943450
ASHU--23	GRSL--23	81.694320	13.271190	-81.251210	-17.614860	.443115	-4.343669
ASHU--23	GRSL--23	81.694320	13.271190	-81.251210	-17.614860	.443115	-4.343669
GRSL--23	TONG--23	146.317600	83.344000	-145.157100	-81.439080	1.160522	1.904922
GRSL--23	TONG--23	146.317600	83.344000	-145.157100	-81.439080	1.160522	1.904922
GRSL--23	RAMP--23	59.476490	57.658090	-59.267010	-63.819100	.209473	-6.161011
GRSL--23	RAMP--23	59.476490	57.658090	-59.267010	-63.819100	.209473	-6.161011
*HARI--23	RAMP--23	97.035290	8.626583	-96.805340	-11.033710	.229950	-2.407124
*HARI--23	RAMP--23	97.035290	8.626583	-96.805340	-11.033710	.229950	-2.407124
MEGH--23	HASN--23	149.131100	72.233500	-148.292600	-74.242250	.838577	-2.008751
MEGH--23	HASN--23	149.131100	72.233500	-148.292600	-74.242250	.838577	-2.008751
COMI--23	MEGH--23	31.673860	-9.543046	-31.623380	-2.825630	.050474	-12.368680
COMI--23	MEGH--23	31.673860	-9.543046	-31.623380	-2.825630	.050474	-12.368680
MEGH--23	HARI--23	76.491130	25.709210	-76.385590	-29.159990	.105537	-3.450777
MEGH--23	HARI--23	76.491130	25.709210	-76.385590	-29.159990	.105537	-3.450777
HAR--360	HARI--23	175.998800	58.123540	-175.927900	-58.160910	.070938	-.037369
HAR--360	HARI--23	175.998800	58.123540	-175.927900	-58.160910	.070938	-.037369
GRSL--23	ISHR--23	134.422600	2.247703	-129.599200	-3.283803	4.823395	-1.036100
GRSL--23	ISHR--23	134.422600	2.247703	-129.599200	-3.283803	4.823395	-1.036100

FROM BUS	TO BUS	SENT MW	SENT MVAR	RECEIVED MW	RECEIVED MVAR	LOSSES MW	LOSSES MVAR
KPT--123	KAPTA--I	29.666240	5.433607	-29.666240	-3.412425	.000000	2.021183
KPT--123	KAPTA--I	29.666240	5.433607	-29.666240	-3.412425	.000000	2.021183
KPT--123	KAPTA--I	29.167430	5.342250	-29.167430	-3.355044	.000000	1.987206
KPT---45	KAPTA--I	48.999950	7.749807	-48.999950	-3.418309	.000000	4.331499
KPT---45	KAPTA--I	48.999950	7.749807	-48.999950	-3.418309	.000000	4.331499
RAZ2x210	RAJN--23	165.999800	51.977360	-165.999800	-40.094060	.000000	11.883300
RAZ2x210	RAJN--23	165.999800	51.977360	-165.999800	-40.094060	.000000	11.883300
SK--1X60	SIKLB--A	55.999920	19.801310	-55.999920	-14.650380	.000000	5.150937
SK--2X28	SIKLB--A	54.999920	19.717900	-54.999920	-14.733790	.000000	4.984114
HRP---CC	HARIP--R	98.999400	32.839360	-98.999400	-14.377120	.000000	18.462240
HARI-360	HAR--360	175.999200	83.733770	-175.999200	-58.133460	.000000	25.600310
HARI-360	HAR--360	175.999200	83.733770	-175.999200	-58.133460	.000000	25.600310
SD----50	SIDDG--J	46.999740	30.019180	-46.999740	-25.478380	.000000	4.540802
AES--450	MEGH--23	129.332800	77.883450	-129.332800	-63.411910	.000000	14.471550
AES--450	MEGH--23	129.332800	77.883450	-129.332800	-63.411910	.000000	14.471550
AES--450	MEGH--23	129.332800	77.883450	-129.332800	-63.411910	.000000	14.471550
AS--2X64	RAJN--23	45.999960	19.363910	-45.999960	-16.878740	.000000	2.485172
AS--1X90	RAJN--23	52.796990	14.043380	-52.796990	-9.449215	.000000	4.594160
AS--1X90	RAJN--23	25.202950	6.703681	-25.202950	-4.510643	.000000	2.193037
AS--1X60	RAJN--23	45.999950	13.515330	-45.999950	-9.977258	.000000	3.538074
AS--3150	ASHU--23	91.999650	51.479190	-91.999650	-44.422810	.000000	7.056377
AS--3150	ASHU--23	91.999650	51.479190	-91.999650	-44.422810	.000000	7.056377
AS--3150	ASHU--23	91.999650	51.479190	-91.999650	-44.422810	.000000	7.056377
MYM--070	MYMNS--G	67.999600	39.622680	-67.999600	-33.428770	.000000	6.193905
GH--2X55	GHRAS--L	24.999830	17.527890	-24.999830	-15.697950	.000000	1.829942
GH--2X55	GHRAS--L	24.999830	17.527890	-24.999830	-15.697950	.000000	1.829942
GH--3210	GRSL--23	168.016200	107.011400	-168.016200	-90.887220	.000000	16.124150
GH--3210	GRSL--23	168.016200	107.011400	-168.016200	-90.887220	.000000	16.124150
GH--3210	GRSL--23	168.016200	107.011400	-168.016200	-90.887220	.000000	16.124150
GH--1210	GRSL--23	187.998700	108.523000	-187.998700	-89.375630	.000000	19.147330
SY--1X20	SYLHE--T	18.999970	11.779190	-18.999970	-9.566309	.000000	2.212885
SHZ---80	SHJIB--Z	56.999880	13.832560	-56.999880	-10.392310	.000000	3.440253
SHZ---70	SHJIB--Z	68.999850	14.599490	-68.999850	-9.625386	.000000	4.974103
FNC--090	FNCHP--S	87.999890	38.350280	-87.999890	-29.596380	.000000	8.753897
KL--1110	GOLPR--A	105.997600	25.662260	-105.997600	-14.362950	.000000	11.299300
KL--1X60	GOLPR--A	59.998680	15.623430	-59.998680	-9.895999	.000000	5.727429
KPC----L	GOLPR--A	57.998730	21.836880	-57.998730	-18.188320	.000000	3.648560
KL--2X28	GOLPR--A	54.998790	15.403260	-54.998790	-10.640540	.000000	4.762722
BR---140	BRISA--L	37.997510	7.350997	-37.997510	.779311	.000000	8.130308
BH--3X20	BHRMR--A	17.832040	8.815969	-17.832040	-7.109709	.000000	1.706259
BH--3X20	BHRMR--A	17.832040	8.815969	-17.832040	-7.109709	.000000	1.706259
BH--3X20	BHRMR--A	17.832040	8.815969	-17.832040	-7.109709	.000000	1.706259
SP--1X20	SAIDP--R	17.996050	1.965693	-17.996050	-.514536	.000000	1.451158
RP--1X20	RANGP--R	17.995950	4.466219	-17.995950	-2.624485	.000000	1.841734
BG----71	BAGBR--I	69.996590	18.637490	-69.996590	-13.390640	.000000	5.246847
IPP--090	BAGBR--I	86.995740	19.998180	-86.995740	-12.029950	.000000	7.968228
BG---100	BAGBR--I	98.995130	21.137530	-98.995130	-10.890600	.000000	10.246930
HATZ--23	HATHA--Z	76.799560	43.185980	-76.799560	-35.277610	.000000	7.908367
HATZ--23	HATHA--Z	76.799560	43.185980	-76.799560	-35.277610	.000000	7.908367
HATZ--23	HATHA--Z	76.799560	43.185980	-76.799560	-35.277610	.000000	7.908367
ASHU--23	ASHUG--J	56.256170	33.743310	-56.256170	-29.312590	.000000	4.430717
ASHU--23	ASHUG--J	56.256170	33.743310	-56.256170	-29.312590	.000000	4.430717
GRSL--23	GHRAS--L	87.045620	55.382020	-87.045620	-47.297980	.000000	8.084038
GRSL--23	GHRAS--L	87.045620	55.382020	-87.045620	-47.297980	.000000	8.084038
TONG--23	TONGG--I	145.156000	81.439760	-145.156000	-66.179700	.000000	15.260060
TONG--23	TONGG--I	145.156000	81.439760	-145.156000	-66.179700	.000000	15.260060
COMI--23	COMI---N	101.318300	56.079280	-101.318300	-48.964010	.000000	7.115276
COMI--23	COMI---N	101.318300	56.079280	-101.318300	-48.964010	.000000	7.115276
HARI--23	HARIP--R	155.278500	78.693530	-155.278500	-62.461900	.000000	16.231640
HARI--23	HARIP--R	155.278500	78.693530	-155.278500	-62.461900	.000000	16.231640
HASN--23	HASNB--D	148.290900	74.242210	-148.290900	-59.036800	.000000	15.205410
HASN--23	HASNB--D	148.290900	74.242210	-148.290900	-59.036800	.000000	15.205410
RAMP--23	RAMPR--A	156.071500	74.853120	-156.071500	-58.662400	.000000	16.190720
RAMP--23	RAMPR--A	156.071500	74.853120	-156.071500	-58.662400	.000000	16.190720
ISHR--23	ISHRD--I	86.391340	2.189041	-86.391340	2.071397	.000000	4.260438
ISHR--23	ISHRD--I	86.391340	2.189041	-86.391340	2.071397	.000000	4.260438

ISHR--23	ISHRD--I	86.391340	2.189041	-86.391340	2.071397	.000000	4.260438

TOTAL SSPLOS= 71.0572 TOTAL SSQLOS= 367.3666

FIXED SHUNT IMPEDANCES

BUS NAME	MVAR GEN
MADNH--T	14.3
HLSHA--R	18.8
KULSH--I	14.3
ULLOO--N	37.8
DHANM--O	37.6
RAMPR--A	38.1
SHAMP--R	36.9
TONGG--I	27.9
KLCEN--T	32.0
JESOR--E	13.5
JHNDA--H	8.9
PATUA--K	72.8
ISHRD--I	28.0
NATOR--E	17.9
RAJSH--I	17.2
BOGUR--A	26.8
RANGP--R	38.5
SAIDP--R	39.6
THAKU--R	34.8

NET MVAR GENERATED= 555.810

TPG-MW= 3871.0490 TQG-MVAR= 1710.5530

TMW LOAD= 3800.0000 TMVAR LOAD= 1899.0000

TP LOSS= 71.0572 TQ LOSS= 367.3666

NO. OF CAPACITOR BANK= 20

TOTAL VAR GEN BY CAP= 555.8097

NO. OF ITERATIONS= 6.000

VOLTAGE LIMIT VIOLATION= 0

THETA LIMIT VIOLATION= 0

GEN.POWER FACTOR VIOLATION= 0

PGSLACK= 544.0485 QGSLACK= 341.0349

APPENDIX - B

BPDB 2015(PLANNED) SYSTEM DATA AND BASE CASE

LOAD FLOW OUTPUT DATA

BPDB 2015 BASE CASE

MVA BASE= 100.0
CONVERGENCE TOLERANCE= .00100
MAXIMUM NUMBER OF ITERATIONS= 100
SLACK BUS IS= GH--3210

BUSBAR DATA

NODE	VOLTAGE P.U.	P.GEN MW	Q.GEN MVAR	P.LOAD MW	Q.LOAD MVAR	NOM.VOLTAGE.
KPT--123	1.000	90.00	45.00	1.50	.75	11.00
KPT---45	1.000	80.00	40.00	2.00	1.00	11.00
RAZ2x210	1.050	254.00	152.00	26.00	13.00	15.00
SK--1X60	1.000	60.00	30.00	4.00	2.00	11.00
SK--2X28	1.000	50.00	25.00	1.00	.50	11.00
HRP---CC	1.000	50.00	25.00	1.00	.50	11.00
HARI-360	1.050	360.00	180.00	8.00	4.00	15.00
SD----50	1.000	50.00	25.00	3.00	1.50	11.00
AES--450	1.050	250.00	125.00	12.00	6.00	15.00
GH--2X55	1.010	100.00	50.00	4.00	2.00	11.00
GH--3210	1.050	610.00	.00	40.00	20.00	15.00
GH--1210	1.050	157.76	75.00	12.00	6.00	15.00
AS--2X64	1.020	55.00	30.00	4.00	2.00	11.00
AS--1X90	1.020	80.00	40.00	2.00	1.00	11.00
AS--1X60	1.020	60.00	30.00	.00	.00	11.00
AS--3150	1.050	400.00	200.00	24.00	12.00	15.00
MYM--070	1.000	70.00	35.00	2.00	1.00	11.00
SHZ---80	1.000	80.00	40.00	.00	.00	11.00
SHZ---70	1.000	70.00	35.00	1.00	.50	11.00
FNC--090	1.000	90.00	45.00	2.00	1.00	11.00
SY--1X20	1.000	20.00	10.00	1.00	.50	11.00
KL--1X60	1.000	60.00	30.00	.00	.00	11.00
KL--1110	1.000	110.00	55.00	5.00	2.50	11.00
KPC----L	1.000	100.00	50.00	10.00	5.00	11.00
KL--2X28	1.000	56.00	28.00	.50	.25	11.00
BR---140	1.000	40.00	20.00	.50	.25	11.00
BH--3X20	1.000	58.00	29.00	.50	.25	11.00
BG----71	1.000	71.00	35.00	1.00	.50	11.00
IPP--090	1.000	90.00	50.00	3.00	1.50	11.00
BG---100	1.000	50.00	25.00	1.00	.50	11.00
RP--1X20	1.000	20.00	10.00	.20	.10	11.00
SP--1X20	1.000	20.00	10.00	.20	.10	11.00
KUL3X150	1.050	400.00	200.00	15.00	7.50	15.00
KULS1210	1.050	160.00	80.00	.00	.00	15.00
RAJN2210	1.050	400.00	200.00	30.00	15.00	15.00
MEG2X450	1.050	600.00	300.00	25.00	12.50	15.00
MEG1X210	1.050	100.00	50.00	5.00	2.50	15.00
ASH2X210	1.050	200.00	100.00	20.00	10.00	15.00
ASHG1210	1.050	70.00	35.00	.00	.00	15.00
HAR1X210	1.050	200.00	100.00	10.00	5.00	15.00
SIDD2210	1.050	400.00	200.00	20.00	10.00	15.00
SIDD2350	1.050	650.00	325.00	25.00	12.50	15.00
GRS3X210	1.050	550.00	275.00	20.00	10.00	15.00
GRS1X210	1.050	100.00	50.00	.00	.00	15.00
BP---250	1.050	200.00	100.00	12.50	6.25	15.00
KAPTA--I	.000	.00	.00	90.00	45.00	132.00
CHNDR--O	.000	.00	.00	100.00	50.00	132.00
HATHA--Z	.000	.00	.00	265.00	132.50	132.00
MADNH--T	.000	.00	.00	100.00	50.50	132.00
SIKLB--A	.000	.00	.00	80.00	40.50	132.00
DOHZR--I	.000	.00	.00	44.00	22.00	132.00
COXBZ--R	.000	.00	.00	26.00	13.00	132.00

NODE	VOLTAGE P.U.	P.GEN MW	Q.GEN MVAR	P.LOAD MW	Q.LOAD MVAR	NOM.VOLTAGE.
HLSHA--R	.000	.00	.00	265.00	132.50	132.00
KULSH--I	.000	.00	.00	500.00	250.00	132.00
BARLI--A	.000	.00	.00	80.00	40.00	132.00
FEN----I	.000	.00	.00	37.00	18.50	132.00
CHOWM--U	.000	.00	.00	37.00	18.50	132.00
COMI---N	.000	.00	.00	100.00	50.00	132.00
COMI---S	.000	.00	.00	80.00	40.00	132.00
CHNDP--R	.000	.00	.00	80.00	40.00	132.00
HARIP--R	.000	.00	.00	480.00	240.00	132.00
SIDDG--J	.000	.00	.00	150.00	75.00	132.00
MANIK--N	.000	.00	.00	25.00	12.50	132.00
ULLOO--N	.000	.00	.00	60.00	30.00	132.00
DHANM--O	.000	.00	.00	280.00	140.00	132.00
RAMPR--A	.000	.00	.00	300.00	150.00	132.00
NARIN--D	.000	.00	.00	25.00	12.50	132.00
SHAMP--R	.000	.00	.00	60.00	30.00	132.00
MADNG--J	.000	.00	.00	30.00	15.00	132.00
HASNB--D	.000	.00	.00	110.00	55.00	132.00
MIRPU--R	.000	.00	.00	200.00	100.00	132.00
KALLY--N	.000	.00	.00	250.00	125.00	132.00
BASHU--N	.000	.00	.00	220.00	110.00	132.00
TONGG--I	.000	.00	.00	200.00	100.00	132.00
KABRP--R	.000	.00	.00	64.00	33.00	132.00
MANIK--G	.000	.00	.00	32.00	16.00	132.00
TANGA--L	.000	.00	.00	45.00	22.50	132.00
GHRAS--L	.000	.00	.00	160.00	80.00	132.00
JYDVP--R	.000	.00	.00	40.00	20.00	132.00
BHULT--A	.000	.00	.00	40.00	20.00	132.00
ASHUG--J	.000	.00	.00	150.00	75.00	132.00
KISHG--J	.000	.00	.00	70.00	35.00	132.00
MYMNS--G	.000	.00	.00	100.00	50.00	132.00
JAMLP--R	.000	.00	.00	35.00	17.50	132.00
NETRO--K	.000	.00	.00	40.00	20.00	132.00
SHJIB--Z	.000	.00	.00	100.00	50.00	132.00
SRMNG--L	.000	.00	.00	50.00	25.50	132.00
FENCG--J	.000	.00	.00	100.00	50.00	132.00
FNCHP--S	.000	.00	.00	100.00	50.00	132.00
SYLHE--T	.000	.00	.00	150.00	75.00	132.00
CHATA--K	.000	.00	.00	20.00	10.00	132.00
GOLPR--A	.000	.00	.00	100.00	50.00	132.00
KLCEN--T	.000	.00	.00	150.00	75.50	132.00
NOAPR--A	.000	.00	.00	50.00	25.00	132.00
JESOR--E	.000	.00	.00	80.00	40.00	132.00
JHNDA--H	.000	.00	.00	60.00	30.00	132.00
BOTAI--L	.000	.00	.00	43.00	21.50	132.00
BHRMR--A	.000	.00	.00	80.00	40.00	132.00
FRIDP--R	.000	.00	.00	33.00	16.50	132.00
MADAP--R	.000	.00	.00	30.00	15.00	132.00
BRISA--L	.000	.00	.00	48.00	24.00	132.00
KAUKH--L	.000	.00	.00	30.00	15.00	132.00
BNDRI--A	.000	.00	.00	20.00	10.00	132.00
BAGRH--T	.000	.00	.00	26.00	13.00	132.00
MANGL--A	.000	.00	.00	14.00	7.00	132.00
PATUA--K	.000	.00	.00	21.00	10.50	132.00
ISHRD--I	.000	.00	.00	80.00	40.00	132.00
NATOR--E	.000	.00	.00	28.00	14.00	132.00
RAJSH--I	.000	.00	.00	48.00	24.00	132.00
NWBGN--G	.000	.00	.00	18.00	9.50	132.00
PABAN--A	.000	.00	.00	44.00	22.50	132.00
SHJDP--R	.000	.00	.00	60.00	30.50	132.00
BAGBR--I	.000	.00	.00	136.00	68.00	132.00
SRJGN--J	.000	.00	.00	24.00	12.00	132.00
BOGUR--A	.000	.00	.00	87.00	43.50	132.00
NAOGO--A	.000	.00	.00	16.00	8.00	132.00
PLSBR--I	.000	.00	.00	28.00	14.00	132.00
RANGP--R	.000	.00	.00	50.00	25.00	132.00
LALMO--N	.000	.00	.00	36.00	18.00	132.00

NODE	VOLTAGE P.U.	P.GEN MW	Q.GEN MVAR	P.LOAD MW	Q.LOAD MVAR	NOM.VOLTAGE.
SAIDP--R	.000	.00	.00	36.00	18.00	132.00
PRBSD--P	.000	.00	.00	25.00	12.50	132.00
THAKU--R	.000	.00	.00	26.00	13.00	132.00
BARAPU-K	.000	.00	.00	80.00	40.00	132.00
BARAP-23	.000	.00	.00	.00	.00	230.00
RAJN--23	.000	.00	.00	.00	.00	230.00
HATZ--23	.000	.00	.00	.00	.00	230.00
COMI--23	.000	.00	.00	.00	.00	230.00
ASHU--23	.000	.00	.00	.00	.00	230.00
GRSL--23	.000	.00	.00	.00	.00	230.00
TONG--23	.000	.00	.00	.00	.00	230.00
SAVR--23	.000	.00	.00	.00	.00	230.00
POST--23	.000	.00	.00	.00	.00	230.00
HARI--23	.000	.00	.00	.00	.00	230.00
MEGH--23	.000	.00	.00	.00	.00	230.00
ISHR--23	.000	.00	.00	.00	.00	230.00
BASUN-23	.000	.00	.00	.00	.00	230.00
KULSI-23	.000	.00	.00	.00	.00	230.00
HALIS-23	.000	.00	.00	.00	.00	230.00
SYLH--23	.000	.00	.00	.00	.00	230.00
MYNSG-23	.000	.00	.00	.00	.00	230.00
SIDD--23	.000	.00	.00	.00	.00	230.00
BHULT-23	.000	.00	.00	.00	.00	230.00
BHER--23	.000	.00	.00	.00	.00	230.00
JESS--23	.000	.00	.00	.00	.00	230.00
BARI--23	.000	.00	.00	.00	.00	230.00
KHULNA23	.000	.00	.00	.00	.00	230.00
BAGHA-23	.000	.00	.00	.00	.00	230.00
BOGRA-23	.000	.00	.00	.00	.00	230.00

NETWORK DATA

NODE TO	NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
KAPTA--I	CHNDR--O	.00460	.01770	.00420	.00000	.00000	.00000	.00000	.00000
KAPTA--I	MADNH--T	.02250	.08570	.02020	.00000	.00000	.00000	.00000	.00000
KAPTA--I	HATHA--Z	.02200	.08400	.01980	.00000	.00000	.00000	.00000	.00000
KAPTA--I	HATHA--Z	.02200	.08400	.01980	.00000	.00000	.00000	.00000	.00000
CHNDR--O	MADNH--T	.01790	.06810	.01600	.00000	.00000	.00000	.00000	.00000
HATHA--Z	MADNH--T	.00520	.01990	.00470	.00000	.00000	.00000	.00000	.00000
HATHA--Z	MADNH--T	.00520	.01990	.00470	.00000	.00000	.00000	.00000	.00000
HATHA--Z	FEN----I	.05160	.19670	.04640	.00000	.00000	.00000	.00000	.00000
HATHA--Z	FEN----I	.05160	.19670	.04640	.00000	.00000	.00000	.00000	.00000
MADNH--T	SIKLB--A	.00930	.03560	.00640	.00000	.00000	.00000	.00000	.00000
MADNH--T	SIKLB--A	.00930	.03560	.00640	.00000	.00000	.00000	.00000	.00000
MADNH--T	KULSH--I	.00740	.03000	.00620	.00000	.00000	.00000	.00000	.00000
MADNH--T	KULSH--I	.00740	.03000	.00620	.00000	.00000	.00000	.00000	.00000
SIKLB--A	HLSHA--R	.00750	.02850	.00670	.00000	.00000	.00000	.00000	.00000
SIKLB--A	DOHZR--I	.01870	.07120	.01680	.00000	.00000	.00000	.00000	.00000
SIKLB--A	DOHZR--I	.01870	.07120	.01680	.00000	.00000	.00000	.00000	.00000
DOHZR--I	COXBZ--R	.04480	.17060	.04020	.00000	.00000	.00000	.00000	.00000
DOHZR--I	COXBZ--R	.04480	.17060	.04020	.00000	.00000	.00000	.00000	.00000
HATHA--Z	BARLI--A	.00700	.02650	.00630	.00000	.00000	.00000	.00000	.00000
HATHA--Z	BARLI--A	.00700	.02650	.00630	.00000	.00000	.00000	.00000	.00000
HATHA--Z	HLSHA--R	.00780	.03190	.00660	.00000	.00000	.00000	.00000	.00000
KULSH--I	BARLI--A	.00750	.02850	.00670	.00000	.00000	.00000	.00000	.00000
KULSH--I	BARLI--A	.00750	.02850	.00670	.00000	.00000	.00000	.00000	.00000
BARLI--A	COMI---N	.08120	.30940	.07290	.00000	.00000	.00000	.00000	.00000
FEN----I	COMI---N	.03680	.14030	.03310	.00000	.00000	.00000	.00000	.00000
FEN----I	COMI---N	.03680	.14030	.03310	.00000	.00000	.00000	.00000	.00000
FEN----I	CHOWM--U	.01860	.07040	.01670	.00000	.00000	.00000	.00000	.00000
FEN----I	CHOWM--U	.01860	.07040	.01670	.00000	.00000	.00000	.00000	.00000
COMI---N	HARIP--R	.04200	.16000	.03770	.00000	.00000	.00000	.00000	.00000
COMI---N	HARIP--R	.04200	.16000	.03770	.00000	.00000	.00000	.00000	.00000
COMI---N	COMI---S	.00920	.03510	.00830	.00000	.00000	.00000	.00000	.00000
HARIP--R	SIDDG--J	.00030	.00110	.00030	.00000	.00000	.00000	.00000	.00000
HARIP--R	SIDDG--J	.00030	.00110	.00030	.00000	.00000	.00000	.00000	.00000
COMI---N	CHNDP--R	.04460	.17010	.04010	.00000	.00000	.00000	.00000	.00000
COMI---N	CHNDP--R	.04460	.17010	.04010	.00000	.00000	.00000	.00000	.00000
HARIP--R	SIDDG--J	.00030	.00110	.00030	.00000	.00000	.00000	.00000	.00000
HARIP--R	SIDDG--J	.00030	.00110	.00030	.00000	.00000	.00000	.00000	.00000
HARIP--R	SHAMP--R	.01860	.07090	.01670	.00000	.00000	.00000	.00000	.00000
HARIP--R	MADNG--J	.00750	.02850	.00670	.00000	.00000	.00000	.00000	.00000
SIDDG--J	MANIK--G	.00730	.02760	.00650	.00000	.00000	.00000	.00000	.00000
SIDDG--J	MANIK--G	.00670	.02560	.00600	.00000	.00000	.00000	.00000	.00000
HARIP--R	ULLOO--N	.01030	.03910	.00920	.00000	.00000	.00000	.00000	.00000

NODE	TO NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
HARIP--R	ULLOO--N	.01030	.03910	.00920	.00000	.00000	.00000	.00000	.00000
HARIP--R	SIDDG--J	.00030	.00110	.00030	.00000	.00000	.00000	.00000	.00000
HARIP--R	SIDDG--J	.00030	.00110	.00030	.00000	.00000	.00000	.00000	.00000
MANIK--N	NARIN--D	.00170	.00660	.00170	.00000	.00000	.00000	.00000	.00000
MANIK--N	NARIN--D	.00170	.00660	.00170	.00000	.00000	.00000	.00000	.00000
HARIP--R	GHRAS--L	.02570	.09680	.02310	.00000	.00000	.00000	.00000	.00000
HARIP--R	BHULT--A	.01400	.05280	.01260	.00000	.00000	.00000	.00000	.00000
BHULT--A	GHRAS--L	.01170	.04400	.01050	.00000	.00000	.00000	.00000	.00000
SHAMP--R	MADNG--J	.00580	.02200	.00520	.00000	.00000	.00000	.00000	.00000
SHAMP--R	MADNG--J	.00580	.02200	.00520	.00000	.00000	.00000	.00000	.00000
MADNG--J	HASNB--D	.00900	.03450	.00810	.00000	.00000	.00000	.00000	.00000
MADNG--J	HASNB--D	.00820	.03090	.00730	.00000	.00000	.00000	.00000	.00000
SHAMP--R	HASNB--D	.01110	.04240	.01000	.00000	.00000	.00000	.00000	.00000
ULLOO--N	DHANM--O	.00320	.01220	.00290	.00000	.00000	.00000	.00000	.00000
ULLOO--N	DHANM--O	.00320	.01220	.00290	.00000	.00000	.00000	.00000	.00000
ULLOO--N	DHANM--O	.00320	.01220	.00290	.00000	.00000	.00000	.00000	.00000
ULLOO--N	RAMPR--A	.00230	.00880	.00210	.00000	.00000	.00000	.00000	.00000
ULLOO--N	RAMPR--A	.00230	.00880	.00210	.00000	.00000	.00000	.00000	.00000
BASHU--N	TONGG--I	.00720	.02710	.00640	.00000	.00000	.00000	.00000	.00000
BASHU--N	TONGG--I	.00720	.02710	.00640	.00000	.00000	.00000	.00000	.00000
RAMPR--A	BASHU--N	.00640	.02420	.00570	.00000	.00000	.00000	.00000	.00000
RAMPR--A	BASHU--N	.00640	.02420	.00570	.00000	.00000	.00000	.00000	.00000
TONGG--I	MIRPU--R	.00840	.03200	.00760	.00000	.00000	.00000	.00000	.00000
TONGG--I	MIRPU--R	.00840	.03200	.00760	.00000	.00000	.00000	.00000	.00000
MIRPU--R	KALLY--N	.00870	.03320	.00780	.00000	.00000	.00000	.00000	.00000
MIRPU--R	KALLY--N	.00870	.03320	.00780	.00000	.00000	.00000	.00000	.00000
KALLY--N	HASNB--D	.01040	.03980	.00940	.00000	.00000	.00000	.00000	.00000
KALLY--N	HASNB--D	.01040	.03980	.00940	.00000	.00000	.00000	.00000	.00000
KALLY--N	HASNB--D	.01040	.03980	.00940	.00000	.00000	.00000	.00000	.00000
TONGG--I	KABRP--R	.01220	.04620	.01100	.00000	.00000	.00000	.00000	.00000
TONGG--I	KABRP--R	.01220	.04620	.01100	.00000	.00000	.00000	.00000	.00000
KABRP--R	MANIK--N	.01520	.05720	.01360	.00000	.00000	.00000	.00000	.00000
KABRP--R	MANIK--N	.01520	.05720	.01360	.00000	.00000	.00000	.00000	.00000
KABRP--R	TANGA--L	.02970	.11260	.02670	.00000	.00000	.00000	.00000	.00000
KABRP--R	TANGA--L	.02970	.11260	.02670	.00000	.00000	.00000	.00000	.00000
GHRAS--L	ASHUG--J	.02520	.09550	.02270	.00000	.00000	.00000	.00000	.00000
GHRAS--L	ASHUG--J	.02520	.09550	.02270	.00000	.00000	.00000	.00000	.00000
GHRAS--L	JYDVP--R	.01750	.06600	.01570	.00000	.00000	.00000	.00000	.00000
GHRAS--L	JYDVP--R	.01750	.06600	.01570	.00000	.00000	.00000	.00000	.00000
JYDVP--R	KABRP--R	.00870	.03320	.00780	.00000	.00000	.00000	.00000	.00000
JYDVP--R	KABRP--R	.00870	.03320	.00780	.00000	.00000	.00000	.00000	.00000
ASHUG--J	SHJIB--Z	.03020	.11120	.02270	.00000	.00000	.00000	.00000	.00000
ASHUG--J	SHJIB--Z	.03020	.11120	.02270	.00000	.00000	.00000	.00000	.00000
SHJIB--Z	SRMNG--L	.02120	.08060	.01880	.00000	.00000	.00000	.00000	.00000
SHJIB--Z	SRMNG--L	.02120	.08060	.01880	.00000	.00000	.00000	.00000	.00000

NODE	TO NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
SRMNG--L	FNCHP--S	.02860	.10870	.02540	.00000	.00000	.00000	.00000	.00000
SRMNG--L	FNCHP--S	.02860	.10870	.02540	.00000	.00000	.00000	.00000	.00000
FENCG--J	FNCHP--S	.00290	.01100	.00260	.00000	.00000	.00000	.00000	.00000
FENCG--J	FNCHP--S	.00290	.01100	.00260	.00000	.00000	.00000	.00000	.00000
FNCHP--S	SYLHE--T	.01430	.05440	.01270	.00000	.00000	.00000	.00000	.00000
FNCHP--S	SYLHE--T	.01430	.05440	.01270	.00000	.00000	.00000	.00000	.00000
SYLHE--T	CHATA--K	.01870	.07200	.01660	.00000	.00000	.00000	.00000	.00000
SYLHE--T	CHATA--K	.01870	.07200	.01660	.00000	.00000	.00000	.00000	.00000
ASHUG--J	KISHG--J	.03000	.11400	.02700	.00000	.00000	.00000	.00000	.00000
ASHUG--J	KISHG--J	.03000	.11400	.02700	.00000	.00000	.00000	.00000	.00000
KISHG--J	MYMNS--G	.03420	.12960	.03070	.00000	.00000	.00000	.00000	.00000
KISHG--J	MYMNS--G	.03420	.12960	.03070	.00000	.00000	.00000	.00000	.00000
MYMNS--G	JAMLP--R	.03180	.12080	.02870	.00000	.00000	.00000	.00000	.00000
MYMNS--G	JAMLP--R	.03180	.12080	.02870	.00000	.00000	.00000	.00000	.00000
MYMNS--G	NETRO--K	.01970	.07480	.01770	.00000	.00000	.00000	.00000	.00000
JAMLP--R	TANGA--L	.05800	.22100	.05210	.00000	.00000	.00000	.00000	.00000
JAMLP--R	TANGA--L	.05800	.22100	.05210	.00000	.00000	.00000	.00000	.00000
GOLPR--A	KLCEN--T	.00060	.00180	.00910	.00000	.00000	.00000	.00000	.00000
GOLPR--A	KLCEN--T	.00060	.00180	.00910	.00000	.00000	.00000	.00000	.00000
GOLPR--A	KLCEN--T	.00060	.00180	.00910	.00000	.00000	.00000	.00000	.00000
GOLPR--A	KLCEN--T	.00060	.00180	.00910	.00000	.00000	.00000	.00000	.00000
KLCEN--T	NOAPR--A	.01680	.04910	.01090	.00000	.00000	.00000	.00000	.00000
KLCEN--T	NOAPR--A	.01680	.04910	.01090	.00000	.00000	.00000	.00000	.00000
NOAPR--A	JESOR--E	.01930	.05620	.01280	.00000	.00000	.00000	.00000	.00000
NOAPR--A	JESOR--E	.01930	.05620	.01280	.00000	.00000	.00000	.00000	.00000
JESOR--E	JHNDA--H	.03470	.10120	.02300	.00000	.00000	.00000	.00000	.00000
JESOR--E	JHNDA--H	.03470	.10120	.02300	.00000	.00000	.00000	.00000	.00000
JHNDA--H	BOTAI--L	.03340	.09760	.02210	.00000	.00000	.00000	.00000	.00000
JHNDA--H	BOTAI--L	.03340	.09760	.02210	.00000	.00000	.00000	.00000	.00000
BOTAI--L	BHRMR--A	.01730	.05060	.01150	.00000	.00000	.00000	.00000	.00000
BOTAI--L	BHRMR--A	.01730	.05060	.01150	.00000	.00000	.00000	.00000	.00000
BHRMR--A	ISHRD--I	.00740	.02160	.00490	.00000	.00000	.00000	.00000	.00000
BHRMR--A	ISHRD--I	.00740	.02160	.00490	.00000	.00000	.00000	.00000	.00000
BHRMR--A	ISHRD--I	.00370	.01880	.00350	.00000	.00000	.00000	.00000	.00000
BHRMR--A	ISHRD--I	.00370	.01880	.00350	.00000	.00000	.00000	.00000	.00000
GOLPR--A	BAGRH--T	.03030	.09920	.02170	.00000	.00000	.00000	.00000	.00000
BAGRH--T	KAUKH--L	.02800	.09160	.02000	.00000	.00000	.00000	.00000	.00000
BAGRH--T	MANGL--A	.02440	.07620	.01480	.00000	.00000	.00000	.00000	.00000
KAUKH--L	BNDRI--A	.00600	.01950	.00430	.00000	.00000	.00000	.00000	.00000
BRISA--L	KAUKH--L	.01850	.06050	.01320	.00000	.00000	.00000	.00000	.00000
BRISA--L	PATUA--K	.02610	.09950	.02350	.00000	.00000	.00000	.00000	.00000
BRISA--L	MADAP--R	.02590	.12880	.01850	.00000	.00000	.00000	.00000	.00000
BRISA--L	MADAP--R	.02590	.12880	.01850	.00000	.00000	.00000	.00000	.00000
MADAP--R	FRIDP--R	.04990	.14800	.03200	.00000	.00000	.00000	.00000	.00000
MADAP--R	FRIDP--R	.04990	.14800	.03200	.00000	.00000	.00000	.00000	.00000

NODE TO	NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
FRIDP--R	BHRMR--A	.08090	.24000	.05210	.00000	.00000	.00000	.00000	.00000
FRIDP--R	BHRMR--A	.08090	.24000	.05210	.00000	.00000	.00000	.00000	.00000
NATOR--E	BOGUR--A	.04550	.14890	.03260	.00000	.00000	.00000	.00000	.00000
NATOR--E	BOGUR--A	.04550	.14890	.03260	.00000	.00000	.00000	.00000	.00000
ISHRD--I	NATOR--E	.02100	.06870	.01510	.00000	.00000	.00000	.00000	.00000
ISHRD--I	NATOR--E	.02100	.06870	.01510	.00000	.00000	.00000	.00000	.00000
NATOR--E	RAJSH--I	.02320	.08800	.02090	.00000	.00000	.00000	.00000	.00000
NATOR--E	RAJSH--I	.02320	.08000	.02090	.00000	.00000	.00000	.00000	.00000
RAJSH--I	NWBGN--G	.02750	.10380	.02440	.00000	.00000	.00000	.00000	.00000
BOGUR--A	NAOGO--A	.02610	.09900	.02350	.00000	.00000	.00000	.00000	.00000
BOGUR--A	PLSBR--I	.03890	.11340	.02540	.00000	.00000	.00000	.00000	.00000
BOGUR--A	PLSBR--I	.03890	.11340	.02540	.00000	.00000	.00000	.00000	.00000
PLSBR--I	RANGP--R	.03670	.12000	.02630	.00000	.00000	.00000	.00000	.00000
PLSBR--I	RANGP--R	.03670	.12000	.02630	.00000	.00000	.00000	.00000	.00000
RANGP--R	SAIDP--R	.02870	.09390	.02080	.00000	.00000	.00000	.00000	.00000
RANGP--R	SAIDP--R	.02870	.09390	.02080	.00000	.00000	.00000	.00000	.00000
RANGP--R	LALMO--N	.02220	.08390	.01970	.00000	.00000	.00000	.00000	.00000
SAIDP--R	PRBSD--P	.02300	.04830	.01050	.00000	.00000	.00000	.00000	.00000
SAIDP--R	PRBSD--P	.02300	.04830	.01050	.00000	.00000	.00000	.00000	.00000
PRBSD--P	THAKU--R	.04990	.10030	.02150	.00000	.00000	.00000	.00000	.00000
PRBSD--P	THAKU--R	.04990	.10030	.02150	.00000	.00000	.00000	.00000	.00000
ISHRD--I	BAGBR--I	.03250	.12320	.02930	.00000	.00000	.00000	.00000	.00000
ISHRD--I	PABAN--A	.00930	.03520	.00840	.00000	.00000	.00000	.00000	.00000
PABAN--A	SHJDP--R	.02600	.09900	.02350	.00000	.00000	.00000	.00000	.00000
BAGBR--I	SRJGN--J	.01970	.07480	.01780	.00000	.00000	.00000	.00000	.00000
BAGBR--I	SRJGN--J	.01970	.07480	.01780	.00000	.00000	.00000	.00000	.00000
SHJDP--R	BAGBR--I	.00460	.01350	.00310	.00000	.00000	.00000	.00000	.00000
SRJGN--J	BOGUR--A	.03830	.14520	.03450	.00000	.00000	.00000	.00000	.00000
SRJGN--J	BOGUR--A	.03830	.14520	.03450	.00000	.00000	.00000	.00000	.00000
BARAPU-K	SAIDP--R	.01750	.06600	.01570	.00000	.00000	.00000	.00000	.00000
BARAPU-K	SAIDP--R	.01750	.06600	.01570	.00000	.00000	.00000	.00000	.00000
BARAPU-K	RANGP--R	.02330	.08800	.02090	.00000	.00000	.00000	.00000	.00000
BARAPU-K	RANGP--R	.02330	.08800	.02090	.00000	.00000	.00000	.00000	.00000
KULSI-23	HATZ--23	.02250	.11560	.22350	.00000	.00000	.00000	.00000	.00000
KULSI-23	HATZ--23	.02250	.11560	.22350	.00000	.00000	.00000	.00000	.00000
RAJN--23	HATZ--23	.00180	.01240	.04700	.00000	.00000	.00000	.00000	.00000
RAJN--23	HATZ--23	.00180	.01240	.04700	.00000	.00000	.00000	.00000	.00000
RAJN--23	HATZ--23	.00180	.01240	.04700	.00000	.00000	.00000	.00000	.00000
HATZ--23	HALIS-23	.00440	.00297	.04440	.00000	.00000	.00000	.00000	.00000
HATZ--23	HALIS-23	.00440	.00297	.04440	.00000	.00000	.00000	.00000	.00000
HATZ--23	HALIS-23	.00440	.00297	.04440	.00000	.00000	.00000	.00000	.00000
HATZ--23	COMI--23	.01160	.07970	.30300	.00000	.00000	.00000	.00000	.00000
HATZ--23	COMI--23	.01160	.07970	.30300	.00000	.00000	.00000	.00000	.00000
COMI--23	MEGH--23	.00500	.03300	.12650	.00000	.00000	.00000	.00000	.00000
COMI--23	MEGH--23	.00500	.03300	.12650	.00000	.00000	.00000	.00000	.00000

NODE TO	NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
COMI--23	MEGH--23	.00500	.03300	.12650	.00000	.00000	.00000	.00000	.00000
MEGH--23	HARI--23	.00160	.01100	.04180	.00000	.00000	.00000	.00000	.00000
MEGH--23	HARI--23	.00160	.01100	.04180	.00000	.00000	.00000	.00000	.00000
MEGH--23	HARI--23	.00160	.01100	.04180	.00000	.00000	.00000	.00000	.00000
COMI--23	ASHU--23	.00870	.06000	.12090	.00000	.00000	.00000	.00000	.00000
COMI--23	ASHU--23	.00870	.06000	.12090	.00000	.00000	.00000	.00000	.00000
ASHU--23	SYLH--23	.02250	.11560	.23350	.00000	.00000	.00000	.00000	.00000
ASHU--23	SYLH--23	.02250	.11560	.23350	.00000	.00000	.00000	.00000	.00000
ASHU--23	MYNSG-23	.01790	.09190	.17760	.00000	.00000	.00000	.00000	.00000
ASHU--23	MYNSG-23	.01790	.09190	.17760	.00000	.00000	.00000	.00000	.00000
ASHU--23	GRSL--23	.00660	.03480	.06520	.00000	.00000	.00000	.00000	.00000
ASHU--23	GRSL--23	.00660	.03480	.06520	.00000	.00000	.00000	.00000	.00000
HARI--23	SIDD--23	.00370	.01910	.03690	.00000	.00000	.00000	.00000	.00000
HARI--23	SIDD--23	.00370	.01910	.03690	.00000	.00000	.00000	.00000	.00000
HARI--23	POST--23	.00300	.02090	.07980	.00000	.00000	.00000	.00000	.00000
HARI--23	POST--23	.00300	.02090	.07980	.00000	.00000	.00000	.00000	.00000
HARI--23	POST--23	.00300	.02090	.07980	.00000	.00000	.00000	.00000	.00000
BASUN-23	SIDD--23	.00240	.02100	.04460	.00000	.00000	.00000	.00000	.00000
BASUN-23	SIDD--23	.00240	.02100	.04460	.00000	.00000	.00000	.00000	.00000
BASUN-23	SIDD--23	.00240	.02100	.04460	.00000	.00000	.00000	.00000	.00000
HARI--23	BHULT-23	.00450	.02290	.04430	.00000	.00000	.00000	.00000	.00000
HARI--23	BHULT-23	.00450	.02290	.04430	.00000	.00000	.00000	.00000	.00000
BHULT-23	GRSL--23	.01040	.02680	.05180	.00000	.00000	.00000	.00000	.00000
BHULT-23	GRSL--23	.01040	.02680	.05180	.00000	.00000	.00000	.00000	.00000
GRSL--23	TONG--23	.00410	.02080	.04020	.00000	.00000	.00000	.00000	.00000
GRSL--23	TONG--23	.00410	.02080	.04020	.00000	.00000	.00000	.00000	.00000
GRSL--23	TONG--23	.00410	.02080	.04020	.00000	.00000	.00000	.00000	.00000
TONG--23	BASUN-23	.00290	.01980	.07590	.00000	.00000	.00000	.00000	.00000
TONG--23	BASUN-23	.00290	.01980	.07590	.00000	.00000	.00000	.00000	.00000
TONG--23	SAVR--23	.00370	.01910	.03690	.00000	.00000	.00000	.00000	.00000
TONG--23	SAVR--23	.00370	.01910	.03690	.00000	.00000	.00000	.00000	.00000
SAVR--23	POST--23	.00290	.01530	.02950	.00000	.00000	.00000	.00000	.00000
SAVR--23	POST--23	.00290	.01530	.02950	.00000	.00000	.00000	.00000	.00000
GRSL--23	ISHR--23	.02670	.03710	.26490	.00000	.00000	.00000	.00000	.00000
GRSL--23	ISHR--23	.02670	.03710	.26490	.00000	.00000	.00000	.00000	.00000
GRSL--23	ISHR--23	.02670	.03710	.26490	.00000	.00000	.00000	.00000	.00000
GRSL--23	ISHR--23	.02670	.03710	.26490	.00000	.00000	.00000	.00000	.00000
GRSL--23	ISHR--23	.02670	.03710	.26490	.00000	.00000	.00000	.00000	.00000
ISHR--23	BHER--23	.00120	.00610	.01180	.00000	.00000	.00000	.00000	.00000
ISHR--23	BHER--23	.00120	.00610	.01180	.00000	.00000	.00000	.00000	.00000
ISHR--23	BOGRA-23	.01790	.09190	.17760	.00000	.00000	.00000	.00000	.00000
ISHR--23	BOGRA-23	.01790	.09190	.17760	.00000	.00000	.00000	.00000	.00000
BHER--23	JESS--23	.02090	.10720	.20720	.00000	.00000	.00000	.00000	.00000
BHER--23	JESS--23	.02090	.10720	.20720	.00000	.00000	.00000	.00000	.00000
JESS--23	BARI--23	.02240	.11490	.22190	.00000	.00000	.00000	.00000	.00000

NODE	TO NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
JESS--23	BARI--23	.02240	.11490	.22190	.00000	.00000	.00000	.00000	.00000
JESS--23	KHULNA23	.00590	.03060	.05920	.00000	.00000	.00000	.00000	.00000
JESS--23	KHULNA23	.00590	.03060	.05920	.00000	.00000	.00000	.00000	.00000
BOGRA-23	BARAP-23	.00850	.04590	.08880	.00000	.00000	.00000	.00000	.00000
BOGRA-23	BARAP-23	.00850	.04590	.08880	.00000	.00000	.00000	.00000	.00000
BOGRA-23	BAGHA-23	.01790	.09190	.17760	.00000	.00000	.00000	.00000	.00000
BOGRA-23	BAGHA-23	.01790	.09190	.17760	.00000	.00000	.00000	.00000	.00000
THAKU--R	THAKU--R	.00000	-2.85710	.00000	.00000	.00000	.00000	.00000	.00000
SAIDP--R	SAIDP--R	.00000	-2.50000	.00000	.00000	.00000	.00000	.00000	.00000
RANGP--R	RANGP--R	.00000	-2.50000	.00000	.00000	.00000	.00000	.00000	.00000
RAJSH--I	RAJSH--I	.00000	-5.00000	.00000	.00000	.00000	.00000	.00000	.00000
BOGUR--A	BOGUR--A	.00000	-3.33330	.00000	.00000	.00000	.00000	.00000	.00000
NATOR--E	NATOR--E	.00000	-5.00000	.00000	.00000	.00000	.00000	.00000	.00000
ISHRD--I	ISHRD--I	.00000	-3.33330	.00000	.00000	.00000	.00000	.00000	.00000
JHNDA--H	JHNDA--H	.00000	-10.00000	.00000	.00000	.00000	.00000	.00000	.00000
JESOR--E	JESOR--E	.00000	-6.66670	.00000	.00000	.00000	.00000	.00000	.00000
KLCEN--T	KLCEN--T	.00000	-1.00000	.00000	.00000	.00000	.00000	.00000	.00000
PATUA--K	PATUA--K	.00000	-1.50000	.00000	.00000	.00000	.00000	.00000	.00000
TONGG--I	TONGG--I	.00000	-10.00000	.00000	.00000	.00000	.00000	.00000	.00000
DHANM--O	DHANM--O	.00000	-2.40000	.00000	.00000	.00000	.00000	.00000	.00000
ULLOO--N	ULLOO--N	.00000	-2.40000	.00000	.00000	.00000	.00000	.00000	.00000
RAMPR--A	RAMPR--A	.00000	-2.40000	.00000	.00000	.00000	.00000	.00000	.00000
SHAMP--R	SHAMP--R	.00000	-2.40000	.00000	.00000	.00000	.00000	.00000	.00000
TONGG--I	TONGG--I	.00000	-4.66670	.00000	.00000	.00000	.00000	.00000	.00000
MADNH--T	MADNH--T	.00000	-6.66670	.00000	.00000	.00000	.00000	.00000	.00000
KULSH--I	KULSH--I	.00000	-6.66670	.00000	.00000	.00000	.00000	.00000	.00000
HLSHA--R	HLSHA--R	.00000	-4.66670	.00000	.00000	.00000	.00000	.00000	.00000
FENCG--J	FENCG--J	.00000	-1.00000	.00000	.00000	.00000	.00000	.00000	.00000
KPT--123	KAPTA--I	.00000	.22220	.00000	.00000	.00000	.00000	.00000	.00000
KPT--123	KAPTA--I	.00000	.22220	.00000	.00000	.00000	.00000	.00000	.00000
KPT--123	KAPTA--I	.00000	.22600	.00000	.00000	.00000	.00000	.00000	.00000
KPT---45	KAPTA--I	.00000	.17600	.00000	.00000	.00000	.00000	.00000	.00000
KPT---45	KAPTA--I	.00000	.17600	.00000	.00000	.00000	.00000	.00000	.00000
RAZ2x210	RAJN--23	.00000	.04330	.00000	.00000	.00000	.00000	.00000	.00000
RAZ2x210	RAJN--23	.00000	.04330	.00000	.00000	.00000	.00000	.00000	.00000
SK--1X60	SIKLB--A	.00000	.14600	.00000	.00000	.00000	.00000	.00000	.00000
SK--2X28	SIKLB--A	.00000	.14600	.00000	.00000	.00000	.00000	.00000	.00000
HRP---CC	HARIP--R	.00000	.16430	.00000	.00000	.00000	.00000	.00000	.00000
HARI-360	HARI--23	.00000	.02500	.00000	.00000	.00000	.00000	.00000	.00000
HARI-360	HARI--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
SD----50	SIDDG--J	.00000	.22220	.00000	.00000	.00000	.00000	.00000	.00000
AES--450	MEGH--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
AES--450	MEGH--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
AES--450	MEGH--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
GH--2X55	GHRAS--L	.00000	.16430	.00000	.00000	.00000	.00000	.00000	.00000

NODE	TO NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
GH--2X55	GHRAS--L	.00000	.16430	.00000	.00000	.00000	.00000	.00000	.00000
GH--3210	GRSL--23	.00000	.04480	.00000	.00000	.00000	.00000	.00000	.00000
GH--3210	GRSL--23	.00000	.04480	.00000	.00000	.00000	.00000	.00000	.00000
GH--3210	GRSL--23	.00000	.04480	.00000	.00000	.00000	.00000	.00000	.00000
GH--1210	GRSL--23	.00000	.04480	.00000	.00000	.00000	.00000	.00000	.00000
AS--2X64	ASHU--23	.00000	.21070	.00000	.00000	.00000	.00000	.00000	.00000
AS--1X90	ASHU--23	.00000	.22000	.00000	.00000	.00000	.00000	.00000	.00000
AS--1X60	ASHU--23	.00000	.21070	.00000	.00000	.00000	.00000	.00000	.00000
AS--3150	ASHU--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
AS--3150	ASHU--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
AS--3150	ASHU--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
MYM--070	MYMNS--G	.00000	.16430	.00000	.00000	.00000	.00000	.00000	.00000
MYM--070	MYMNS--G	.00000	.16430	.00000	.00000	.00000	.00000	.00000	.00000
SHZ---80	SHJIB--Z	.00000	.10000	.00000	.00000	.00000	.00000	.00000	.00000
SHZ---70	SHJIB--Z	.00000	.10000	.00000	.00000	.00000	.00000	.00000	.00000
FNC--090	FNCHP--S	.00000	.10000	.00000	.00000	.00000	.00000	.00000	.00000
SY--1X20	SYLHE--T	.00000	.44280	.00000	.00000	.00000	.00000	.00000	.00000
KL--1X60	GOLPR--A	.00000	.14900	.00000	.00000	.00000	.00000	.00000	.00000
KL--1110	GOLPR--A	.00000	.09500	.00000	.00000	.00000	.00000	.00000	.00000
KPC----L	GOLPR--A	.00000	.10000	.00000	.00000	.00000	.00000	.00000	.00000
KL--2X28	GOLPR--A	.00000	.14600	.00000	.00000	.00000	.00000	.00000	.00000
BR---140	BRISA--L	.00000	.10000	.00000	.00000	.00000	.00000	.00000	.00000
BH--3X20	BHRMR--A	.00000	.21070	.00000	.00000	.00000	.00000	.00000	.00000
BG----71	BAGBR--I	.00000	.10000	.00000	.00000	.00000	.00000	.00000	.00000
IPP--090	BAGBR--I	.00000	.10000	.00000	.00000	.00000	.00000	.00000	.00000
BG---100	BAGBR--I	.00000	.16430	.00000	.00000	.00000	.00000	.00000	.00000
SP--1X20	SAIDP--R	.00000	.64280	.00000	.00000	.00000	.00000	.00000	.00000
RP--1X20	RANGP--R	.00000	.64280	.00000	.00000	.00000	.00000	.00000	.00000
KUL3X150	KULSI-23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
KUL3X150	KULSI-23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
KUL3X150	KULSI-23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
KULS1210	KULSI-23	.00000	.05880	.00000	.00000	.00000	.00000	.00000	.00000
RAJN2210	RAJN--23	.00000	.04880	.00000	.00000	.00000	.00000	.00000	.00000
RAJN2210	RAJN--23	.00000	.04880	.00000	.00000	.00000	.00000	.00000	.00000
MEG2X450	MEGH--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
MEG2X450	MEGH--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
MEG2X450	MEGH--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
MEG2X450	MEGH--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
MEG2X450	MEGH--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
MEG2X450	MEGH--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
MEG1X210	MEGH--23	.00000	.04880	.00000	.00000	.00000	.00000	.00000	.00000
ASH2X210	ASHU--23	.00000	.04880	.00000	.00000	.00000	.00000	.00000	.00000
ASH2X210	ASHU--23	.00000	.04880	.00000	.00000	.00000	.00000	.00000	.00000
ASHG1210	ASHU--23	.00000	.04880	.00000	.00000	.00000	.00000	.00000	.00000
HAR1X210	HARI--23	.00000	.04880	.00000	.00000	.00000	.00000	.00000	.00000

NODE	TO NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
SIDD2210	SIDD--23	.00000	.04880	.00000	.00000	.00000	.00000	.00000	.00000
SIDD2210	SIDD--23	.00000	.04880	.00000	.00000	.00000	.00000	.00000	.00000
SIDD2350	SIDD--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
SIDD2350	SIDD--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
SIDD2350	SIDD--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
SIDD2350	SIDD--23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
GRS3X210	GRSL--23	.00000	.04880	.00000	.00000	.00000	.00000	.00000	.00000
GRS3X210	GRSL--23	.00000	.04880	.00000	.00000	.00000	.00000	.00000	.00000
GRS3X210	GRSL--23	.00000	.04880	.00000	.00000	.00000	.00000	.00000	.00000
GRS1X210	GRSL--23	.00000	.04880	.00000	.00000	.00000	.00000	.00000	.00000
BP---250	BARAP-23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
BP---250	BARAP-23	.00000	.07000	.00000	.00000	.00000	.00000	.00000	.00000
HATZ--23	HATHA--Z	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
HATZ--23	HATHA--Z	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
HATZ--23	HATHA--Z	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
ASHU--23	ASHUG--J	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
ASHU--23	ASHUG--J	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
KULSI-23	KULSH--I	.00000	.00330	.00000	.00000	.00000	.00000	.00000	.00000
KULSI-23	KULSH--I	.00000	.00330	.00000	.00000	.00000	.00000	.00000	.00000
SIDD--23	SIDDG--J	.00000	.00330	.00000	.00000	.00000	.00000	.00000	.00000
SIDD--23	SIDDG--J	.00000	.00330	.00000	.00000	.00000	.00000	.00000	.00000
POST--23	HASNB--D	.00000	.00330	.00000	.00000	.00000	.00000	.00000	.00000
POST--23	HASNB--D	.00000	.00330	.00000	.00000	.00000	.00000	.00000	.00000
BASUN-23	RAMPR--A	.00000	.00330	.00000	.00000	.00000	.00000	.00000	.00000
BASUN-23	RAMPR--A	.00000	.00330	.00000	.00000	.00000	.00000	.00000	.00000
HARI--23	HARIP--R	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
HARI--23	HARIP--R	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
GRSL--23	GHRAS--L	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
GRSL--23	GHRAS--L	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
TONG--23	TONGG--I	.00000	.00530	.00000	.00000	.00000	.00000	.00000	.00000
TONG--23	TONGG--I	.00000	.00530	.00000	.00000	.00000	.00000	.00000	.00000
COMI--23	COMI---N	.00000	.00530	.00000	.00000	.00000	.00000	.00000	.00000
COMI--23	COMI---N	.00000	.00530	.00000	.00000	.00000	.00000	.00000	.00000
ISHR--23	ISHRD--I	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
ISHR--23	ISHRD--I	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
ISHR--23	ISHRD--I	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
HALIS-23	HLSHA--R	.00000	.00530	.00000	.00000	.00000	.00000	.00000	.00000
HALIS-23	HLSHA--R	.00000	.00530	.00000	.00000	.00000	.00000	.00000	.00000
MYNSG-23	MYMNS--G	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
MYNSG-23	MYMNS--G	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
SYLH--23	SYLHE--T	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
SYLH--23	SYLHE--T	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
KHULNA23	GOLPR--A	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
KHULNA23	GOLPR--A	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
JESS--23	JESOR--E	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000

NODE TO	NODE	RESISTANCE	REACTANCE	SHUNT SUSC.	INIT.TAP	B.TAP	STEP	T.TAP	VOLTAGE
JESS--23	JESOR--E	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
BARI--23	BRISA--L	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
BARI--23	BRISA--L	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
BHER--23	BHRMR--A	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
BHER--23	BHRMR--A	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
BAGHA-23	BAGBR--I	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
BAGHA-23	BAGBR--I	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
BOGRA-23	BOGUR--A	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
BOGRA-23	BOGUR--A	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
BARAP-23	BARAPU-K	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000
BARAP-23	BARAPU-K	.00000	.05330	.00000	.00000	.00000	.00000	.00000	.00000

MACHINES' DATA

	Installed Capacity (MW)	x'_d	H
KPT--123	130	.2150	6.36
KPT---45	100	.1760	4.79
RAZ2x210	420	.0810	24.70
SK--1X60	60	.2920	3.64
SK--2X28	56	.3710	1.64
HRP---CC	99	.1910	1.15
HARI-360	360	.0510	8.75
SD----50	50	.4640	2.88
AES--450	450	.0410	11.34
GH--2X55	110	.1460	8.75
GH--3210	630	.0430	37.05
GH--1210	210	.1300	12.35
AS--2X64	128	.1030	7.84
AS--1X90	90	.1360	6.92
AS--1X60	60	.2010	5.46
AS--3150	450	.0460	11.34
MYM--070	70	.2160	4.29
SHZ---80	80	.1810	4.29
SHZ---70	70	.2160	4.29
FNC--090	90	.1290	0.37
SY--1X20	20	.9230	1.99
KL--1X60	60	.2920	3.64
KL--1110	110	.2000	1.44
KPC----L	110	.3430	4.78
KL--2X28	56	.2760	4.78
BR---140	40	.4680	3.85
BH--3X20	60	.2530	5.92
BG----71	71	.2170	4.29
IPP--090	90	.1750	0.37
BG---100	100	.1790	1.44
RP--1X20	20	.9680	1.93
SP--1X20	20	.9680	1.93
KUL3X150	450	.0410	25.12
KULS1210	210	.1300	12.35
RAJN2210	420	.0650	24.70
MEG2X450	900	.0210	25.12
MEG1X210	210	.1300	12.35
ASH2X210	420	.0650	24.70
ASHG1210	210	.1300	12.35
HAR1X210	210	.1300	12.35
SIDD2210	420	.0650	24.70
SIDD2350	700	.0260	41.17
GRS3X210	630	.0430	37.05
GRS1X210	210	.1300	12.35
BP---250	250	.1100	14.70

FAULT AT BUS= 135

SL.NO.OF FAULTY LINES TRIPPED = 211

FAULT CLEARING TIME= .0800

LOAD FLOW OUTPUT

TOTAL NUMBER OF ELECTRICAL NODES	=	148
TOTAL NUMBER OF LINES INCLUDING TRANSFORMERS	=	347
TOTAL NO. OF IN-PHASE TRANSFORMERS	=	0
NO.OF CONTROLLABLE IN-PHASE TRANSFORMERS	=	0
NO.OF FIXED TAP IN-PHASE TRANSFORMERS	=	0
NO.OF REACTORS	=	21

BASE CASE LOAD FLOW CONVERGED IN 4 ITERATIONS

BUS VOLTAGE AND GENERATION

BUS	BUS	BUS	VOLTAGE			GENERATION		LOAD		MISMATCH	
NO.	NAME	TYPE	KV	PU	ANG	MW	MVAR	MW	MVAR	MW	MVAR
1	KPT--123	PV	11.0	1.00	-4.6	90.0	38.9	1.5	.8	.00	.00
2	KPT---45	PV	11.0	1.00	-4.5	80.0	33.5	2.0	1.0	.00	.00
3	RAZ2x210	PV	15.7	1.05	-2.3	254.0	168.2	26.0	13.0	.00	.00
4	SK--1X60	PV	11.0	1.00	-3.4	60.0	19.5	4.0	2.0	.00	.00
5	SK--2X28	PV	11.0	1.00	-4.0	50.0	17.5	1.0	.5	.00	.00
6	HRP---CC	PV	11.0	1.00	.1	50.0	1.3	1.0	.5	.00	.00
7	HARI-360	PV	15.7	1.05	1.0	360.0	168.1	8.0	4.0	.00	.00
8	SD----50	PV	11.0	1.00	1.6	50.0	2.8	3.0	1.5	.00	.00
9	AES--450	PV	15.7	1.05	1.5	250.0	94.1	12.0	6.0	.00	.00
10	GH--2X55	PV	11.1	1.01	-1.3	100.0	23.4	4.0	2.0	.00	.00
11	GH--3210	SLACK	15.7	1.05	.0	512.0	206.6	40.0	20.0	.00	.00
12	GH--1210	PV	15.7	1.05	-.3	157.8	67.5	12.0	6.0	.00	.00
13	AS--2X64	PV	11.2	1.02	3.5	55.0	1.4	4.0	2.0	.00	.00
14	AS--1X90	PV	11.2	1.02	7.0	80.0	4.3	2.0	1.0	.00	.00
15	AS--1X60	PV	11.2	1.02	4.5	60.0	.4	.0	.0	.00	.00
16	AS--3150	PV	15.7	1.05	2.2	400.0	132.2	24.0	12.0	.00	.00
17	MYM--070	PV	11.0	1.00	-4.2	70.0	31.6	2.0	1.0	.00	.00
18	SHZ---80	PV	11.0	1.00	-3.5	80.0	29.2	.0	.0	.00	.00
19	SHZ---70	PV	11.0	1.00	-4.2	70.0	28.9	1.0	.5	.00	.00
20	FNC--090	PV	11.0	1.00	-7.9	90.0	50.0	2.0	1.0	.01	.00
21	SY--1X20	PV	11.0	1.00	-7.2	20.0	11.8	1.0	.5	.00	.00
22	KL--1X60	PV	11.0	1.00	-9.5	60.0	19.6	.0	.0	.01	.00
23	KL--1110	PV	11.0	1.00	-8.8	110.0	34.2	5.0	2.5	.01	.00
24	KPC----L	PV	11.0	1.00	-9.4	100.0	34.2	10.0	5.0	.01	.00
25	KL--2X28	PV	11.0	1.00	-9.9	56.0	19.7	.5	.3	.01	.00
26	BR---140	PV	11.0	1.00	-15.1	40.0	24.1	.5	.3	.01	.00
27	BH--3X20	PV	11.0	1.00	-3.4	58.0	14.4	.5	.3	.00	.00
28	BG----71	PV	11.0	1.00	-7.4	71.0	26.5	1.0	.5	.01	.00
29	IPP--090	PV	11.0	1.00	-6.4	90.0	28.9	3.0	1.5	.01	.00
30	BG---100	PV	11.0	1.00	-6.8	50.0	16.8	1.0	.5	.00	.00
31	RP--1X20	PV	11.0	1.00	-8.6	20.0	1.5	.2	.1	.00	.00
32	SP--1X20	PV	11.0	1.00	-8.8	20.0	.2	.2	.1	.00	.00
33	KUL3X150	PV	15.7	1.05	-2.8	400.0	275.0	15.0	7.5	.00	.00
34	KULS1210	PV	15.7	1.05	-2.6	160.0	106.8	.0	.0	.00	.00
35	RAJN2210	PV	15.7	1.05	-.1	400.0	163.6	30.0	15.0	.00	.00
36	MEG2X450	PV	15.7	1.05	2.1	600.0	194.2	25.0	12.5	.00	.00
37	MEG1X210	PV	15.7	1.05	1.0	100.0	43.7	5.0	2.5	.00	.00
38	ASH2X210	PV	15.7	1.05	-.1	200.0	114.0	20.0	10.0	.00	.00
39	ASHG1210	PV	15.7	1.05	-.6	70.0	51.3	.0	.0	.00	.00
40	HAR1X210	PV	15.7	1.05	2.5	200.0	71.2	10.0	5.0	.00	.00
41	SIDD2210	PV	15.7	1.05	1.3	400.0	209.0	20.0	10.0	.00	.00
42	SIDD2350	PV	15.7	1.05	2.2	650.0	299.1	25.0	12.5	.01	.00
43	GRS3X210	PV	15.7	1.05	.8	550.0	188.3	20.0	10.0	.01	.00
44	GRS1X210	PV	15.7	1.05	-1.2	100.0	54.6	.0	.0	.00	.00
45	BP---250	PV	15.7	1.05	-8.2	200.0	120.1	12.5	6.3	.01	.00
46	KAPTA--I	PQ	128.5	.97	-8.5	.0	.0	90.0	45.0	.01	.00

BUS NO.	BUS NAME	BUS TYPE	VOLTAGE KV	PU	ANG	GENERATION MW	MVAR	LOAD MW	MVAR	MISMATCH MW	MVAR
47	CHNDR--O	PQ	127.2	.96	-9.3	.0	.0	100.0	50.0	.00	.00
48	HATHA--Z	PQ	129.4	.98	-8.5	.0	.0	265.0	132.5	.00	.00
49	MADNH--T	PQ	129.1	.98	-8.7	.0	.0	100.0	50.5	.00	.00
50	SIKLB--A	PQ	129.1	.98	-8.2	.0	.0	80.0	40.5	.00	.00
51	DOHZR--I	PQ	126.8	.96	-9.6	.0	.0	44.0	22.0	.00	00
52	COXBZ--R	PQ	124.9	.95	-10.9	.0	.0	26.0	13.0	.00	.00
53	HLSHA--R	PQ	131.1	.99	-7.0	.0	.0	265.0	132.5	-.01	.01
54	KULSH--I	PQ	130.5	.99	-8.3	.0	.0	500.0	250.0	.02	.01
55	BARLI--A	PQ	129.5	.98	-8.6	.0	.0	80.0	40.0	.00	.00
56	FEN----I	PQ	129.1	.98	-7.7	.0	.0	37.0	18.5	.00	.00
57	CHOWM--U	PQ	127.8	.97	-8.4	.0	.0	37.0	18.5	.00	.00
58	COMI---N	PQ	133.4	1.01	-4.4	.0	.0	100.0	50.0	.00	.00
59	COMI---S	PQ	130.5	.99	-5.8	.0	.0	80.0	40.0	.00	.00
60	CHNDP--R	PQ	126.4	.96	-7.9	.0	.0	80.0	40.0	.00	.00
61	HARIP--R	PQ	132.3	1.00	-4.5	.0	.0	480.0	240.0	-.03	-.02
62	SIDDG--J	PQ	132.3	1.00	-4.4	.0	.0	150.0	75.0	.01	.11
63	MANIK--N	PQ	126.7	.96	-8.5	.0	.0	25.0	12.5	.00	.00
64	ULLOO--N	PQ	129.8	.98	-6.6	.0	.0	60.0	30.0	.00	-.01
65	DHANM--O	PQ	128.9	.98	-7.2	.0	.0	280.0	140.0	-.01	.00
66	RAMPR--A	PQ	130.4	.99	-6.3	.0	.0	300.0	150.0	-.01	.00
67	NARIN--D	PQ	126.6	.96	-8.5	.0	.0	25.0	12.5	.00	.00
68	SHAMP--R	PQ	131.9	1.00	-5.3	.0	.0	60.0	30.0	.00	.00
69	MADNG--J	PQ	131.8	1.00	-5.1	.0	.0	30.0	15.0	.00	.00
70	HASNB--D	PQ	132.0	1.00	-4.9	.0	.0	110.0	55.0	-.01	-.02
71	MIRPU--R	PQ	127.7	.97	-7.5	.0	.0	200.0	100.0	-.01	.00
72	KALLY--N	PQ	128.2	.97	-7.0	.0	.0	250.0	125.0	.00	.00
73	BASHU--N	PQ	129.1	.98	-7.0	.0	.0	220.0	110.0	.00	.00
74	TONGG--I	PQ	130.6	.99	-6.3	.0	.0	200.0	100.0	.00	.00
75	KABRP--R	PQ	128.2	.97	-7.7	.0	.0	64.0	33.0	.00	.00
76	MANIK--G	PQ	131.9	1.00	-4.6	.0	.0	32.0	16.0	.00	.00
77	TANGA--L	PQ	126.3	.96	-9.0	.0	.0	45.0	22.5	.00	.00
78	GHRAS--L	PQ	131.4	1.00	-5.8	.0	.0	160.0	80.0	.00	.00
79	JYDVP--R	PQ	128.8	.98	-7.3	.0	.0	40.0	20.0	.00	.00
80	BHULT--A	PQ	130.9	.99	-5.7	.0	.0	40.0	20.0	.00	.00
81	ASHUG--J	PQ	131.2	.99	-6.3	.0	.0	150.0	75.0	.00	.00
82	KISHG--J	PQ	128.1	.97	-7.9	.0	.0	70.0	35.0	.00	.00
83	MYMNS--G	PQ	128.9	.98	-7.4	.0	.0	100.0	50.0	.00	.00
84	JAMLP--R	PQ	126.9	.96	-8.8	.0	.0	35.0	17.5	.00	.00
85	NETRO--K	PQ	125.8	.95	-9.1	.0	.0	40.0	20.0	.00	.00
86	SHJIB--Z	PQ	128.6	.97	-8.2	.0	.0	100.0	50.0	.00	.00
87	SRMNG--L	PQ	126.3	.96	-11.0	.0	.0	50.0	25.5	.00	.00
88	FENCG--J	PQ	126.2	.96	-13.6	.0	.0	100.0	50.0	-.01	.00
89	FNCHP--S	PQ	126.1	.96	-13.2	.0	.0	100.0	50.0	-.01	.00
90	SYLHE--T	PQ	125.9	.95	-12.2	.0	.0	150.0	75.0	-.01	.00
91	CHATA--K	PQ	125.2	.95	-12.6	.0	.0	20.0	10.0	.00	.00
92	GOLPR--A	PQ	128.7	.97	-14.7	.0	.0	100.0	50.0	-.03	-.02
93	KLCEN--T	PQ	128.7	.97	-14.8	.0	.0	150.0	75.5	-.02	.01
94	NOAPR--A	PQ	127.2	.96	-15.2	.0	.0	50.0	25.0	-.01	.00
95	JESOR--E	PQ	127.1	.96	-15.1	.0	.0	80.0	40.0	-.02	.00
96	JHNDA--H	PQ	125.8	.95	-14.5	.0	.0	60.0	30.0	-.01	.00
97	BOTAI--L	PQ	127.1	.96	-12.2	.0	.0	43.0	21.5	.01	.00
98	BHRMR--A	PQ	129.1	.98	-10.5	.0	.0	80.0	40.0	.01	.00
99	FRIDP--R	PQ	126.1	.96	-15.4	.0	.0	33.0	16.5	.01	.00
100	MADAP--R	PQ	126.6	.96	-17.1	.0	.0	30.0	15.0	-.02	.00
101	BRISA--L	PQ	129.0	.98	-17.4	.0	.0	48.0	24.0	-.04	-.01
102	KAUKH--L	PQ	125.4	.95	-18.5	.0	.0	30.0	15.0	-.01	.00
103	BNDRI--A	PQ	125.0	.95	-18.7	.0	.0	20.0	10.0	-.01	.00
104	BAGRH--T	PQ	124.9	.95	-17.7	.0	.0	26.0	13.0	.00	.00
105	MANGL--A	PQ	123.8	.94	-18.3	.0	.0	14.0	7.0	.00	.00
106	PATUA--K	PQ	136.0	1.03	-19.5	.0	.0	21.0	10.5	-.01	.00
107	ISHRD--I	PQ	129.3	.98	-10.4	.0	.0	80.0	40.0	.00	-.01
108	NATOR--E	PQ	128.6	.97	-12.7	.0	.0	28.0	14.0	.00	.00
109	RAJSH--I	PQ	126.8	.96	-14.3	.0	.0	48.0	24.0	-.01	.00
110	NWBGN--G	PQ	124.9	.95	-15.3	.0	.0	18.0	9.5	.00	.00
111	PABAN--A	PQ	127.8	.97	-11.4	.0	.0	44.0	22.5	.00	.00

BUS NO.	BUS NAME	BUS TYPE	VOLTAGE KV	PU	ANG	GENERATION MW	MVAR	LOAD MW	MVAR	MISMATCH MW	MVAR
112	SHJDP--R	PQ	128.0	.97	-11.9	.0	.0	60.0	30.5	.00	.00
113	BAGBR--I	PQ	128.9	.98	-11.6	.0	.0	136.0	68.0	-.03	.00
114	SRJGN--J	PQ	128.9	.98	-12.5	.0	.0	24.0	12.0	.00	.00
115	BOGUR--A	PQ	130.3	.99	-13.3	.0	.0	87.0	43.5	-.02	.00
116	NAOGO--A	PQ	128.8	.98	-14.2	.0	.0	16.0	8.0	.00	.00
117	PLSBR--I	PQ	130.3	.99	-15.0	.0	.0	28.0	14.0	.00	.00
118	RANGP--R	PQ	131.9	1.00	-15.9	.0	.0	50.0	25.0	-.01	.00
119	LALMO--N	PQ	128.8	.98	-17.4	.0	.0	36.0	18.0	-.01	.00
120	SAIDP--R	PQ	133.0	1.01	-16.0	.0	.0	36.0	18.0	.00	.00
121	PRBSD--P	PQ	132.7	1.01	-16.8	.0	.0	25.0	12.5	.00	.00
122	THAKU--R	PQ	133.4	1.01	-17.9	.0	.0	26.0	13.0	.00	.00
123	BARAPU-K	PQ	132.9	1.01	-14.7	.0	.0	80.0	40.0	-.02	-.01
124	BARAP-23	PQ	233.2	1.01	-11.7	.0	.0	.0	.0	.01	.00
125	RAJN--23	PQ	234.4	1.02	-4.9	.0	.0	.0	.0	.00	.00
126	HATZ--23	PQ	231.2	1.01	-6.2	.0	.0	.0	.0	-.03	-.01
127	COMI--23	PQ	233.4	1.01	-3.8	.0	.0	.0	.0	.00	.01
128	ASHU--23	PQ	236.1	1.03	-2.4	.0	.0	.0	.0	.00	-.01
129	GRSL--23	PQ	235.9	1.03	-3.8	.0	.0	.0	.0	-.12	-.03
130	TONG--23	PQ	229.3	1.00	-5.5	.0	.0	.0	.0	.01	.01
131	SAVR--23	PQ	230.2	1.00	-4.9	.0	.0	.0	.0	.00	.00
132	POST--23	PQ	230.7	1.00	-4.5	.0	.0	.0	.0	.01	.02
133	HARI--23	PQ	235.3	1.02	-2.4	.0	.0	.0	.0	.00	.00
134	MEGH--23	PQ	237.3	1.03	-1.5	.0	.0	.0	.0	-.01	.00
135	ISHR--23	PQ	227.0	.99	-7.3	.0	.0	.0	.0	.19	.00
136	BASUN-23	PQ	228.1	.99	-5.7	.0	.0	.0	.0	.00	-.03
137	KULSI-23	PQ	228.7	.99	-7.8	.0	.0	.0	.0	-.01	.01
138	HALIS-23	PQ	229.4	1.00	-6.3	.0	.0	.0	.0	.00	.00
139	SYLH--23	PQ	223.1	.97	-8.9	.0	.0	.0	.0	.03	.00
140	MYNSG-23	PQ	228.3	.99	-5.5	.0	.0	.0	.0	.00	.00
141	SIDD--23	PQ	231.8	1.01	-3.7	.0	.0	.0	.0	.01	-.01
142	BHULT-23	PQ	235.9	1.03	-3.0	.0	.0	.0	.0	.00	.00
143	BHER--23	PQ	226.5	.98	-7.9	.0	.0	.0	.0	.04	.00
144	JESS--23	PQ	224.2	.97	-13.8	.0	.0	.0	.0	.02	.00
145	BARI--23	PQ	224.8	.98	-16.3	.0	.0	.0	.0	.00	.00
146	KHULNA23	PQ	224.2	.97	-14.2	.0	.0	.0	.0	-.02	.00
147	BAGHA-23	PQ	227.0	.99	-11.5	.0	.0	.0	.0	.00	.00
148	BOGRA-23	PQ	229.4	1.00	-11.4	.0	.0	.0	.0	.01	.00
						7643.8	3242.1	7531.9	3770.4	-.08	-.05

LINE FLOW

FROM BUS	TO BUS	SENT MW	MVAR	RECEIVED MW	MVAR	LOSSES MW	MVAR
KAPTA--I	CHNDR--O	80.755430	34.809920	-80.379670	-33.758150	.375763	1.051769
KAPTA--I	MADNH--T	1.102047	-6.435509	-1.094614	4.539160	.007433	-1.896349
*HATHA--Z	KAPTA--I	2.694307	6.107032	-2.681185	-7.947585	.013121	-1.840552
*HATHA--Z	KAPTA--I	2.694307	6.107032	-2.681185	-7.947585	.013121	-1.840552
*MADNH--T	CHNDR--O	19.742980	15.191620	-19.622480	-16.242050	.120493	-1.050426
HATHA--Z	MADNH--T	16.182760	5.831083	-16.166690	-6.220032	.016069	-.388948
HATHA--Z	MADNH--T	16.182760	5.831083	-16.166690	-6.220032	.016069	-.388948
*FEN----I	HATHA--Z	6.119328	-5.164806	-6.094418	.812065	.024909	-4.352741
*FEN----I	HATHA--Z	6.119328	-5.164806	-6.094418	.812065	.024909	-4.352741
*SIKLB--A	MADNH--T	18.132060	-6.403598	-18.096500	5.927330	.035564	-.476268
*SIKLB--A	MADNH--T	18.132060	-6.403598	-18.096500	5.927330	.035564	-.476268
*KULSH--I	MADNH--T	25.168350	27.475770	-25.061950	-27.644380	.106400	-.168608
*KULSH--I	MADNH--T	25.168350	27.475770	-25.061950	-27.644380	.106400	-.168608
*HLSHA--R	SIKLB--A	82.626360	31.220930	-82.031270	-29.610370	.595085	1.610559
SIKLB--A	DOHZR--I	35.382680	13.721480	-35.096570	-14.210810	.286118	-.489332

FROM BUS	TO BUS	SENT MW	SENT MVAR	RECEIVED MW	RECEIVED MVAR	LOSSES MW	LOSSES MVAR
SIKLB--A	DOHZR--I	35.382680	13.721480	-35.096570	-14.210810	.286118	-.489332
DOHZR--I	COXBZ--R	13.096470	3.210762	-13.000760	-6.500178	.095707	-3.289416
DOHZR--I	COXBZ--R	13.096470	3.210762	-13.000760	-6.500178	.095707	-3.289416
HATHA--Z	BARLI--A	6.465466	-4.249354	-6.461280	3.659299	.004186	-.590055
HATHA--Z	BARLI--A	6.465466	-4.249354	-6.461280	3.659299	.004186	-.590055
*HLSHA--R	HATHA--Z	84.421540	18.856440	-83.828550	-17.073890	.592987	1.782549
KULSH--I	BARLI--A	21.528160	20.433560	-21.459440	-20.822290	.068716	-.388729
KULSH--I	BARLI--A	21.528160	20.433560	-21.459440	-20.822290	.068716	-.388729
*COMI---N	BARLI--A	24.655620	.334579	-24.159250	-5.674473	.496368	-5.339893
*COMI---N	FEN----I	43.961300	11.694640	-43.200430	-12.066120	.760872	-.371487
*COMI---N	FEN----I	43.961300	11.694640	-43.200430	-12.066120	.760872	-.371487
FEN----I	CHOWM--U	18.582270	7.980690	-18.500100	-9.249998	.082176	-1.269309
FEN----I	CHOWM--U	18.582270	7.980690	-18.500100	-9.249998	.082176	-1.269309
COMI---N	HARIP--R	2.317292	2.941221	-2.305331	-6.713407	.011961	-3.772186
COMI---N	HARIP--R	2.317292	2.941221	-2.305331	-6.713407	.011961	-3.772186
COMI---N	COMI---S	80.749310	42.030820	-79.999630	-40.000080	.749687	2.030739
*SIDDG--J	HARIP--R	102.111600	34.095540	-102.076100	-33.999480	.035530	.096054
*SIDDG--J	HARIP--R	102.111600	34.095540	-102.076100	-33.999480	.035530	.096054
COMI---N	CHNDP--R	40.937490	19.690720	-39.999360	-20.000080	.938126	-.309359
COMI---N	CHNDP--R	40.937490	19.690720	-39.999360	-20.000080	.938126	-.309359
*SIDDG--J	HARIP--R	102.111600	34.095540	-102.076100	-33.999480	.035530	.096054
*SIDDG--J	HARIP--R	102.111600	34.095540	-102.076100	-33.999480	.035530	.096054
HARIP--R	SHAMP--R	19.281770	-1.737939	-19.212690	.329472	.069077	-1.408467
HARIP--R	MADNG--J	37.620670	1.246212	-37.514850	-1.514293	.105816	-.268080
SIDDG--J	MANIK--G	15.424070	7.129265	-15.402710	-7.699499	.021362	-.570233
SIDDG--J	MANIK--G	16.619570	7.785587	-16.596620	-8.299144	.022942	-.513557
HARIP--R	ULLOO--N	99.415890	21.894710	-98.350570	-18.757720	1.065315	3.136986
HARIP--R	ULLOO--N	99.415890	21.894710	-98.350570	-18.757720	1.065315	3.136986
*SIDDG--J	HARIP--R	102.111600	34.095540	-102.076100	-33.999480	.035530	.096054
*SIDDG--J	HARIP--R	102.111600	34.095540	-102.076100	-33.999480	.035530	.096054
MANIK--N	NARIN--D	12.502960	6.107896	-12.499550	-6.250900	.003416	-.143004
MANIK--N	NARIN--D	12.502960	6.107896	-12.499550	-6.250900	.003416	-.143004
HARIP--R	GHRAS--L	24.436970	-.844450	-24.284030	-.884083	.152933	-1.728533
HARIP--R	BHULT--A	42.623610	8.747994	-42.357930	-8.997566	.265682	-.249572
BHULT--A	GHRAS--L	2.358379	-11.002280	-2.344662	10.017440	.013717	-.984838
*MADNG--J	SHAMP--R	13.288920	-5.386444	-13.277110	4.912462	.011810	-.473982
*MADNG--J	SHAMP--R	13.288920	-5.386444	-13.277110	4.912462	.011810	-.473982
*HASNB--D	MADNG--J	9.017459	.563034	-9.010054	-1.343628	.007405	-.780594
*HASNB--D	MADNG--J	10.061390	.672353	-10.052910	-1.369600	.008481	-.697248
*HASNB--D	SHAMP--R	14.255130	-2.350533	-14.232170	1.439086	.022959	-.911448
ULLOO--N	DHANM--O	93.661060	34.403740	-93.331440	-33.424850	.329613	.978889
ULLOO--N	DHANM--O	93.661060	34.403740	-93.331440	-33.424850	.329613	.978889
ULLOO--N	DHANM--O	93.661060	34.403740	-93.331440	-33.424850	.329613	.978889
*RAMPR--A	ULLOO--N	72.282220	28.027440	-72.140250	-27.688390	.141968	.339048
*RAMPR--A	ULLOO--N	72.282220	28.027440	-72.140250	-27.688390	.141968	.339048
*TONGG--I	BASHU--N	50.389980	30.059420	-50.135350	-29.720380	.254631	.339043
*TONGG--I	BASHU--N	50.389980	30.059420	-50.135350	-29.720380	.254631	.339043
RAMPR--A	BASHU--N	60.144140	25.793910	-59.862350	-25.278850	.281792	.515066
RAMPR--A	BASHU--N	60.144140	25.793910	-59.862350	-25.278850	.281792	.515066
TONGG--I	MIRPU--R	74.532660	48.879200	-73.848160	-46.999310	.684502	1.879890
TONGG--I	MIRPU--R	74.532660	48.879200	-73.848160	-46.999310	.684502	1.879890
*KALLY--N	MIRPU--R	26.213450	2.512493	-26.149270	-3.000322	.064180	-.487828
*KALLY--N	MIRPU--R	26.213450	2.512493	-26.149270	-3.000322	.064180	-.487828
*HASNB--D	KALLY--N	102.131800	47.496560	-100.807400	-43.341190	1.324333	4.155376
*HASNB--D	KALLY--N	102.131800	47.496560	-100.807400	-43.341190	1.324333	4.155376
*HASNB--D	KALLY--N	102.131800	47.496560	-100.807400	-43.341190	1.324333	4.155376
TONGG--I	KABRP--R	55.831700	25.380290	-55.359730	-24.650160	.471973	.730133
TONGG--I	KABRP--R	55.831700	25.380290	-55.359730	-24.650160	.471973	.730133
KABRP--R	MANIK--N	25.128400	11.565440	-25.002550	-12.359060	.125856	-.793618
KABRP--R	MANIK--N	25.128400	11.565440	-25.002550	-12.359060	.125856	-.793618
KABRP--R	TANGA--L	20.550180	5.500811	-20.402720	-7.422799	.147459	-1.921988
KABRP--R	TANGA--L	20.550180	5.500811	-20.402720	-7.422799	.147459	-1.921988
GHRAS--L	ASHUG--J	7.869714	-1.315993	-7.853986	-.870677	.015728	-2.186670
GHRAS--L	ASHUG--J	7.869714	-1.315993	-7.853986	-.870677	.015728	-2.186670
GHRAS--L	JYDVP--R	42.757290	18.311770	-42.370250	-18.377810	.387039	-.066044

FROM BUS	TO BUS	SENT MW	SENT MVAR	RECEIVED MW	RECEIVED MVAR	LOSSES MW	LOSSES MVAR
GHRAS--L	JYDVP--R	42.757290	18.311770	-42.370250	-18.377810	.387039	-.066044
JYDVP--R	KABRP--R	22.370540	8.377440	-22.317890	-8.915276	.052652	-.537835
JYDVP--R	KABRP--R	22.370540	8.377440	-22.317890	-8.915276	.052652	-.537835
ASHUG--J	SHJIB--Z	32.546990	8.263487	-32.196200	-9.169897	.350796	-.906410
ASHUG--J	SHJIB--Z	32.546990	8.263487	-32.196200	-9.169897	.350796	-.906410
SHJIB--Z	SRMNG--L	56.696240	6.546101	-55.965660	-5.520735	.730576	1.025365
SHJIB--Z	SRMNG--L	56.696240	6.546101	-55.965660	-5.520735	.730576	1.025365
SRMNG--L	FNCHP--S	30.963480	-7.228661	-30.652370	6.090494	.311110	-1.138167
SRMNG--L	FNCHP--S	30.963480	-7.228661	-30.652370	6.090494	.311110	-1.138167
*FNCHP--S	FENCG--J	50.087490	-20.569030	-49.994170	20.685110	.093323	.116079
*FNCHP--S	FENCG--J	50.087490	-20.569030	-49.994170	20.685110	.093323	.116079
*SYLHE--T	FNCHP--S	25.550310	-9.644157	-25.434710	8.927290	.115606	-.716867
*SYLHE--T	FNCHP--S	25.550310	-9.644157	-25.434710	8.927290	.115606	-.716867
SYLHE--T	CHATA--K	10.023790	3.593346	-9.999199	-4.999859	.024595	-1.406512
SYLHE--T	CHATA--K	10.023790	3.593346	-9.999199	-4.999859	.024595	-1.406512
ASHUG--J	KISHG--J	28.267390	11.984240	-27.970900	-13.462490	.296495	-1.478251
ASHUG--J	KISHG--J	28.267390	11.984240	-27.970900	-13.462490	.296495	-1.478251
*MYMNS--G	KISHG--J	7.048786	1.205168	-7.028399	-4.037355	.020387	-2.832187
*MYMNS--G	KISHG--J	7.048786	1.205168	-7.028399	-4.037355	.020387	-2.832187
MYMNS--G	JAMLP--R	19.747150	5.659199	-19.600630	-7.797800	.146524	-2.138601
MYMNS--G	JAMLP--R	19.747150	5.659199	-19.600630	-7.797800	.146524	-2.138601
MYMNS--G	NETRO--K	40.426580	19.974770	-39.999360	-19.999860	.427223	-.025095
JAMLP--R	TANGA--L	2.100863	-.952007	-2.096766	-3.826921	.004097	-4.778928
JAMLP--R	TANGA--L	2.100863	-.952007	-2.096766	-3.826921	.004097	-4.778928
GOLPR--A	KLCEN--T	48.055210	1.254525	-48.038730	-2.072671	.016483	-.818147
GOLPR--A	KLCEN--T	48.055210	1.254525	-48.038730	-2.072671	.016483	-.818147
GOLPR--A	KLCEN--T	48.055210	1.254525	-48.038730	-2.072671	.016483	-.818147
GOLPR--A	KLCEN--T	48.055210	1.254525	-48.038730	-2.072671	.016483	-.818147
KLCEN--T	NOAPR--A	21.086660	13.883190	-20.971320	-14.570080	.115345	-.686898
KLCEN--T	NOAPR--A	21.086660	13.883190	-20.971320	-14.570080	.115345	-.686898
*JESOR--E	NOAPR--A	4.028903	-3.244340	-4.024063	2.070536	.004840	-1.173804
*JESOR--E	NOAPR--A	4.028903	-3.244340	-4.024063	2.070536	.004840	-1.173804
*JHNDA--H	JESOR--E	5.857773	-12.575960	-5.793865	10.651750	.063908	-1.924209
*JHNDA--H	JESOR--E	5.857773	-12.575960	-5.793865	10.651750	.063908	-1.924209
*BOTAI--L	JHNDA--H	36.330390	-2.752369	-35.853930	2.116645	.476463	-.635725
*BOTAI--L	JHNDA--H	36.330390	-2.752369	-35.853930	2.116645	.476463	-.635725
*BHRMR--A	BOTAI--L	58.469040	8.769250	-57.834610	-7.996717	.634426	.772533
*BHRMR--A	BOTAI--L	58.469040	8.769250	-57.834610	-7.996717	.634426	.772533
*ISHRD--I	BHRMR--A	10.094750	4.157462	-10.085490	-4.599987	.009260	-.442525
*ISHRD--I	BHRMR--A	10.094750	4.157462	-10.085490	-4.599987	.009260	-.442525
*ISHRD--I	BHRMR--A	11.210280	6.646096	-11.203690	-6.948045	.006597	-.301949
*ISHRD--I	BHRMR--A	11.210280	6.646096	-11.203690	-6.948045	.006597	-.301949
GOLPR--A	BAGRH--T	52.575660	12.103190	-51.639510	-11.041780	.936153	1.061409
BAGRH--T	KAUKH--L	11.577010	-7.846894	-11.520010	6.235037	.056994	-1.611857
BAGRH--T	MANGL--A	14.061920	5.890352	-13.996390	-6.999396	.065529	-1.109044
KAUKH--L	BNDRI--A	20.027500	9.720439	-19.994280	-9.999637	.033216	-.279198
BRISA--L	KAUKH--L	38.992870	31.340600	-38.500060	-30.954430	.492805	.386177
BRISA--L	PATUA--K	22.033800	-58.688330	-20.994820	60.280270	1.038980	1.591942
*MADAP--R	BRISA--L	.688863	-14.255700	-.638112	12.774280	.050750	-1.481423
*MADAP--R	BRISA--L	.688863	-14.255700	-.638112	12.774280	.050750	-1.481423
*FRIDP--R	MADAP--R	15.848450	-9.182861	-15.678360	6.756155	.170091	-2.426706
*FRIDP--R	MADAP--R	15.848450	-9.182861	-15.678360	6.756155	.170091	-2.426706
*BHRMR--A	FRIDP--R	33.289750	-3.017389	-32.351650	.934338	.938103	-2.083052
*BHRMR--A	FRIDP--R	33.289750	-3.017389	-32.351650	.934338	.938103	-2.083052
NATOR--E	BOGUR--A	4.588453	-11.609300	-4.529770	8.666729	.058682	-2.942575
NATOR--E	BOGUR--A	4.588453	-11.609300	-4.529770	8.666729	.058682	-2.942575
ISHRD--I	NATOR--E	52.545490	-7.813236	-51.930050	8.386119	.615444	.572883
ISHRD--I	NATOR--E	52.545490	-7.813236	-51.930050	8.386119	.615444	.572883
NATOR--E	RAJSH--I	31.782990	5.819566	-31.524570	-6.794800	.258417	-.975234
NATOR--E	RAJSH--I	34.896930	5.597633	-34.588440	-6.489304	.308495	-.891670
RAJSH--I	NWBGN--G	18.118080	7.739593	-17.996830	-9.499382	.121256	-1.759789
BOGUR--A	NAOGO--A	16.081070	6.050693	-15.997950	-7.999463	.083120	-1.948770
BOGUR--A	PLSBR--I	22.864400	-8.492147	-22.634710	6.686765	.229691	-1.805382
BOGUR--A	PLSBR--I	22.864400	-8.492147	-22.634710	6.686765	.229691	-1.805382
PLSBR--I	RANGP--R	8.636743	-13.686360	-8.550670	11.374510	.086073	-2.311848

FROM BUS	TO BUS	SENT MW	SENT MVAR	RECEIVED MW	RECEIVED MVAR	LOSSES MW	LOSSES MVAR
PLSBR--I	RANGP--R	8.636743	-13.686360	-8.550670	11.374510	.086073	-2.311848
RANGP--R	SAIDP--R	.059077	-10.116720	-.035353	8.100878	.023723	-2.015847
RANGP--R	SAIDP--R	.059077	-10.116720	-.035353	8.100878	.023723	-2.015847
RANGP--R	LALMO--N	36.364440	17.476150	-35.994470	-17.998580	.369972	-.522421
SAIDP--R	PRBSD--P	25.818720	-7.722351	-25.655840	7.001117	.162884	-.721233
SAIDP--R	PRBSD--P	25.818720	-7.722351	-25.655840	7.001117	.162884	-.721233
PRBSD--P	THAKU--R	13.156290	-13.250380	-12.997660	11.384540	.158626	-1.865839
PRBSD--P	THAKU--R	13.156290	-13.250380	-12.997660	11.384540	.158626	-1.865839
ISHRD--I	BAGBR--I	15.322940	-2.956906	-15.242580	.459142	.080357	-2.497763
ISHRD--I	PABAN--A	51.740500	18.326250	-51.446940	-18.011760	.293564	.314486
PABAN--A	SHJDP--R	7.450425	-4.487202	-7.431830	2.352691	.018595	-2.134511
BAGBR--I	SRJGN--J	19.466170	-6.001629	-19.382380	4.622220	.083790	-1.379409
BAGBR--I	SRJGN--J	19.466170	-6.001629	-19.382380	4.622220	.083790	-1.379409
*BAGBR--I	SHJDP--R	52.752200	33.109760	-52.564360	-32.851780	.187843	.257984
SRJGN--J	BOGUR--A	7.383139	-10.621710	-7.328898	7.500715	.054241	-3.120993
SRJGN--J	BOGUR--A	7.383139	-10.621710	-7.328898	7.500715	.054241	-3.120993
BARAPU-K	SAIDP--R	34.098930	-10.482520	-33.881940	9.708484	.216999	-.774041
BARAPU-K	SAIDP--R	34.098930	-10.482520	-33.881940	9.708484	.216999	-.774041
BARAPU-K	RANGP--R	24.933000	1.532111	-24.788570	-3.088614	.144438	-1.556503
BARAPU-K	RANGP--R	24.933000	1.532111	-24.788570	-3.088614	.144438	-1.556503
*HATZ--23	KULSI-23	24.338060	-6.153416	-24.200300	-15.478140	.137764	-21.631560
*HATZ--23	KULSI-23	24.338060	-6.153416	-24.200300	-15.478140	.137764	-21.631560
RAJN--23	HATZ--23	199.333600	84.556700	-198.513800	-83.724080	.819763	.832626
RAJN--23	HATZ--23	199.333600	84.556700	-198.513800	-83.724080	.819763	.832626
RAJN--23	HATZ--23	199.333600	84.556700	-198.513800	-83.724080	.819763	.832626
HATZ--23	HALIS-23	145.059700	51.980100	-144.014200	-55.725180	1.045517	-3.745079
HATZ--23	HALIS-23	145.059700	51.980100	-144.014200	-55.725180	1.045517	-3.745079
HATZ--23	HALIS-23	145.059700	51.980100	-144.014200	-55.725180	1.045517	-3.745079
*COMI--23	HATZ--23	54.318370	-10.087240	-53.982670	-18.520500	.335701	-28.607750
*COMI--23	HATZ--23	54.318370	-10.087240	-53.982670	-18.520500	.335701	-28.607750
*MEGH--23	COMI--23	134.503500	28.297020	-133.596200	-35.557210	.907318	-7.260195
*MEGH--23	COMI--23	134.503500	28.297020	-133.596200	-35.557210	.907318	-7.260195
*MEGH--23	COMI--23	134.503500	28.297020	-133.596200	-35.557210	.907318	-7.260195
MEGH--23	HARI--23	168.163500	56.428460	-167.686900	-57.564210	.476593	-1.135757
MEGH--23	HARI--23	168.163500	56.428460	-167.686900	-57.564210	.476593	-1.135757
MEGH--23	HARI--23	168.163500	56.428460	-167.686900	-57.564210	.476593	-1.135757
*ASHU--23	COMI--23	44.017540	7.919962	-43.840780	-19.299710	.176762	-11.379750
*ASHU--23	COMI--23	44.017540	7.919962	-43.840780	-19.299710	.176762	-11.379750
ASHU--23	SYLH--23	103.643200	23.137800	-101.082100	-33.275970	2.561066	-10.138170
ASHU--23	SYLH--23	103.643200	23.137800	-101.082100	-33.275970	2.561066	-10.138170
ASHU--23	MYNSG-23	63.824130	17.600420	-63.008930	-31.528430	.815208	-13.928010
ASHU--23	MYNSG-23	63.824130	17.600420	-63.008930	-31.528430	.815208	-13.928010
ASHU--23	GRSL--23	68.052490	-12.502370	-67.757320	7.192832	.295174	-5.309539
ASHU--23	GRSL--23	68.052490	-12.502370	-67.757320	7.192832	.295174	-5.309539
HARI--23	SIDD--23	131.778900	56.566960	-131.044000	-56.578100	.734940	-.011139
HARI--23	SIDD--23	131.778900	56.566960	-131.044000	-56.578100	.734940	-.011139
HARI--23	POST--23	185.951000	69.672940	-184.803600	-69.870670	1.147385	-.197731
HARI--23	POST--23	185.951000	69.672940	-184.803600	-69.870670	1.147385	-.197731
HARI--23	POST--23	185.951000	69.672940	-184.803600	-69.870670	1.147385	-.197731
*SIDD--23	BASUN-23	173.110200	58.050090	-172.315800	-55.555910	.794434	2.494183
*SIDD--23	BASUN-23	173.110200	58.050090	-172.315800	-55.555910	.794434	2.494183
*SIDD--23	BASUN-23	173.110200	58.050090	-172.315800	-55.555910	.794434	2.494183
HARI--23	BHULT-23	43.472420	-22.844980	-43.373040	18.701900	.099380	-4.143078
HARI--23	BHULT-23	43.472420	-22.844980	-43.373040	18.701900	.099380	-4.143078
BHULT-23	GRSL--23	43.374980	-18.702620	-43.163720	13.797210	.211262	-4.905412
BHULT-23	GRSL--23	43.374980	-18.702620	-43.163720	13.797210	.211262	-4.905412
GRSL--23	TONG--23	169.980500	107.236800	-168.388400	-103.273100	1.592117	3.963715
GRSL--23	TONG--23	169.980500	107.236800	-168.388400	-103.273100	1.592117	3.963715
GRSL--23	TONG--23	169.980500	107.236800	-168.388400	-103.273100	1.592117	3.963715
TONG--23	BASUN-23	23.982320	20.976580	-23.947690	-28.245020	.034628	-7.268436
TONG--23	BASUN-23	23.982320	20.976580	-23.947690	-28.245020	.034628	-7.268436
*SAVR--23	TONG--23	52.260000	7.167623	-52.156070	-10.313510	.103931	-3.145892
*SAVR--23	TONG--23	52.260000	7.167623	-52.156070	-10.313510	.103931	-3.145892
*POST--23	SAVR--23	52.339750	4.626821	-52.259810	-7.166286	.079941	-2.539465
*POST--23	SAVR--23	52.339750	4.626821	-52.259810	-7.166286	.079941	-2.539465

FROM BUS	TO BUS	SENT MW	SENT MVAR	RECEIVED MW	RECEIVED MVAR	LOSSES MW	LOSSES MVAR
GRSL--23	ISHR--23	164.228500	-19.506420	-157.375300	2.197606	6.853165	-17.308820
GRSL--23	ISHR--23	164.228500	-19.506420	-157.375300	2.197606	6.853165	-17.308820
GRSL--23	ISHR--23	164.228500	-19.506420	-157.375300	2.197606	6.853165	-17.308820
GRSL--23	ISHR--23	164.228500	-19.506420	-157.375300	2.197606	6.853165	-17.308820
GRSL--23	ISHR--23	164.228500	-19.506420	-157.375300	2.197606	6.853165	-17.308820
ISHR--23	BHER--23	173.734700	1.452127	-173.362900	-.708703	.371750	.743424
ISHR--23	BHER--23	173.734700	1.452127	-173.362900	-.708703	.371750	.743424
ISHR--23	BOGRA-23	72.230580	-31.368040	-71.176640	19.297490	1.053947	-12.070560
ISHR--23	BOGRA-23	72.230580	-31.368040	-71.176640	19.297490	1.053947	-12.070560
BHER--23	JESS--23	91.616780	-13.900450	-89.804100	3.314077	1.812683	-10.586370
BHER--23	JESS--23	91.616780	-13.900450	-89.804100	3.314077	1.812683	-10.586370
JESS--23	BARI--23	34.405320	-18.733200	-34.110330	-.887796	.294991	-19.620990
JESS--23	BARI--23	34.405320	-18.733200	-34.110330	-.887796	.294991	-19.620990
JESS--23	KHULNA23	17.161490	-6.109553	-17.142430	.585366	.019058	-5.524188
JESS--23	KHULNA23	17.161490	-6.109553	-17.142430	.585366	.019058	-5.524188
BOGRA-23	BARAP-23	5.400787	-41.360660	-5.281681	33.021420	.119106	-8.339241
BOGRA-23	BARAP-23	5.400787	-41.360660	-5.281681	33.021420	.119106	-8.339241
BOGRA-23	BAGHA-23	3.233946	1.920398	-3.211231	-19.287550	.022715	-17.367150
BOGRA-23	BAGHA-23	3.233946	1.920398	-3.211231	-19.287550	.022715	-17.367150
KPT--123	KAPTA--I	29.666700	12.793380	-29.666700	-10.474070	.000000	2.319310
KPT--123	KAPTA--I	29.666700	12.793380	-29.666700	-10.474070	.000000	2.319310
KPT--123	KAPTA--I	29.167880	12.578280	-29.167880	-10.297960	.000000	2.280314
KPT---45	KAPTA--I	39.000570	16.258730	-39.000570	-13.116430	.000000	3.142300
KPT---45	KAPTA--I	39.000570	16.258730	-39.000570	-13.116430	.000000	3.142300
RAZ2x210	RAJN--23	114.000400	77.577640	-114.000400	-70.110000	.000000	7.467644
RAZ2x210	RAJN--23	114.000400	77.577640	-114.000400	-70.110000	.000000	7.467644
SK--1X60	SIKLB--A	56.001260	17.514100	-56.001260	-12.487410	.000000	5.026696
SK--2X28	SIKLB--A	49.001090	16.963660	-49.001090	-13.037850	.000000	3.925817
HRP---CC	HARIP--R	48.999480	.773136	-48.999480	3.172631	.000000	3.945767
HARI-360	HARI--23	259.366700	120.951800	-259.366700	-102.380100	.000000	18.571640
HARI-360	HARI--23	92.630980	43.197040	-92.630980	-36.564370	.000000	6.632671
SD----50	SIDDG--J	46.999490	1.262443	-46.999490	3.649472	.000000	4.911914
AES--450	MEGH--23	79.332990	29.354530	-79.332990	-24.811280	.000000	4.543255
AES--450	MEGH--23	79.332990	29.354530	-79.332990	-24.811280	.000000	4.543255
AES--450	MEGH--23	79.332990	29.354530	-79.332990	-24.811280	.000000	4.543255
GH--2X55	GHRAS--L	47.999320	10.691040	-47.999320	-6.796089	.000000	3.894948
GH--2X55	GHRAS--L	47.999320	10.691040	-47.999320	-6.796089	.000000	3.894948
GH--3210	GRSL--23	157.330600	62.192420	-157.330600	-50.562530	.000000	11.629890
GH--3210	GRSL--23	157.330600	62.192420	-157.330600	-50.562530	.000000	11.629890
GH--3210	GRSL--23	157.330600	62.192420	-157.330600	-50.562530	.000000	11.629890
GH--1210	GRSL--23	145.758500	61.461570	-145.758500	-51.293380	.000000	10.168190
AS--2X64	ASHU--23	50.999670	-.616398	-50.999670	5.884609	.000000	5.268211
AS--1X90	ASHU--23	77.999470	3.331048	-77.999470	9.557241	.000000	12.888290
AS--1X60	ASHU--23	59.999610	.394948	-59.999610	6.895956	.000000	7.290904
AS--3150	ASHU--23	125.332500	40.069380	-125.332500	-29.076780	.000000	10.992600
AS--3150	ASHU--23	125.332500	40.069380	-125.332500	-29.076780	.000000	10.992600
AS--3150	ASHU--23	125.332500	40.069380	-125.332500	-29.076780	.000000	10.992600
MYM--070	MYMNS--G	33.999490	15.290160	-33.999490	-13.006810	.000000	2.283341
MYM--070	MYMNS--G	33.999490	15.290160	-33.999490	-13.006810	.000000	2.283341
SHZ---80	SHJIB--Z	79.997780	29.206210	-79.997780	-21.953650	.000000	7.252558
SHZ---70	SHJIB--Z	68.998110	28.362520	-68.998110	-22.797330	.000000	5.565195
FNC--090	FNCHP--S	87.991910	49.046040	-87.991910	-38.898040	.000000	10.147990
SY--1X20	SYLHE--T	18.998440	11.331490	-18.998440	-9.164684	.000000	2.166808
KL--1X60	GOLPR--A	59.993020	19.562680	-59.993020	-13.629630	.000000	5.933054
KL--1110	GOLPR--A	104.987700	31.744050	-104.987700	-20.315460	.000000	11.428590
KPC----L	GOLPR--A	89.989530	29.203750	-89.989530	-20.252780	.000000	8.950975
KL--2X28	GOLPR--A	55.493580	19.461720	-55.493580	-14.412620	.000000	5.049102
BR---140	BRISA--L	39.493430	23.848740	-39.493430	-21.720320	.000000	2.128422
BH--3X20	BHRMR--A	57.495050	14.149910	-57.495050	-6.762978	.000000	7.386928
BG----71	BAGBR--I	69.994910	25.994430	-69.994910	-20.419460	.000000	5.574970
IPP--090	BAGBR--I	86.993590	27.365370	-86.993590	-19.048520	.000000	8.316843
BG---100	BAGBR--I	48.996410	16.315580	-48.996410	-11.933900	.000000	4.381680
SP--1X20	SAIDP--R	19.797960	.091268	-19.797960	2.428312	.000000	2.519579
RP--1X20	RANGP--R	19.797780	1.427565	-19.797780	1.105006	.000000	2.532571
KUL3X150	KULSI-23	128.334600	89.158790	-128.334600	-73.654790	.000000	15.504010

FROM BUS	TO BUS	SENT MW	SENT MVAR	RECEIVED MW	RECEIVED MVAR	LOSSES MW	LOSSES MVAR
KUL3X150	KULSI-23	128.334600	89.158790	-128.334600	-73.654790	.000000	15.504010
KUL3X150	KULSI-23	128.334600	89.158790	-128.334600	-73.654790	.000000	15.504010
KULS1210	KULSI-23	160.001600	106.780000	-160.001600	-87.045650	.000000	19.734390
RAJN2210	RAJN--23	185.000600	74.318250	-185.000600	-56.724260	.000000	17.593990
RAJN2210	RAJN--23	185.000600	74.318250	-185.000600	-56.724260	.000000	17.593990
MEG2X450	MEGH--23	95.832940	30.289770	-95.832940	-23.876030	.000000	6.413738
MEG2X450	MEGH--23	95.832940	30.289770	-95.832940	-23.876030	.000000	6.413738
MEG2X450	MEGH--23	95.832940	30.289770	-95.832940	-23.876030	.000000	6.413738
MEG2X450	MEGH--23	95.832940	30.289770	-95.832940	-23.876030	.000000	6.413738
MEG2X450	MEGH--23	95.832940	30.289770	-95.832940	-23.876030	.000000	6.413738
MEG2X450	MEGH--23	95.832940	30.289770	-95.832940	-23.876030	.000000	6.413738
MEG1X210	MEGH--23	94.999590	41.221860	-94.999590	-36.474990	.000000	4.746876
ASH2X210	ASHU--23	89.999440	51.983110	-89.999440	-47.201950	.000000	4.781162
ASH2X210	ASHU--23	89.999440	51.983110	-89.999440	-47.201950	.000000	4.781162
ASHG1210	ASHU--23	69.999570	51.258300	-69.999570	-47.926750	.000000	3.331554
HAR1X210	HARI--23	189.998800	66.164270	-189.998800	-48.247580	.000000	17.916690
SIDD2210	SIDD--23	189.998300	99.503520	-189.998300	-79.142330	.000000	20.361190
SIDD2210	SIDD--23	189.998300	99.503520	-189.998300	-79.142330	.000000	20.361190
SIDD2350	SIDD--23	156.248600	71.650960	-156.248600	-52.890740	.000000	18.760220
SIDD2350	SIDD--23	156.248600	71.650960	-156.248600	-52.890740	.000000	18.760220
SIDD2350	SIDD--23	156.248600	71.650960	-156.248600	-52.890740	.000000	18.760220
SIDD2350	SIDD--23	156.248600	71.650960	-156.248600	-52.890740	.000000	18.760220
GRS3X210	GRSL--23	176.664800	59.445750	-176.664800	-44.067000	.000000	15.378750
GRS3X210	GRSL--23	176.664800	59.445750	-176.664800	-44.067000	.000000	15.378750
GRS3X210	GRSL--23	176.664800	59.445750	-176.664800	-44.067000	.000000	15.378750
GRS1X210	GRSL--23	99.998970	54.629880	-99.998970	-48.882860	.000000	5.747017
BP---250	BARAP-23	93.744720	56.925380	-93.744720	-49.288390	.000000	7.636993
BP---250	BARAP-23	93.744720	56.925380	-93.744720	-49.288390	.000000	7.636993
HATZ--23	HATHA--Z	73.224260	48.195360	-73.224260	-44.142080	.000000	4.053276
HATZ--23	HATHA--Z	73.224260	48.195360	-73.224260	-44.142080	.000000	4.053276
HATZ--23	HATHA--Z	73.224260	48.195360	-73.224260	-44.142080	.000000	4.053276
ASHU--23	ASHUG--J	127.959300	67.456880	-127.959300	-56.876740	.000000	10.580140
ASHU--23	ASHUG--J	127.959300	67.456880	-127.959300	-56.876740	.000000	10.580140
KULSI-23	KULSH--I	296.706500	169.476100	-296.706500	-165.581500	.000000	3.894669
KULSI-23	KULSH--I	296.706500	169.476100	-296.706500	-165.581500	.000000	3.894669
SIDD--23	SIDDG--J	373.867000	154.425100	-373.867000	-149.110600	.000000	5.314499
SIDD--23	SIDDG--J	373.867000	154.425100	-373.867000	-149.110600	.000000	5.314499
POST--23	HASNB--D	224.862400	100.170100	-224.862400	-98.179720	.000000	1.990372
POST--23	HASNB--D	224.862400	100.170100	-224.862400	-98.179720	.000000	1.990372
BASUN-23	RAMPR--A	282.420100	111.585500	-282.420100	-108.491100	.000000	3.094360
BASUN-23	RAMPR--A	282.420100	111.585500	-282.420100	-108.491100	.000000	3.094360
HARI--23	HARIP--R	68.349750	41.711890	-68.349750	-38.446620	.000000	3.265270
HARI--23	HARIP--R	68.349750	41.711890	-68.349750	-38.446620	.000000	3.265270
GRSL--23	GHRAS--L	69.313610	58.961800	-69.313610	-54.766100	.000000	4.195694
GRSL--23	GHRAS--L	69.313610	58.961800	-69.313610	-54.766100	.000000	4.195694
TONG--23	TONGG--I	280.752700	144.240300	-280.752700	-138.929000	.000000	5.311386
TONG--23	TONGG--I	280.752700	144.240300	-280.752700	-138.929000	.000000	5.311386
COMI--23	COMI---N	189.918100	82.717120	-189.918100	-80.507390	.000000	2.209724
COMI--23	COMI---N	189.918100	82.717120	-189.918100	-80.507390	.000000	2.209724
ISHR--23	ISHRD--I	98.253200	16.282610	-98.253200	-10.853720	.000000	5.428895
ISHR--23	ISHRD--I	98.253200	16.282610	-98.253200	-10.853720	.000000	5.428895
ISHR--23	ISHRD--I	98.253200	16.282610	-98.253200	-10.853720	.000000	5.428895
HALIS-23	HLSHA--R	216.020700	83.587940	-216.020700	-80.729690	.000000	2.858253
HALIS-23	HLSHA--R	216.020700	83.587940	-216.020700	-80.729690	.000000	2.858253
MYNSG-23	MYMNS--G	63.007970	31.528370	-63.007970	-28.844320	.000000	2.684048
MYNSG-23	MYMNS--G	63.007970	31.528370	-63.007970	-28.844320	.000000	2.684048
SYLH--23	SYLHE--T	101.069000	33.275630	-101.069000	-26.864560	.000000	6.411070
SYLH--23	SYLHE--T	101.069000	33.275630	-101.069000	-26.864560	.000000	6.411070
KHULNA23	GOLPR--A	17.150910	-.585379	-17.150910	.750637	.000000	.165258
KHULNA23	GOLPR--A	17.150910	-.585379	-17.150910	.750637	.000000	.165258
JESS--23	JESOR--E	38.226280	21.529540	-38.226280	-20.449460	.000000	1.080074
JESS--23	JESOR--E	38.226280	21.529540	-38.226280	-20.449460	.000000	1.080074
BARI--23	BRISA--L	34.111330	.887029	-34.111330	-.237072	.000000	.649958
BARI--23	BRISA--L	34.111330	.887029	-34.111330	-.237072	.000000	.649958
BHER--23	BHRMR--A	81.727110	14.607250	-81.727110	-10.817990	.000000	3.789259

FROM BUS	TO BUS	SENT MW	SENT MVAR	RECEIVED MW	RECEIVED MVAR	LOSSES MW	LOSSES MVAR
BHER--23	BHRMR--A	81.727110	14.607250	-81.727110	-10.817990	.000000	3.789259
BAGHA-23	BAGBR--I	3.213164	19.287710	-3.213164	-19.078560	.000000	.209154
BAGHA-23	BAGBR--I	3.213164	19.287710	-3.213164	-19.078560	.000000	.209154
BOGRA-23	BOGUR--A	62.536900	20.141470	-62.536900	-17.828930	.000000	2.312536
BOGRA-23	BOGUR--A	62.536900	20.141470	-62.536900	-17.828930	.000000	2.312536
BARAP-23	BARAPU-K	99.023190	16.266690	-99.023190	-11.046330	.000000	5.220356
BARAP-23	BARAPU-K	99.023190	16.266690	-99.023190	-11.046330	.000000	5.220356

TOTAL SSPLOS= 111.9171 TOTAL SSQLOS= 206.8024

FIXED SHUNT IMPEDANCES

BUS NO	MVAR GEN
MADNH--T	14.4
HLSHA--R	21.1
KULSH--I	14.7
ULLOO--N	40.3
DHANM--O	39.7
RAMPR--A	40.7
SHAMP--R	41.6
TONGG--I	30.8
FENCG--J	91.4
KLCEN--T	95.0
JESOR--E	13.9
JHNDA--H	9.1
PATUA--K	70.8
ISHRD--I	28.8
NATOR--E	19.0
RAJSH--I	18.5
BOGUR--A	29.2
RANGP--R	39.9
SAIDP--R	40.6
THAKU--R	35.8

NET MVAR GENERATED= 735.085

TPG-MW= 7643.7520 TQG-MVAR= 3242.1210

TMW LOAD= 7531.9000 TMVAR LOAD= 3770.4500

TP LOSS= 111.9171 TQ LOSS= 206.8024

NO. OF CAPACITOR BANK= 21

TOTAL VAR GEN BY CAP= 735.0853

NO. OF ITERATIONS= 4.000

VOLTAGE LIMIT VIOLATION= 0

THETA LIMIT VIOLATION= 0

GEN.POWER FACTOR VIOLATION= 0

PGSLACK= 511.9918 QGSLACK= 206.5782

APPENDIX – C

TABLES AND SWING CURVES PREPARED FROM

RESULTS OF LOAD FLOW AND STABILITY STUDIES

Table C.1: Summary of steady state performance for tbe 2004 system under base case and import (through Ishurdi) condition.

Import Power (MW)	**150**	**200**	**250**	**300**	**350**	**400**	**450**	**500**	**Base case**
Total real power gen. (ΣP_G)	3717.001	3668.094	3622.084	3579.553	3539.497	3483.741	3442.454	3403.144	3871.049
Total real load (ΣP_L)	3800.00	3800.00	3800.00	3800.00	3800.00	3800.00	3800.00	3800.00	3800.00
Number of generating unit	46	46	46	46	46	46	46	46	46
Number of PV bus	32	32	32	32	32	32	32	32	32
Number of 132KV circuits (*)	157	157	157	157	157	157	157	157	157
Number of 230KV circuits including EWI (*)	25	25	25	25	25	25	25	25	25
Total real power loss (ΣP_{Loss})	67.004	68.084	72.075	79.562	89.532	83.735	92.463	103.136	71.057
Number of capacitor bank	20	20	20	20	20	20	20	20	20
Total MVAR generate by capacitor	564.226	563.439	561.914	559.678	556.122	539.466	558.651	555.582	555.81
$-45^0 \leq \theta \leq +45^0$	OK	OK	OK	OK	OK	OK	OK	OK	OK
$\lvert\theta_{max}\rvert$	30.6	28.8	27.1	25.6	27.7	26.5	26.4	31.3	36.8
Number of iterations	6	6	6	6	6	6	6	6	6
Gen. p. f. $\geq$ 0.8	OK	OK	OK	OK	OK	OK	OK	OK	OK
$P_{G\ slack}$	460.001	461.094	465.084	472.553	482.497	476.741	485.454	496.114	544.049
$Q_{G\ slack}$	320.155	320.526	323.184	327.992	334.378	329.606	334.248	342.366	341.035
$0.9 \leq Vi \leq 1.05$	OK	OK	OK	OK	OK	OK	OK	OK	OK
Ghorashal To Ishurdi (EWI) Circuit Number	2	2	2	2	2	2	2	2	2
EWI Line Flow per circuit (MW)	68.497	45.341	23.256	2.227	7.238	**20.646	**41.54	**61.642	134.423
Number of Tie- line circuits	2	2	2	2	2	3	3	3	--

(*) Most of the lines comprise 2 circuits each.

(**) Flow in reverse direction.

Table C.2: Summary of steady state performance for the 2004 system under base case and export (through Ishurdi) condition.

Export Power (MW)	150	200	250	300	350	400	450	500	Base case
Total real power gen. (ΣP_G)	4037.63	4100.228	4166.797	4208.068	4272.505	4328.878	4397.425	4468.027	3871.049
Total real load (ΣP_L)	3950.00	4000.00	4050.00	4100.00	4150.00	4200.00	4250.00	4300.00	3800.00
Number of generating unit	46	46	46	46	46	46	46	46	46
Number of PV bus	32	32	32	32	32	32	32	32	32
Number of 132KV circuits (*)	157	157	157	157	157	157	157	157	157
Number of 230KV circuits including EWI (*)	26	26	26	27	27	27	27	27	25
Total real power loss (ΣP_{Loss})	87.626	100.26	116.839	108.081	122.586	128.943	147.557	168.122	71.057
Number of capacitor bank	20	20	20	20	20	20	20	20	20
Total MVAR generate by capacitor	562.395	559..357	555.057	563.092	559.947	561.185	557.719	553.645	555.81
$-45^0 \le \theta \le +45^0$	OK	OK	OK	OK	OK	OK	OK	Violation	OK
$\lvert\theta_{max}\rvert$	37.1	39.1	44	36.40	39.10	39.1	41.0	45.5	36.8
Number of iterations	6	6	7	6	6	6	6	7	6
Gen. p. f. $\ge$ 0.8	OK	OK	OK	OK	OK	OK	OK	OK	OK
$P_{G\ slack}$	560.626	573.228	589.797	581.069	595.505	601.878	620.425	640.027	544.049
$Q_{G\ slack}$	336.122	345.844	362.007	334.945	349.090	350.403	367.172	693.575	341.035
$0.9 \le Vi \le 1.05$	OK	OK	OK	OK	OK	OK	OK	OK	OK
Ghorashal To Ishurdi (EWI) Circuit Number	3	3	3	4	4	4	4	4	2
EWI Line Flow per circuit (MW)	144.092	164.617	186.505	140.071	155.920	169.176	185.335	200.56	134.423
Number of Tie-line circuits	2	2	2	3	3	4	4	4	--

(*) Most of the lines comprise 2 circuits each.

(**) Flow in reverse direction.

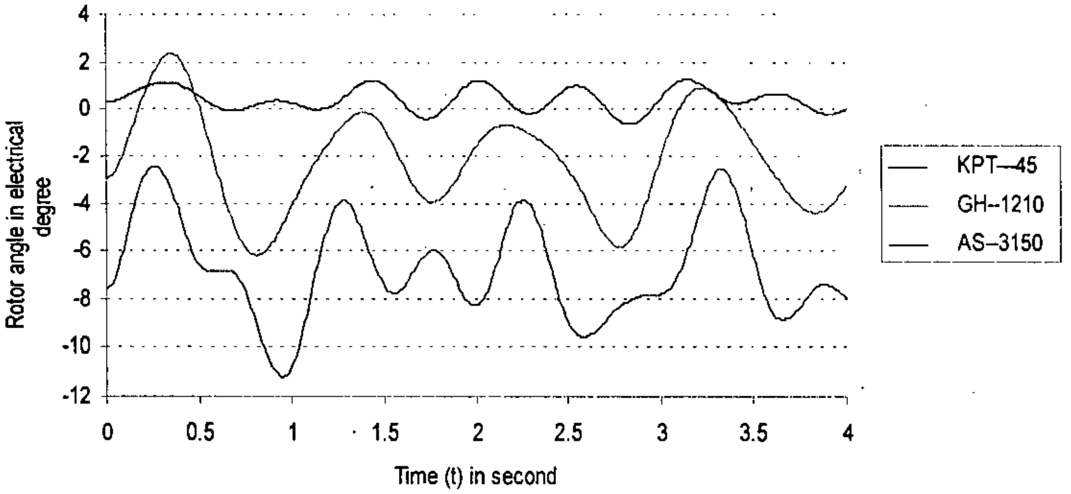

Fig C.1a: Swing curves for selected machines for a fault on the Ishurdi-23 bus of EWI line in the 2004 system.

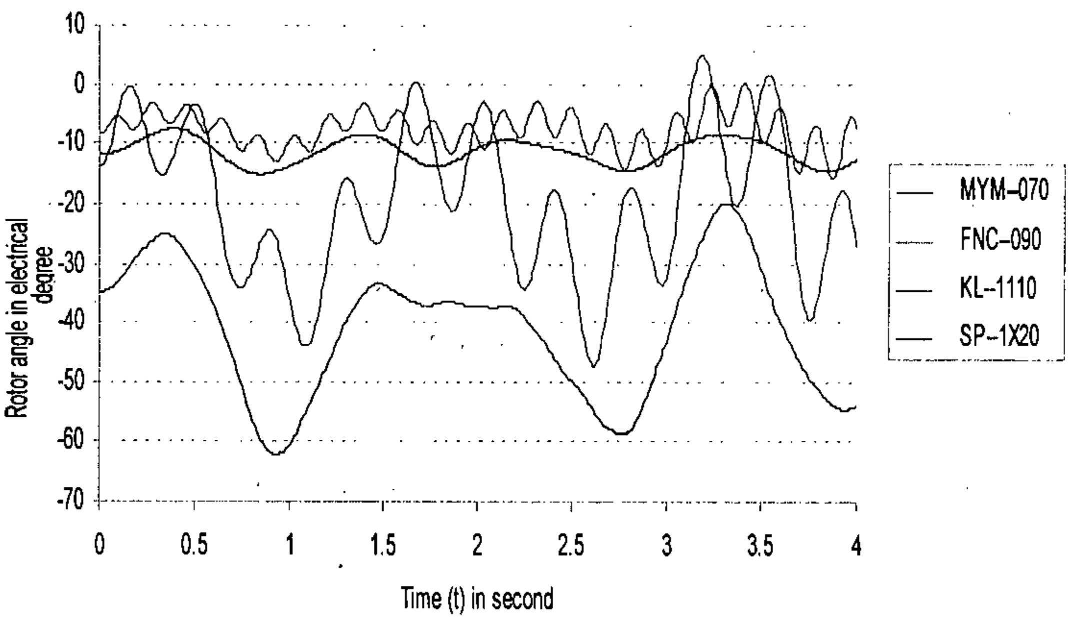

Fig C.1b: Swing curves for selected machines for a fault on the Ishurdi -23 bus of EWI line in the 2004 system.

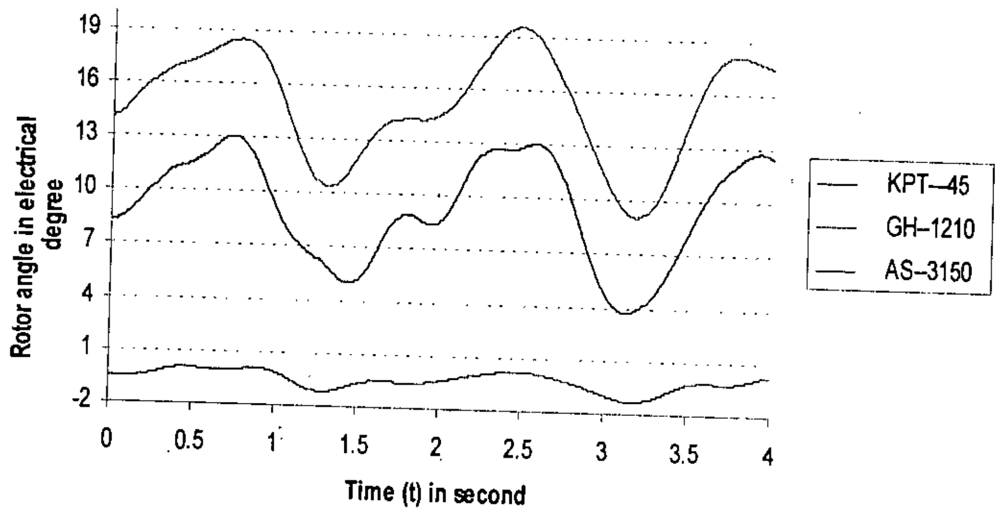

Fig C.2a: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while importing 500 MW power from India through Ishurdi bus in the 2004 system.

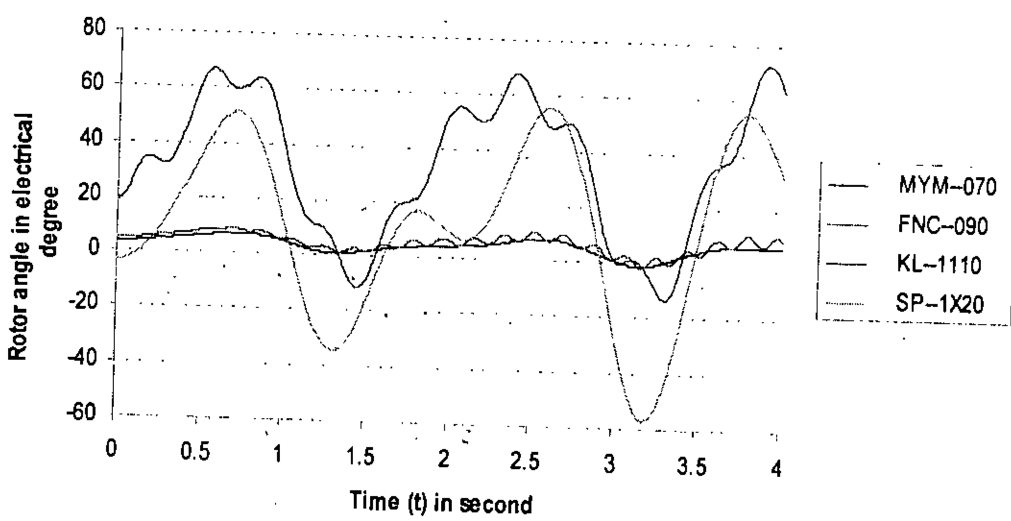

Fig C.2b: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while importing 500 MW power from India through Ishurdi bus in the 2004 system.

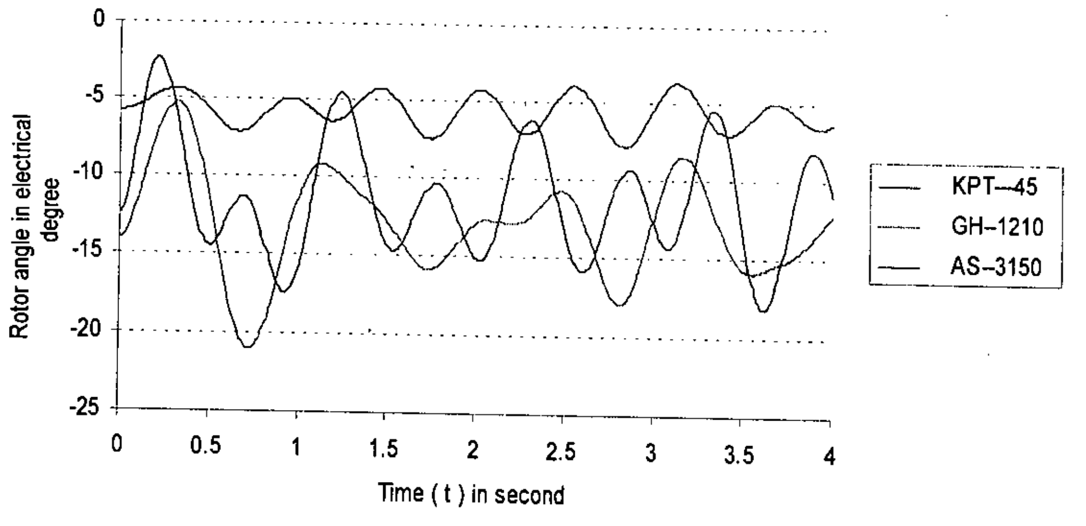

Fig C.3a: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while exporting 450 MW power to India through Ishurdi bus in the 2004 system.

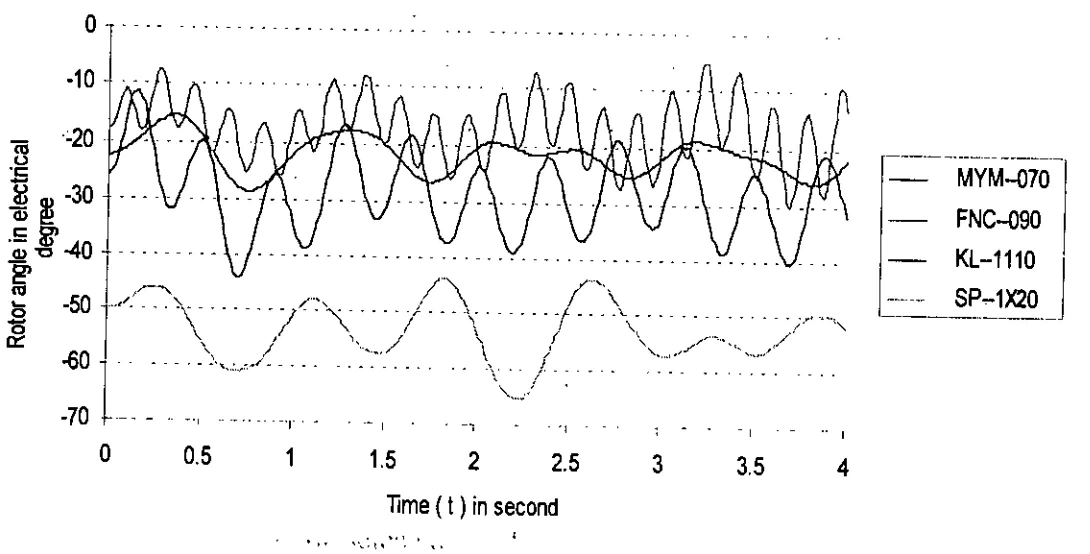

Fig C.3b: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while exporting 450 MW power to India through Ishurdi bus in the 2004 system.

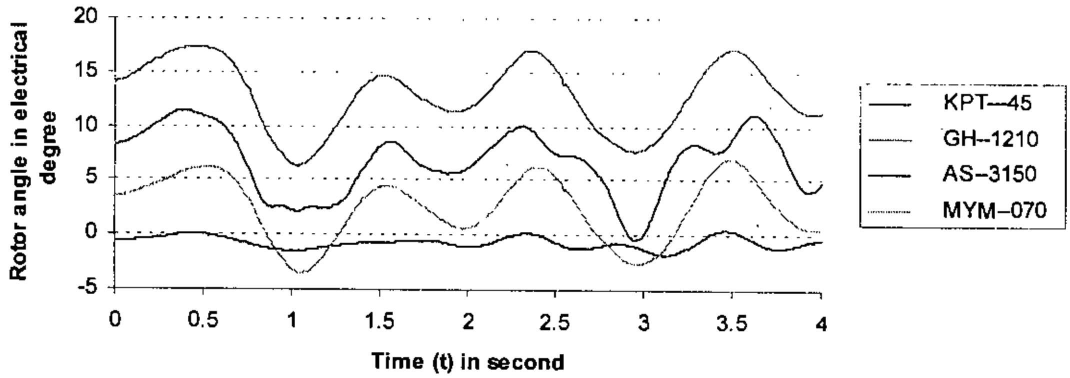

Fig C.4a: Swing curves for selected machines for a fault on the Ishurdi bus at India-shurdi tie line while importing 500MW power from India through Ishurdi bus in the 2004 system.

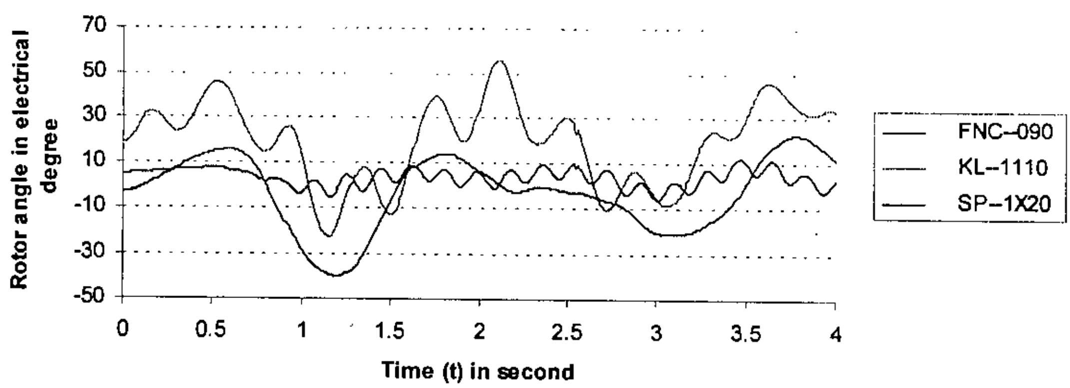

Fig C.4b: Swing curves for selected machines for a fault on the Ishurdi bus at India-Ishurdi tie line while importing 500MW power from India through Ishurdi bus in the 2004 system.

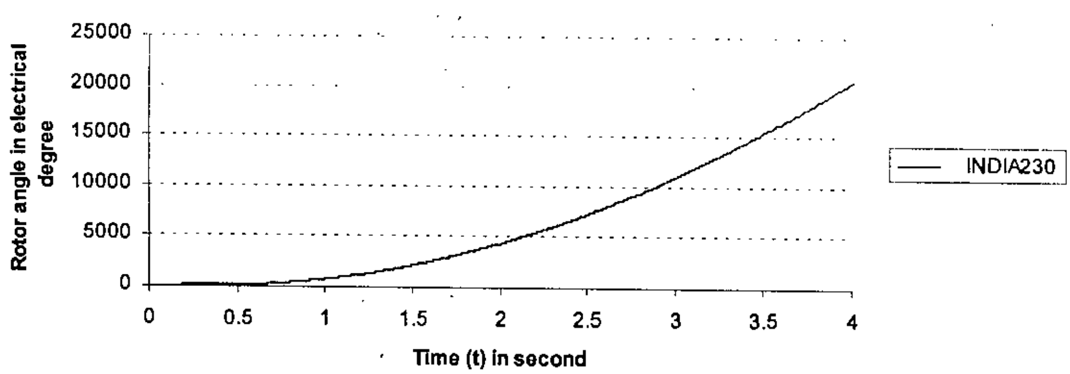

Fig C.4c: Swing curves for selected machines for a fault on the Ishurdi bus at India-Ishurdi tie line while importing 500MW power from India through Ishurdi bus in the 2004 system.

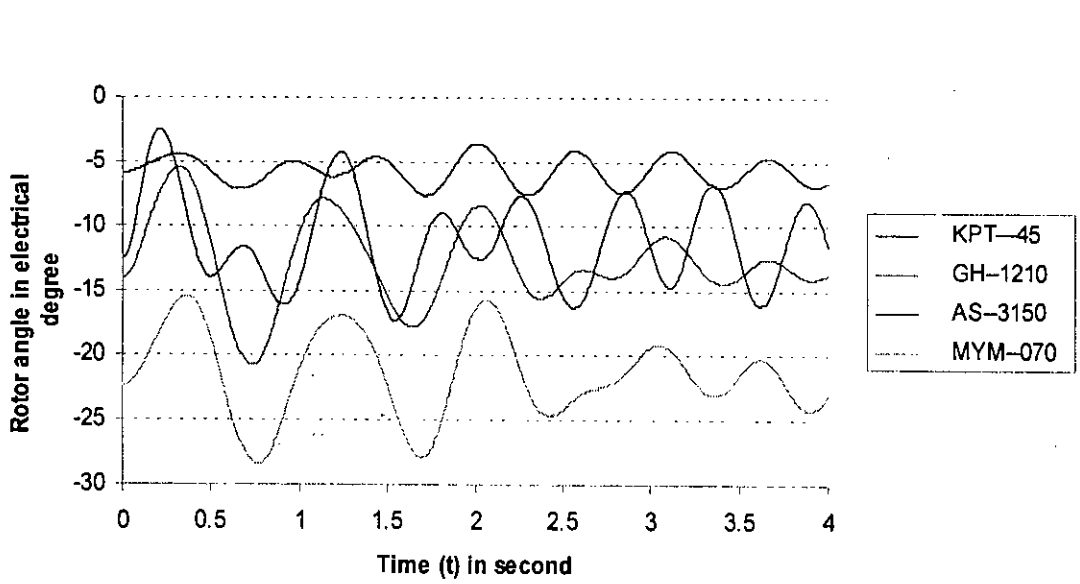

Fig C.5a: Swing curves for selected machines for a fault on the Ishurdi-23 bus of India-Ishurdi tie line while exporting 450 MW power to India through Ishurdi bus in the 2004 system.

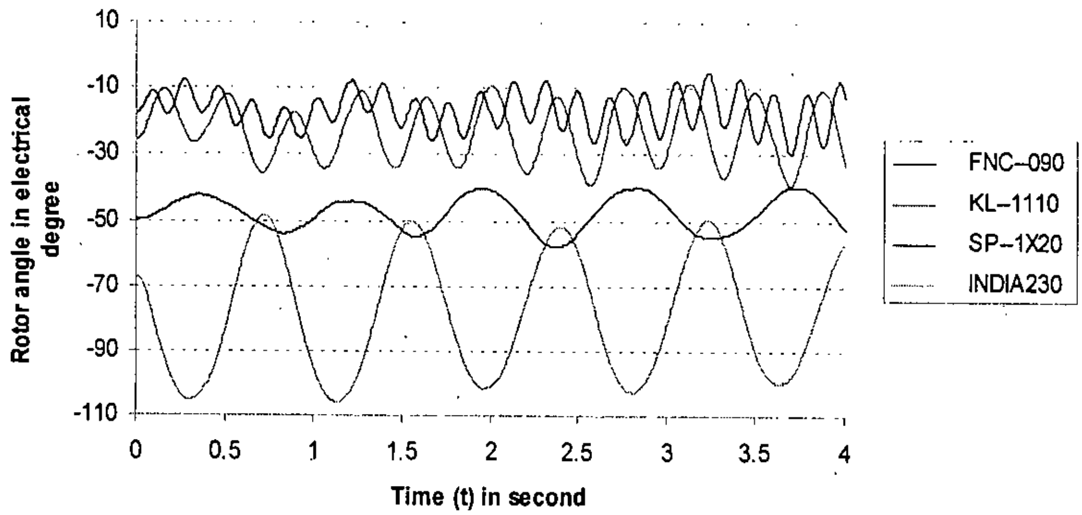

Fig C.5b: Swing curves for selected machines for a fault on the Ishurdi-23 bus of India-Ishurdi tie line while exporting 450 MW power to India through Ishurdi bus in the 2004 system.

Table C.3: Summary of steady state performance for the 2004 system under base case and import (through Thakurgaon and Sreemongal) condition.

Import from India to	**Thakurgaon**			**Sreemongal**			**Base Case**
Import Power (MW)	**50**	**100**	**150**	**50**	**100**	**150**	
Total real power gen. (ΣP_G)	3806.604	3754.844	3708.721	3821.124	3776.534	3734.702	3871.049
Total real load (ΣP_L)	3800.00	3800.00	3800.00	3800.00	3800.00	3800.00	3800.00
Number of generating unit	46	46	46	46	46	46	46
Number of PV bus	32	32	32	32	32	32	32
Number of 132KV circuits (*)	157	157	157	157	157	157	157
Number of 230KV circuits including EWI (*)	25	25	25	25	25	25	25
Total real power loss (ΣP_{Loss})	56.592	54.822	58.649	71.128	76.555	84.709	71.057
Number of capacitor bank	20	20	20	20	20	20	20
Total MVAR generate by capacitor	564.708	562.756	559.604	555.946	555.600	555.188	555.81
$-45^0 \leq \theta \leq +45^0$	OK	OK	OK	OK	OK	OK	OK
$\lvert\theta_{max}\rvert$	23.7	18.4	16.2	36.8	36.8	36.9	36.8
Number of iterations	5	5	4	4	6	6	6
Gen. p. f. $\geq$ 0.8	OK	OK	OK	OK	OK	OK	OK
$P_{G\ slack}$	529.604	527.844	531.721	544.124	549.534	557.702	544.049
$Q_{G\ slack}$	330.725	327.807	326.418	339.932	342.939	346.881	341.035
$0.9 \leq Vi \leq 1.05$	OK	OK	OK	OK	OK	OK	OK
Ghorashal To Ishurdi (EWI) Circuit Number	2	2	2	2	2	2	2
EWI line flow per circuit (MW)	103.302	77.798	55.681	134.42	134.425	134.435	134.423
Number of Tie-line circuits	2	2	2	2	2	2	--

(*) Most of the lines comprise 2 circuits each.

Table C.4: Summary of steady state performance for the 2004 system under base case and export (through Thakurgaon and Srimngal) condition.

Export to India from	**Thakurgaon**			**Srimngal**			**Base Case**
Export Power (MW)	**50**	**100**	**150**	**50**	**100**	**150**	
Total real power gen. (ΣP_G)	3946.500	4015.448		3922.597	3977.328	4034.849	3871.049
Total real load (ΣP_L)	3850.00	3880.00		3850.00	3900.00	3950.00	3800.00
Number of generating unit	46	46		46	46	46	46
Number of PV bus	32	32		32	32	32	32
Number of 132KV circuits (*)	157	157		157	157	157	157
Number of 230KV circuits including EWI (*)	25	25		25	25	25	25
Total real power loss (ΣP_{Loss})	96.539	135.510		72.599	77.356	84.865	71.057
Number of capacitor bank	20	20		20	20	20	20
Total MVAR generate by capacitor	544.659	526.137		555.937	556.249	556.148	555.81
$-45^0 \leq \theta \leq +45^0$	Violation	Violation		OK	OK	OK	OK
$\lvert\theta_{max}\rvert$	56.58	77.04		36.8	36.0	36.1	36.8
Number of iterations	9	16		6	6	6	6
Gen. p. f. $\geq$ 0.8	OK	Violation		OK	OK	OK	OK
$P_{G\ slack}$	569.500	588.447		545.597	550.328	557.849	544.049
$Q_{G\ slack}$	350.772	371.165		340.278	340.776	343.429	341.035
$0.9 \leq Vi \leq 1.05$	OK	Violation		OK	OK	OK	OK
Ghorashal To Ishurdi (EWI) Circuit Number	2	2		2	2	2	2
EWI line flow per circuit (MW)	152.120	185.14		134.419	126.494	126.502	134.423
Number of Tie-line circuits	2	2		2	2	2	--

(*) Most of the lines comprise 2 circuits each.

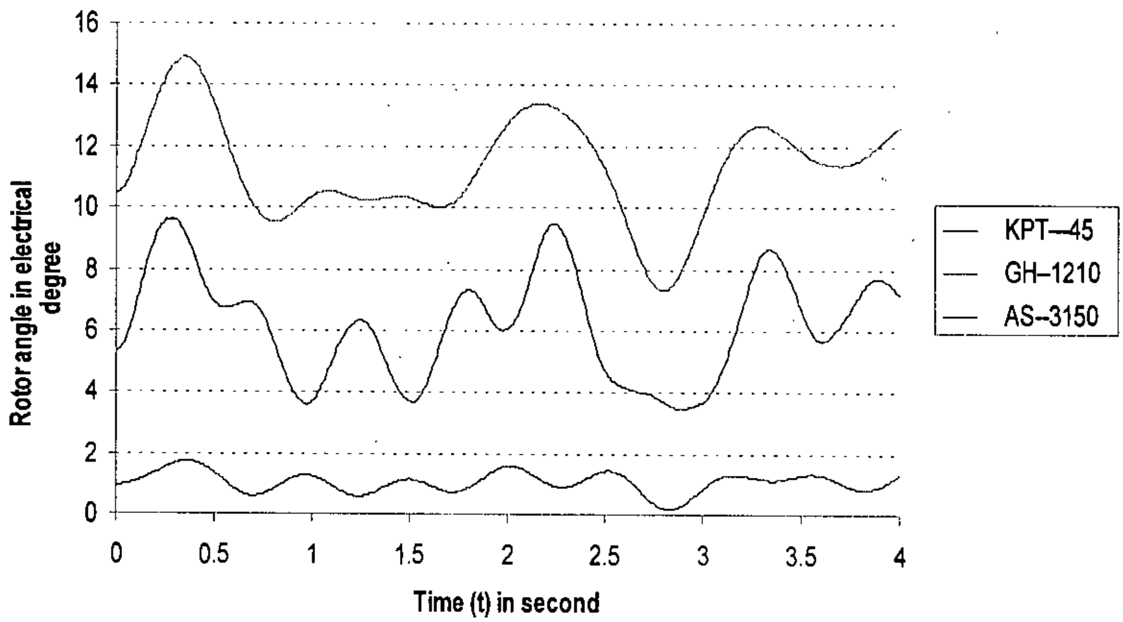

Fig C.6a: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while importing 150 MW power from India through Thakurgaon bus in the 2004 system.

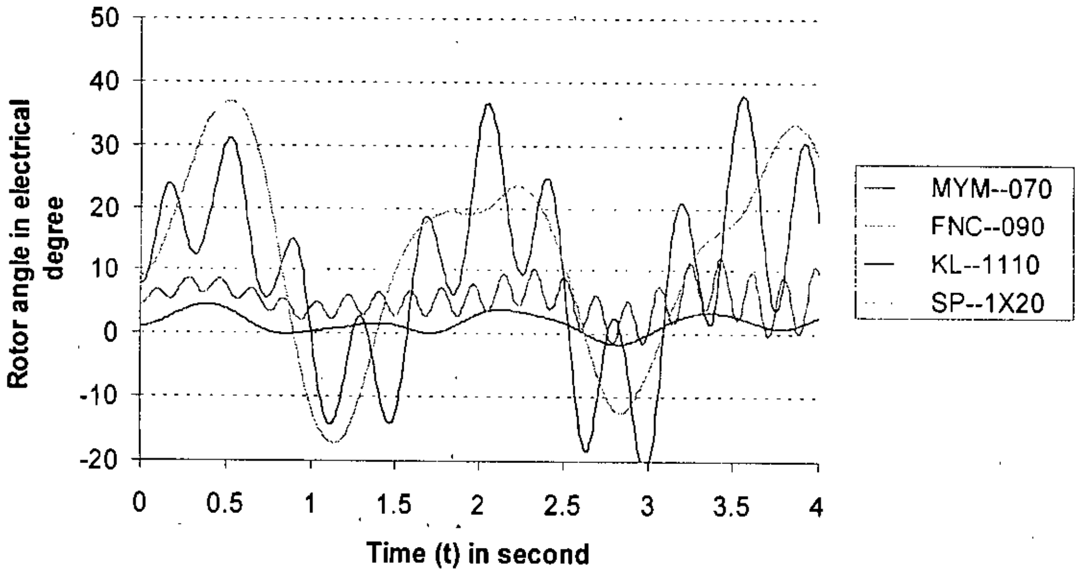

Fig C.6b: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while importing 150 MW power from India through Thakurgaon bus in the 2004 system.

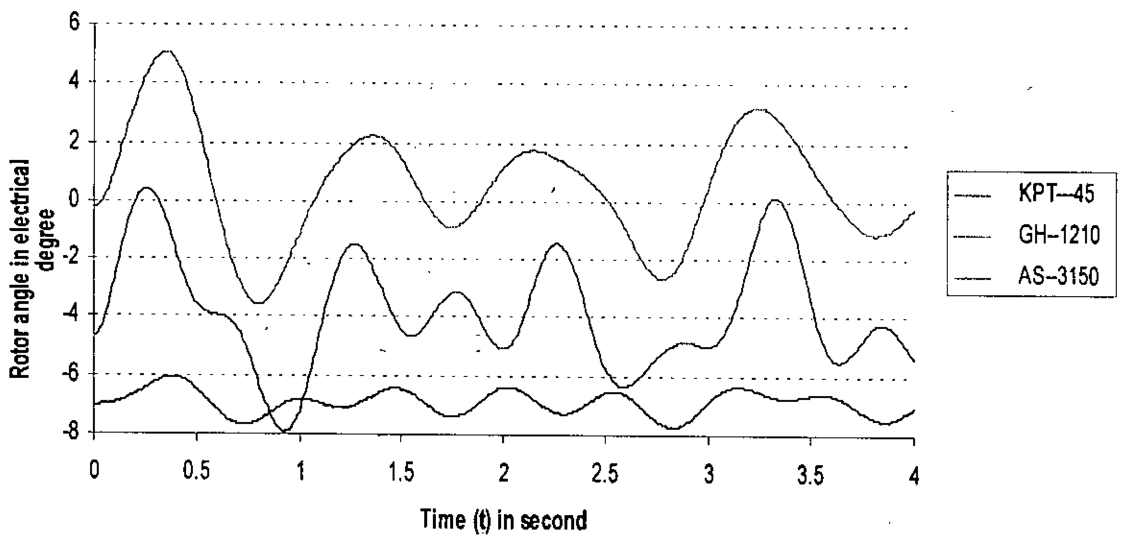

Fig C.7a: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while importing 150 MW power from India through Sreemongal bus in the 2004 system.

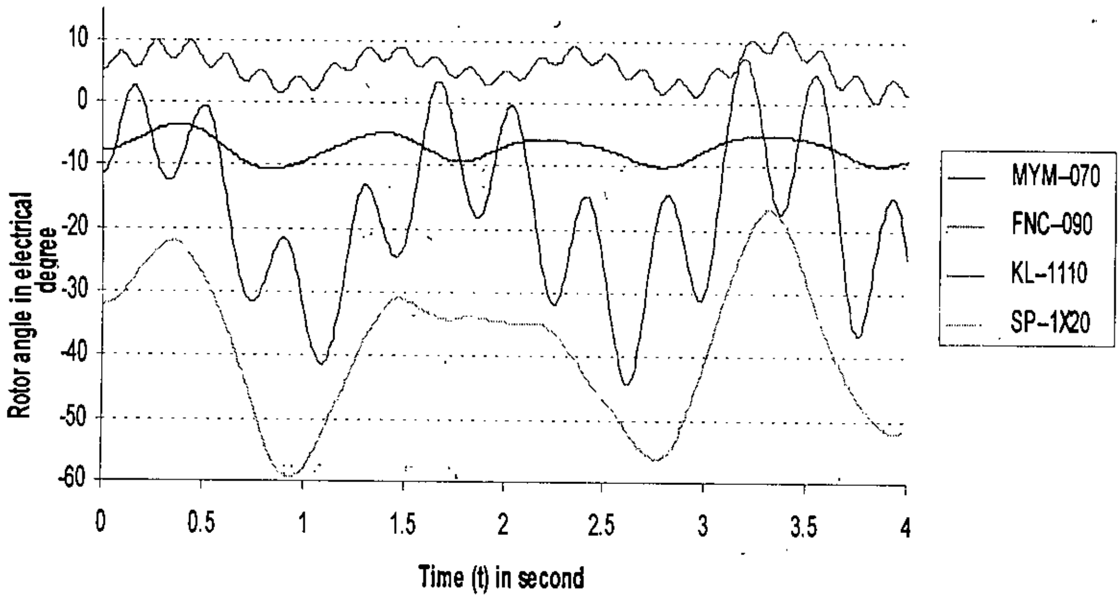

Fig C.7b: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while importing 150 MW power from India through Sreemongal bus in the 2004 system.

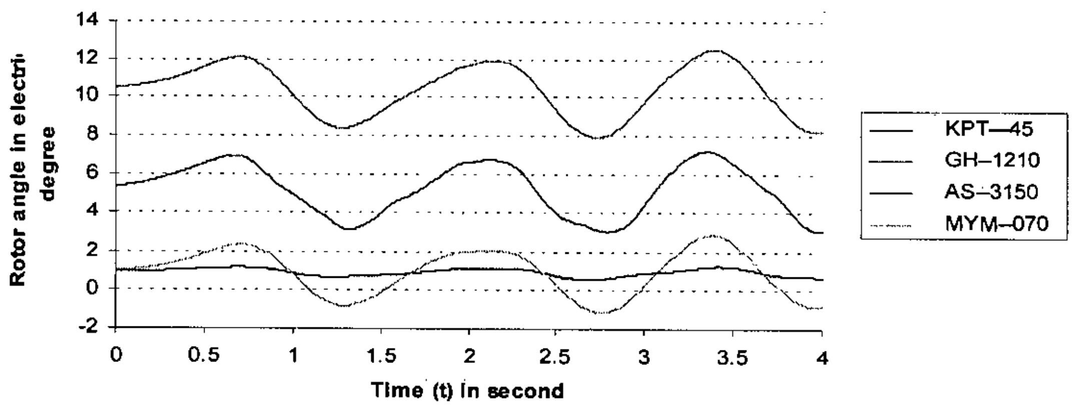

Fig C.8a: Swing curves for selected machines for a fault on the Thakurgaon bus of India-Thakurgaon tie line while importing 150 MW power from India through Thakurgaon bus in the 2004 system.

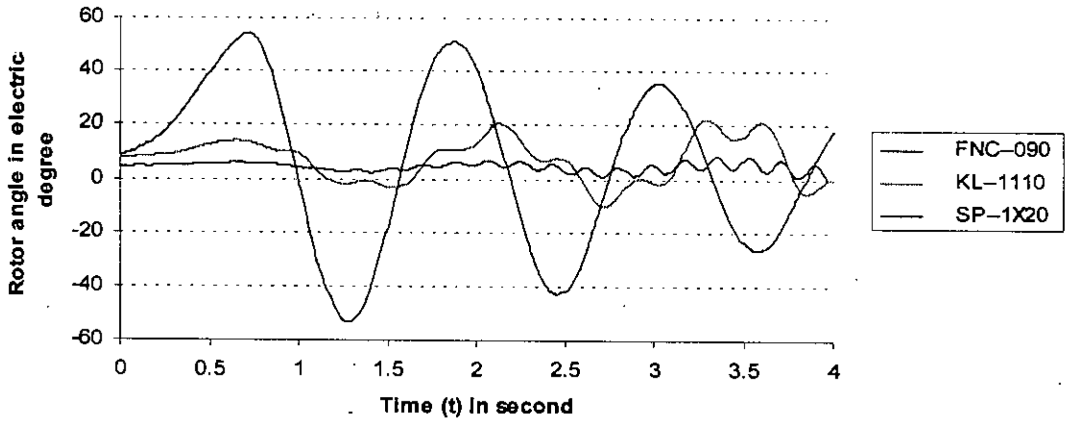

Fig C.8b: Swing curves for selected machines for a fault on the Thakurgaon bus of India-Thakurgaon tie line while importing 150 MW power from India through Thakurgaon bus in the 2004 system.

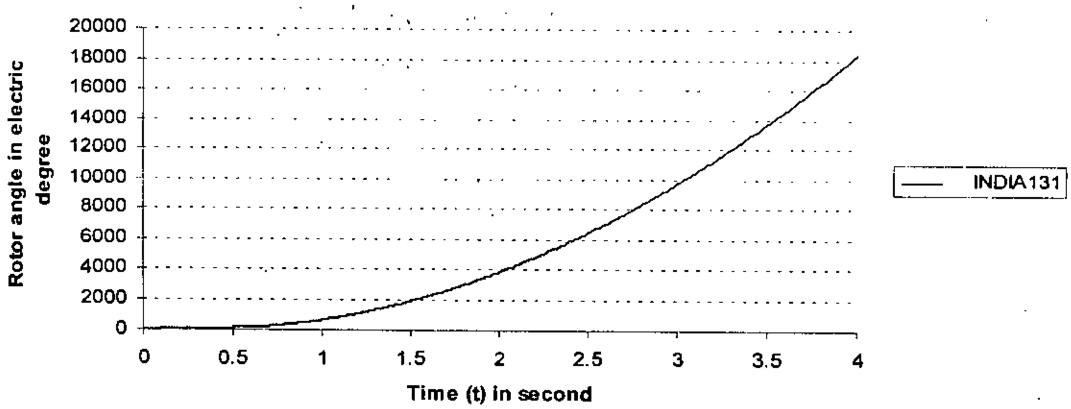

Fig C.8c: Swing curves for selected machines for a fault on the Thakurgaon bus of India-Thakurgaon tie line while importing 150 MW power from India through Thakurgaon bus in the 2004 system.

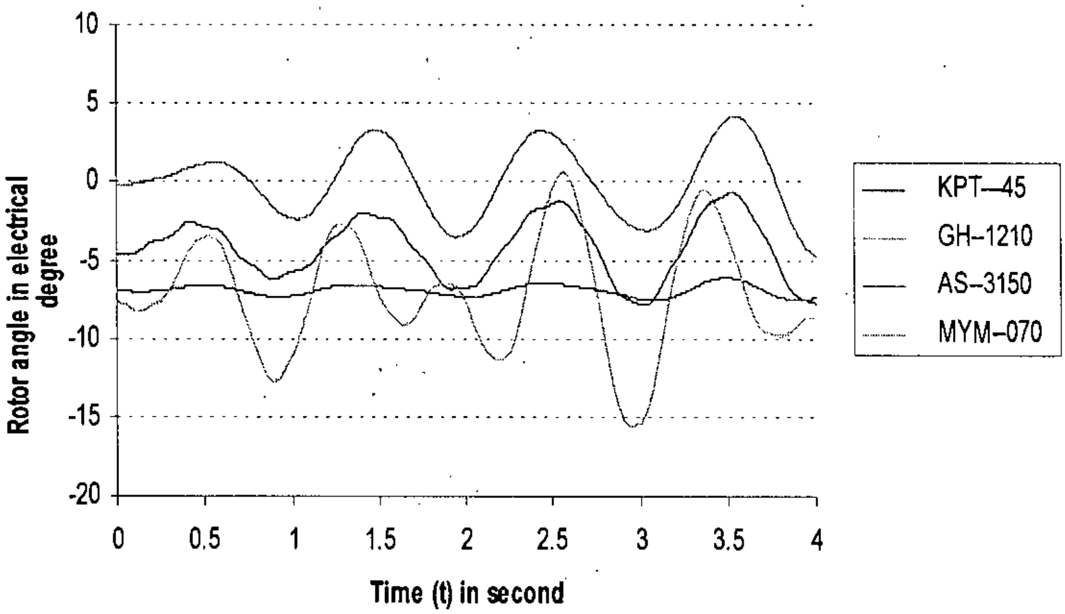

Fig C.9a: Swing curves for selected machines for a fault on the Sreemongal bus of India-Sreemongal tie line while importing 150 MW power from India through Sreemongal bus in the 2004 system.

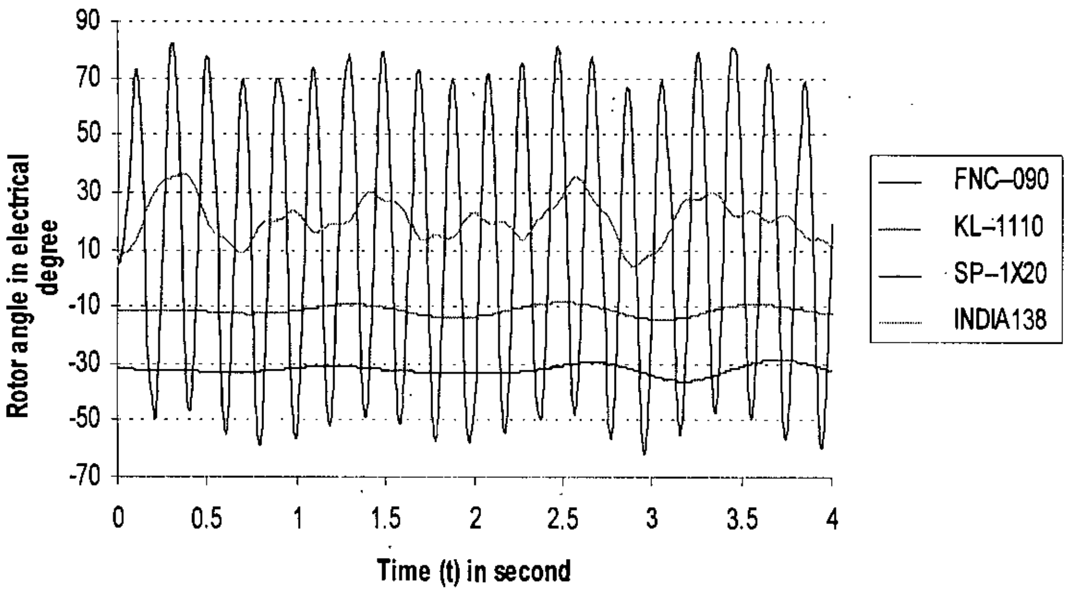

Fig C.9b: Swing curves for selected machines for a fault on the Sreemongal bus of India-Sreemongal tie line while importing 150 MW power from India through Sreemongal bus in the 2004 system.

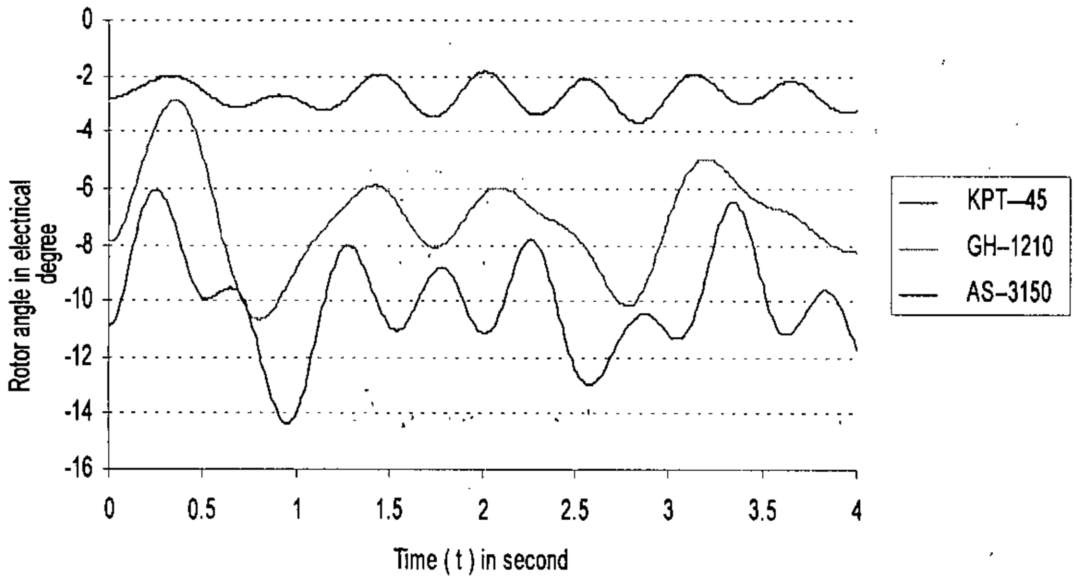

Fig C.10a: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while exporting 150 MW power to India through Sreemongal bus in the 2004 system.

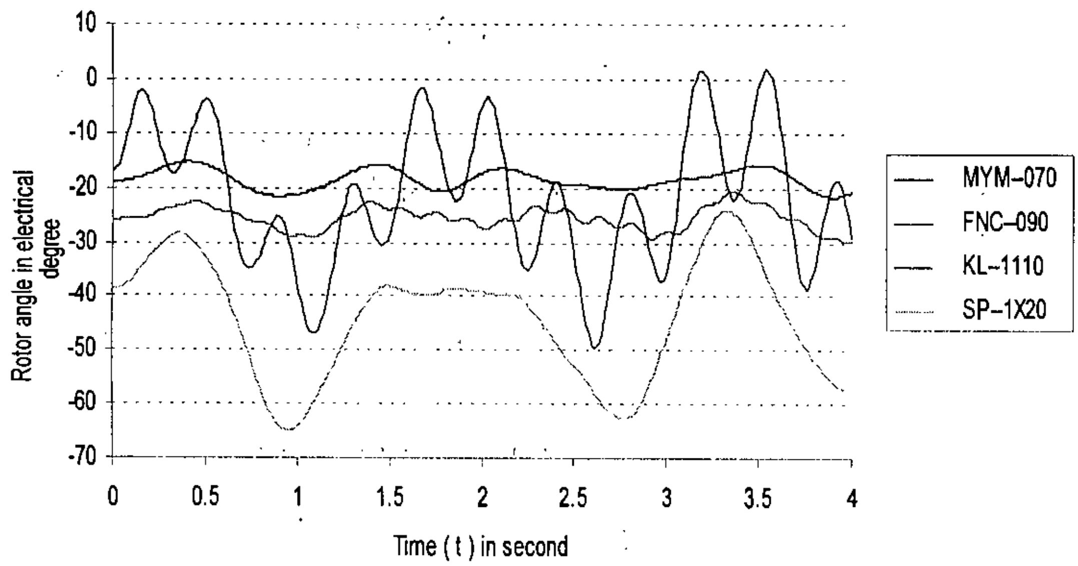

Fig C.10b: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while exporting 150 MW power to India through Sreemongal bus in the 2004 system.

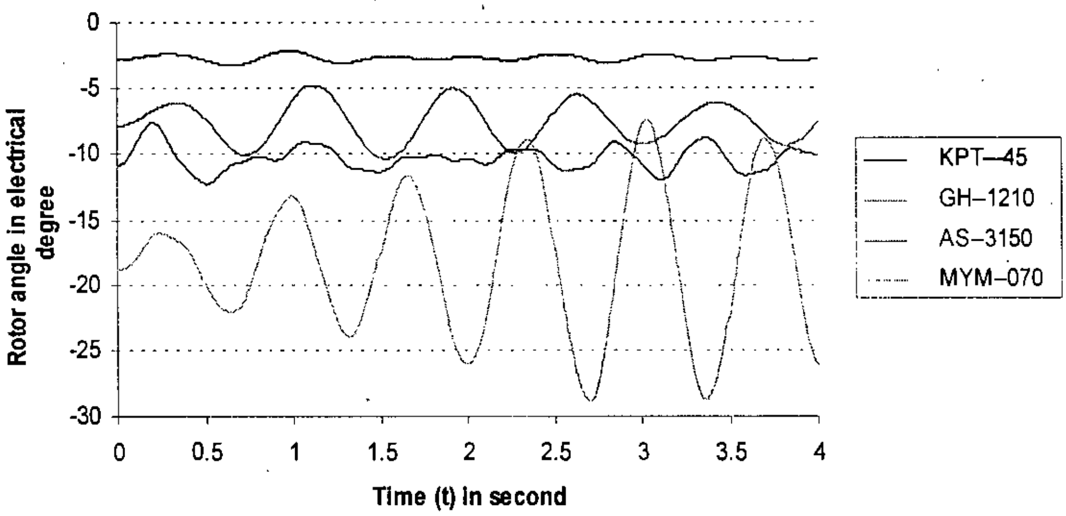

Fig C.11a: Swing curves for selected machines for a fault on the Sreemongal bus of India-Sreemongal tie line while exporting 150 MW power to India through Sreemongal bus in the 2004 system.

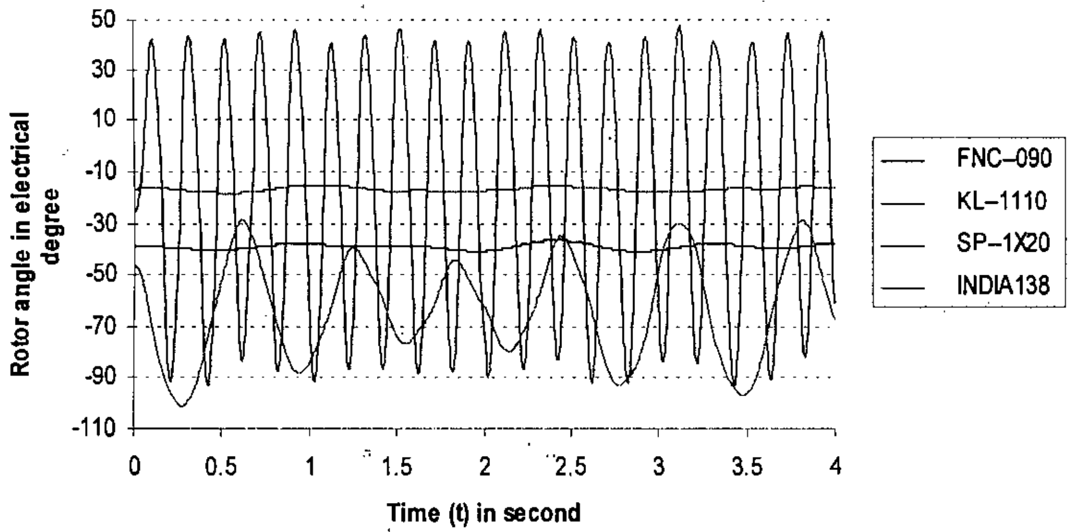

Fig C.11b: Swing curves for selected machines for a fault on the Sreemongal bus of India-Sreemongal tie line while exporting 150 MW power to India through Sreemongal bus in the 2004 system.

Table C.5: Summary of steady state performance for the 2015 system under base case and import (through Ishurdi) condition.

Import Power (MW)	**150**	**200**	**250**	**300**	**350**	**400**	**450**	**500**	**Base case**
Total real power gen. (ΣP_G)	7483.93	7440.503	7393.582	7349.752	7306.775	7267.474	7218.432	7174.488	7643.752
Total real load (ΣP_L)	7531.9	7531.9	7531.9	7531.9	7531.9	7531.9	7531.9	7531.9	7531.90
Number of generating unit	68	68	68	68	68	68	68	68	68
Number of PV bus	45	45	45	45	45	45	45	45	45
Number of 132KV Circuits (*)	165	165	165	165	165	165	165	165	165
Number of 230KV Circuits including EWI(*)	64	64	64	64	64	64	62	62	64
Total real power loss (ΣP_{Loss})	102.033	108.651	111.714	117.841	125.942	135.634	136.668	142.933	111.917
Number of capacitor bank	21	21	21	21	21	21	21	21	21
Total MVAR generate by capacitor	740.033	738.698	738.64	738.347	737.915	737.261	732.314	731.941	735.085
$-45^0 \leq \theta \leq +45^0$	OK	OK	OK	OK	OK	OK	OK	OK	OK
$\lvert \theta_{max} \rvert$	17.4	18.4	18.1	19.9	24.6	29	20.8	22.2	19.5
Number of iterations	4	4	4	4	4	4	4	4	4
Gen. p. f. ≥ 0.8	OK	OK	OK	OK	OK	OK	OK	OK	OK
$P_{G\ slack}$	502.17	508.74	511.822	517.991	520.015	580.714	581.672	587.908	511.99
$Q_{G\ slack}$	199.729	203.45	206.782	211.22	216.074	225.125	226.891	213.843	206.578
$0.9 \leq Vi \leq 1.05$	OK	OK	OK	OK	OK	OK	OK	OK	OK
Ghorashal To Ishurdi (EWI) Circuit Number	5	5	5	5	5	5	3	3	5
EWI line flow per circuit	122.09	123.419	114.136	105.229	96.71	88.606	148.551	134.028	164.288
Number of Tie-line Circuits	2	2	2	2	2	2	3	3	--

(*) Most of the lines comprise 2 circuits each.

Table C.6: Summary of steady state performance for the 2015 system under base case and export (through Ishurdi) condition.

Export Power (MW)	150	200	250	300	350	400	450	500	Base case
Total real power gen. ($\sum P_G$)	7819.518	7870.882	7934.388	8001.703	8042.788	8100.918	8163.894	8225.895	7643.752
Total real load ($\sum P_L$)	7681.90	7731.9	7781.90	7831.90	7881.90	7931.90	7981.90	8031.90	7531.90
Number of generating unit	68	68	68	68	68	68	68	68	68
Number of PV bus	45	45	45	45	45	45	45	45	45
Number of 132KV circuits (*)	165	165	165	165	165	165	165	165	165
Number of 230KV circuits including EWI (*)	64	65	65	65	66	66	66	67	64
Total real power loss ($\sum P_{Loss}$)	137.626	138.99	152.50	169.958	160.925	169.125	182.174	194.064	111.917
Number of capacitor bank	21	21	21	21	21	21	21	21	21
Total MVAR generate by capacitor	882.455	884.677	972.494	1043.814	1067.82	1134.567	1188.57	1288.799	735.085
$-45^0 \leq \theta \leq +45^0$	OK	OK	OK	OK	OK	OK	OK	OK	OK
$\lvert\theta_{max}\rvert$	20.7	20.8	24.6	28.7	23.2	25.6	28.3	29.8	19.5
Number of iterations	5	5	5	5	5	5	5	6	4
Gen. p. f. ≥ 0.8	OK	OK	OK	OK	OK	OK	OK	OK	OK
$P_{G\ slack}$	537.757	539.122	552.578	569.943	561.027	569.158	582.133	569.134	511.99
$Q_{G\ slack}$	205.913	204.285	205.53	211.221	203.448	204.761	207.209	193.967	206.578
$0.9 \leq Vi \leq 1.05$	OK	OK	OK	OK	OK	OK	OK	OK	OK
Ghorashal To Ishurdi (EWI) Circuit Number	5	6	6	6	7	7	7	8	5
EWI line flow per circuit	198.933	174.29	184.864	195.917	173.755	174.917	180.336	165.368	164.288
Number of Tie- line circuits	2	2	2	2	3	3	3	3	--

(*) Most of the lines comprise 2 circuits each.

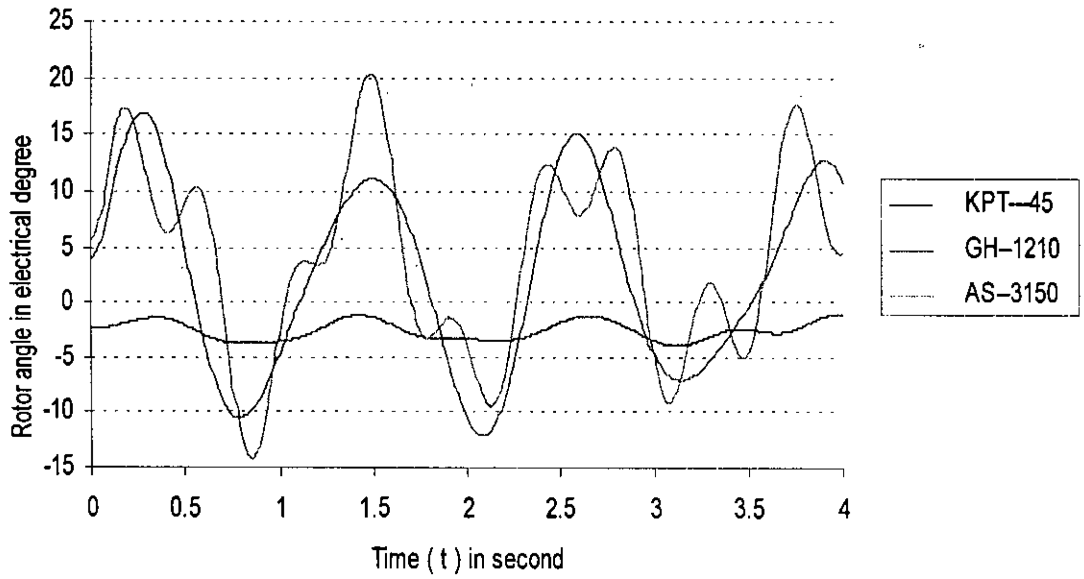

Fig C.12a: Swing curves for selected machines for a fault on the Ishurdi-23 bus of EWI line in the 2015 system.

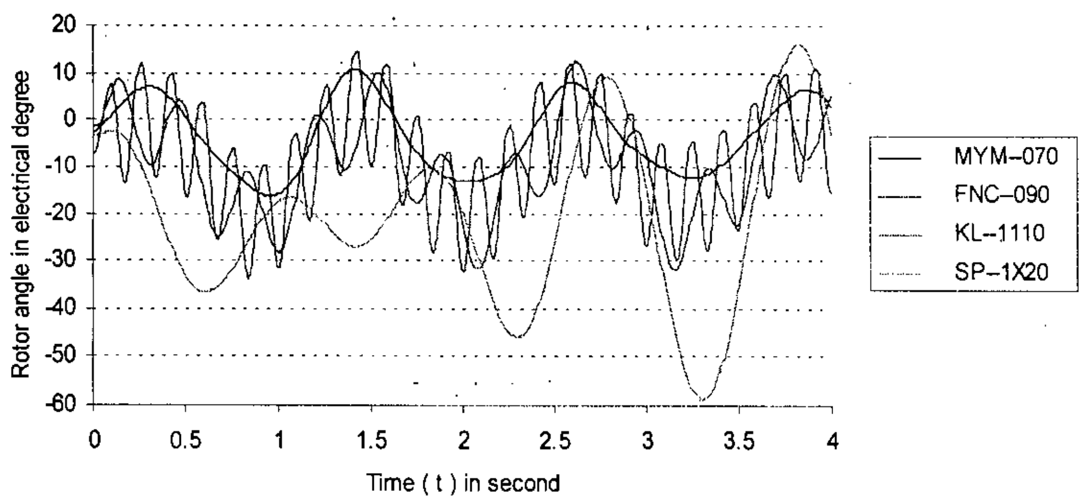

Fig C.12b: Swing curves for selected machines for a fault on the Ishurdi -23 bus of EWI line in the 2015 system.

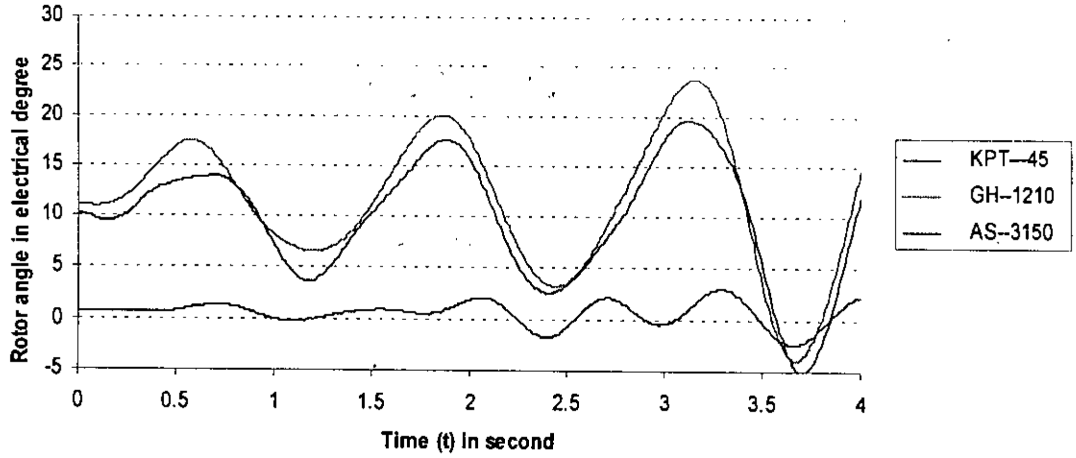

Fig C.13a: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while importing 500 MW power from India through Ishurdi bus in the 2015 system.

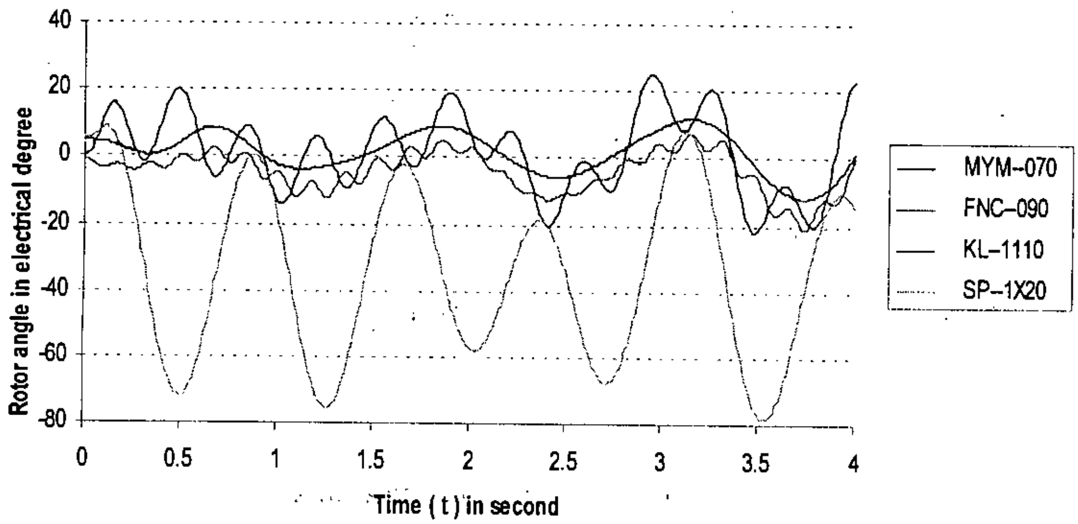

Fig C.13b: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while importing 500 MW power from India through Ishurdi bus in the 2015 system.

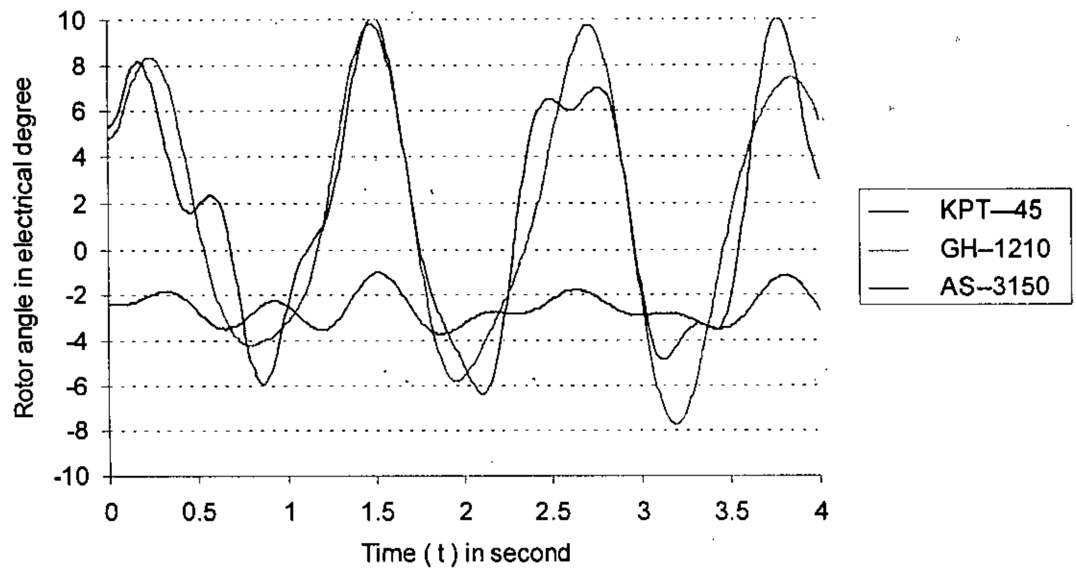

Fig C.14a: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while exporting 500 MW power to India through Ishurdi bus in the 2015 system.

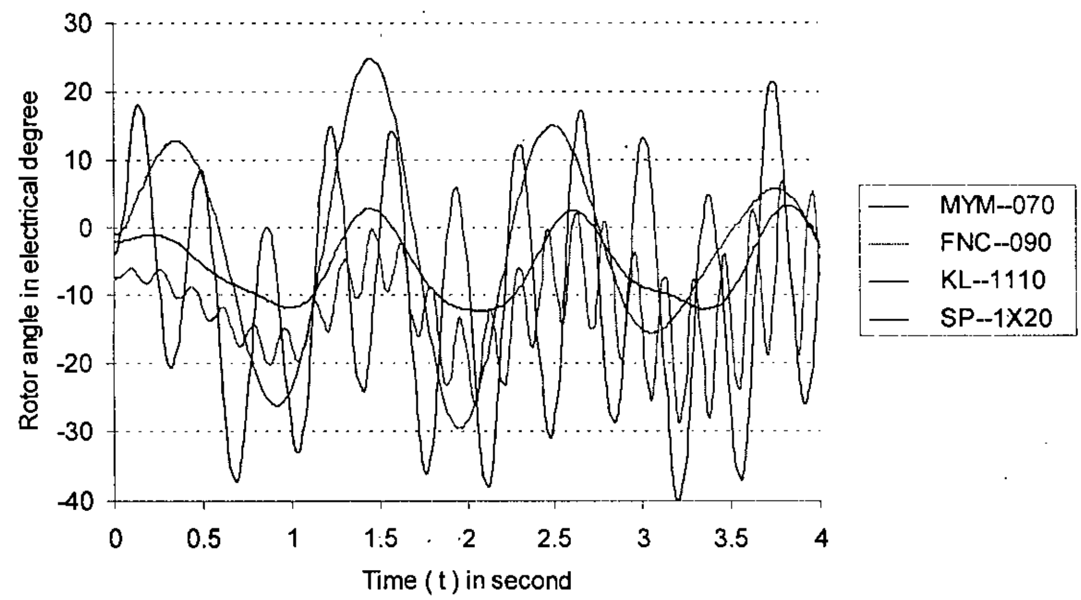

Fig C.14b: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while exporting 500 MW power to India through Ishurdi bus in the 2015 system.

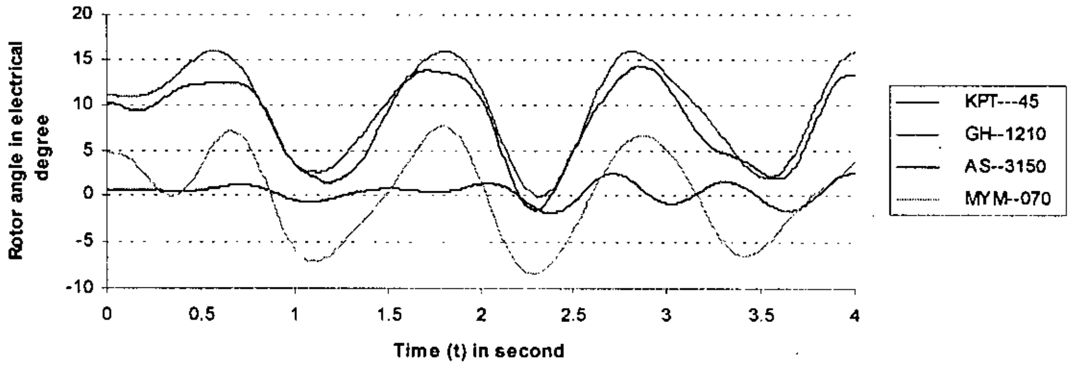

Fig C.15a: Swing curves for selected machines for a fault on the Ishurdi bus at India-Ishurdi tie line while importing 500 MW power from India through Ishurdi bus in the 2015 system.

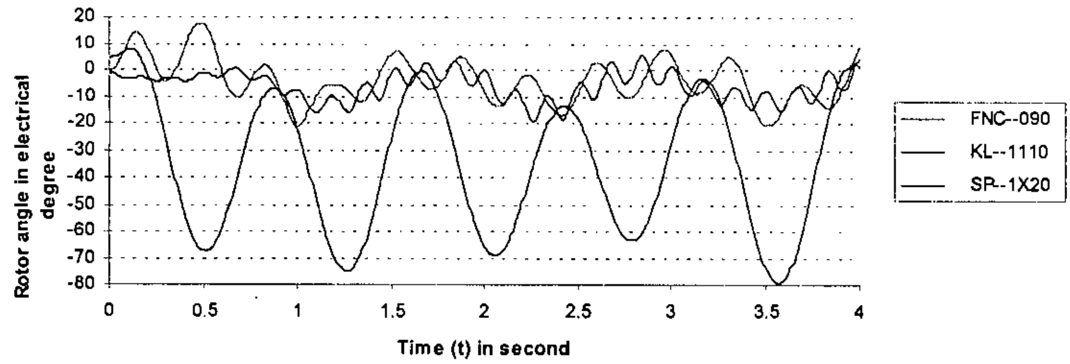

Fig C.15b: Swing curves for selected machines for a fault on the Ishurdi bus at India-Ishurdi tie line while importing 500 MW power from India through Ishurdi bus in the 2015 system.

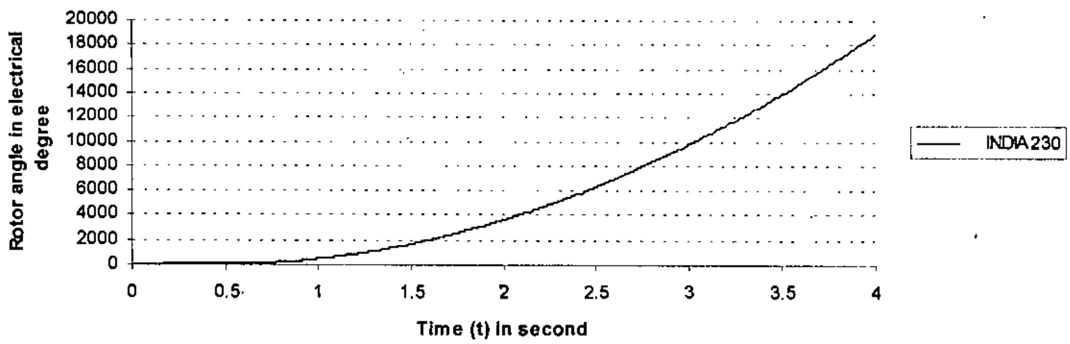

Fig C.15c: Swing curves for selected machines for a fault on the Ishurdi bus at India-Ishurdi tie line while importing 500 MW power from India through Ishurdi bus in the 2015 system.

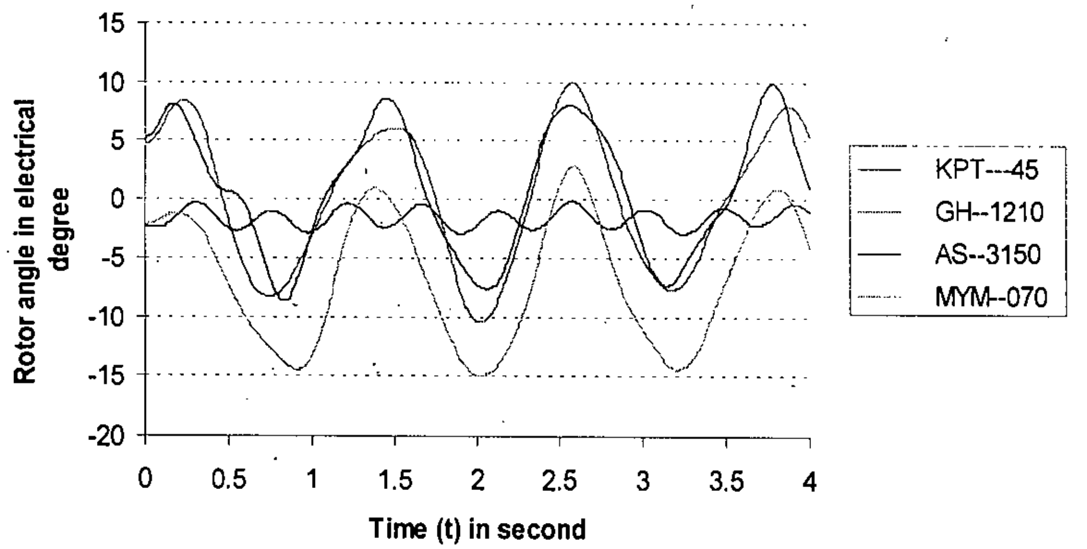

Fig C.16a: Swing curves for selected machines for a fault on the Ishurdi-23 bus of India-Ishurdi tie line while exporting 500 MW power to India through Ishurdi bus in the 2015 system.

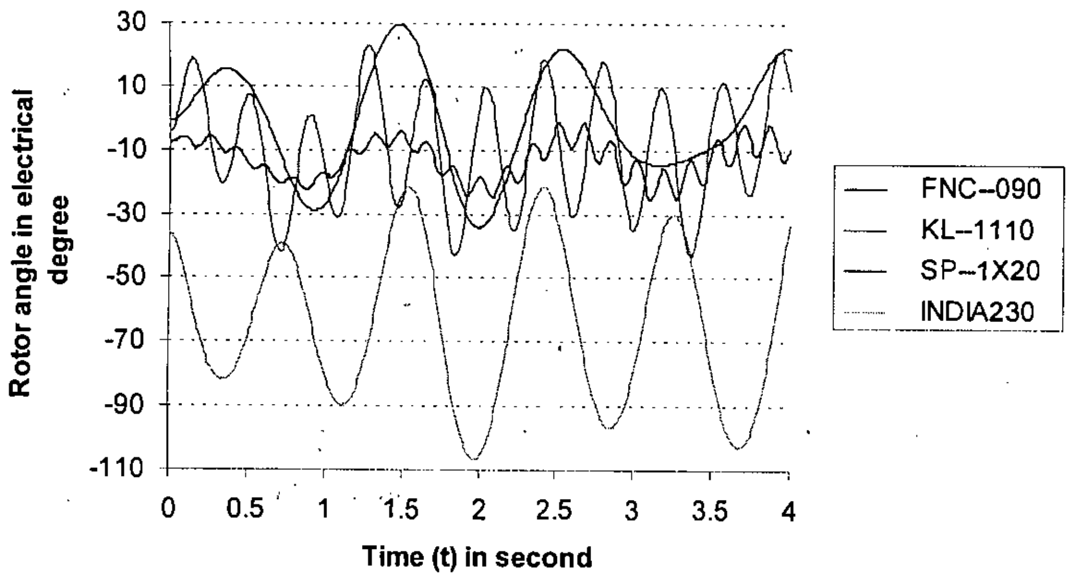

Fig C.16b: Swing curves for selected machines for a fault on the Ishurdi-23 bus of India-Ishurdi tie line while exporting 500 MW power to India through Ishurdi bus in the 2015 system.

Table C.7: Summary of steady state performance for the 2015 system under base case and import (through Thakurgaon and Sreemongal) condition.

Import from India to	**Thakurgaon**			**Sreemongal**			**Base Case**
Import Power (MW)	**50**	**100**	**150**	**50**	**100**	**150**	
Total real power gen. (ΣP_G)	7587.531	7534.912	7487.831	7593.833	7545.263	7499.143	7643.752
Total real load (ΣP_L)	7531.90	7531.90	7531.90	7531.90	7531.90	7531.90	7531.90
Number of generating unit	68	68	68	68	68	68	68
Number of PV bus	45	45	45	45	45	45	45
Number of 132KV Circuits (*)	165	165	165	165	165	165	165
Number of 230KV Circuits including EWI (*)	64	64	64	64	64	64	64
Total real power loss (ΣP_{Loss})	105.651	103.005	105.963	111.009	112.42	116.317	111.917
Number of capacitor bank	21	21	21	21	21	21	21
Total MVAR generate by capacitor	735.287	638.335	638.18	736.723	736.461	703.33	735.085
$-45^0 \leq \theta \leq +45^0$	OK	OK	OK	OK	OK	OK	OK
$\lvert\theta_{max}\rvert$	18.7	18.8	18.1	18.7	19.1	18.8	19.5
Number of iterations	4	4	4	4	4	4	4
Gen. p. f. $\geq$ 0.8	OK	OK	OK	OK	OK	OK	OK
$P_{G\ slack}$	455.77	503.152	456.071	512.072	463.502	417.383	511.99
$Q_{G\ slack}$	203.634	208.669	207.41	206.208	204.445	204.376	206.578
$0.9 \leq Vi \leq 1.05$	OK	OK	OK	OK	OK	OK	OK
Ghorashal To Ishurdi (EWI) Circuit Number	5	5	5	5	5	5	5
EWI line flow per circuit	152.973	143.052	135.646	164.229	164.232	164.237	164.288
Number of Tie- line Circuits	2	2	2	2	2	2	--

(*) Most of the lines comprise 2 circuits each.

Table C.8: Summary of steady state performance for the 2015 system under base case and export (through Thakurgaon and Sreemongal) condition.

Export to India from	**Thakurgaon**			**Sreemongal**			**Base Case**
Export Power (MW)	**50**	**100**	**150**	**50**	**100**	**150**	
Total real power gen. (ΣP_G)	7707.526	7776.75	7846.99	7693.067	7755.101	7814.45	7643.752
Total real load (ΣP_L)	7581.90	7631.90	7681.90	7531.90	7631.90	7681.90	7531.90
Number of generating unit	68	68	68	68	68	68	68
Number of PV bus	45	45	45	45	45	45	45
Number of 132KV circuits (*)	165	165	165	165	165	165	165
Number of 230KV circuits including EWI (*)	64	64	64	64	64	64	64
Total real power loss (ΣP_{Loss}).	125.623	144.903	165.178	111.213	123.18	132.665	111.917
Number of capacitor bank	21	21	21	21	21	21	21
Total MVAR generate by capacitor	840.983	837.463	829.255	887.02	885.045	884.249	735.085
$-45^0 \leq \theta \leq +45^0$	OK	OK	OK	OK	OK	OK	OK
$\|\theta_{max}\|$	26.3	36.2	41.5	17.6	22.7	28.9	19.5
Number of iterations	5	6	7	4	5	5	4
Gen. p. f. $\geq$ 0.8	OK	OK	OK	OK	OK	OK	OK
$P_{G\ slack}$	475.766	494.99	515.238	411.307	523.341	532.807	511.99
$Q_{G\ slack}$	207.918	211.788	213.35	201.477	207.718	209.224	206.578
$0.9 \leq Vi \leq 1.05$	OK	OK	OK	OK	OK	OK	OK
Ghorashal To Ishurdi (EWI) Circuit Number	5	5	5	5	5	5	5
EWI line flow per circuit	176.589	190.391	194.465	153.067	164.22	162.223	164.288
Number of Tie- line circuits	2	2	2	2	2	2	--

(*) Most of the lines comprise 2 circuits each.

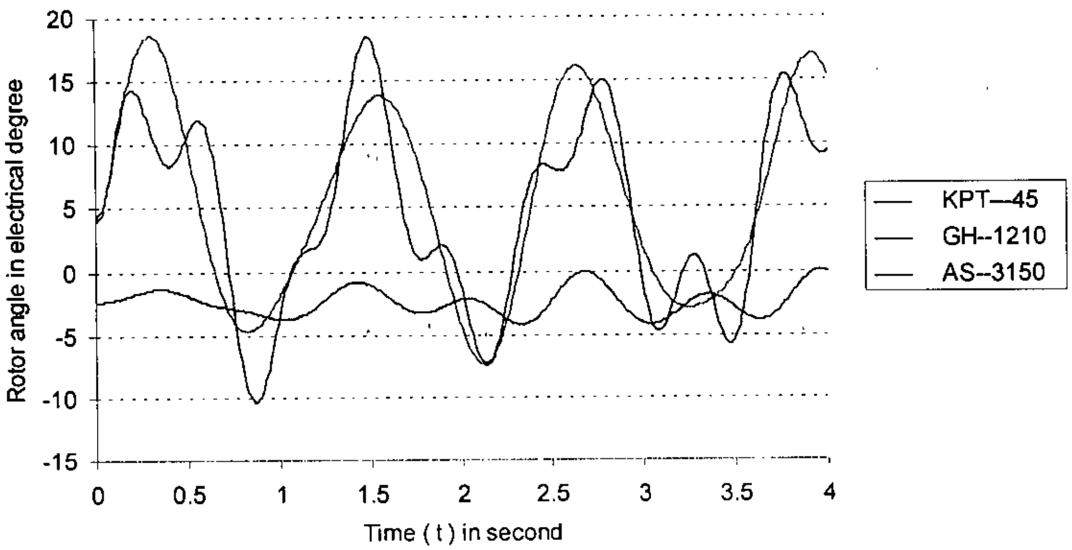

Fig C.17a: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while importing 150 MW power from India through Thakurgaon bus in the 2015 system.

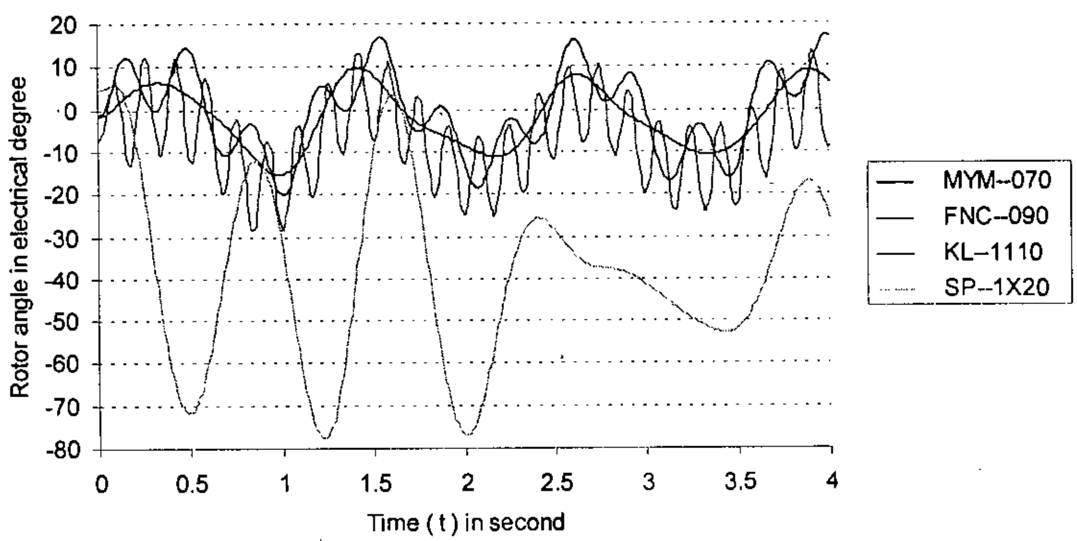

Fig C.17b: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while importing 150 MW power from India through Thakurgaon bus in the 2015 system.

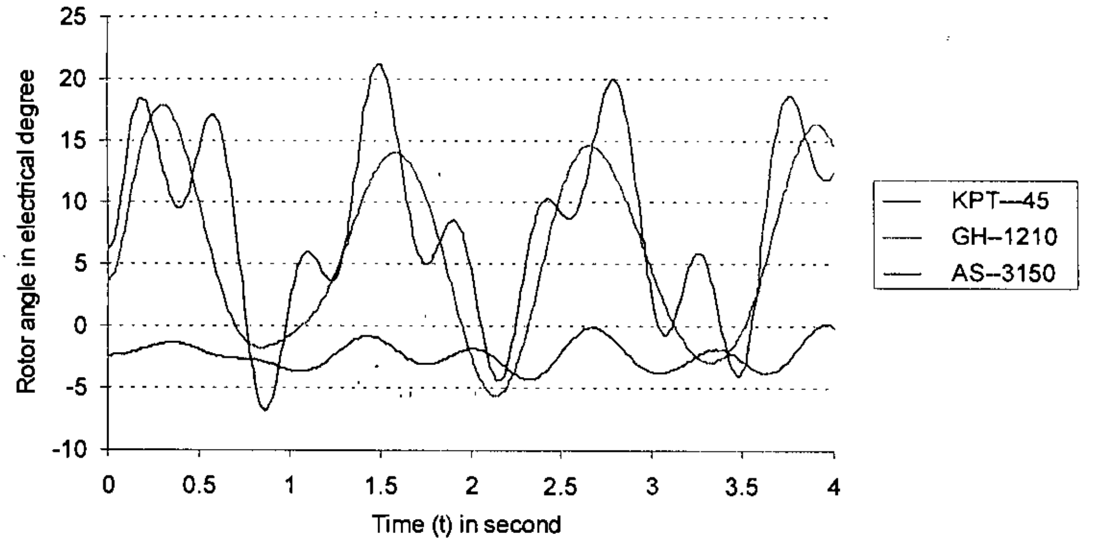

Fig C.18a: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while importing 150 MW power from India through Sreemongal bus in the 2015 system.

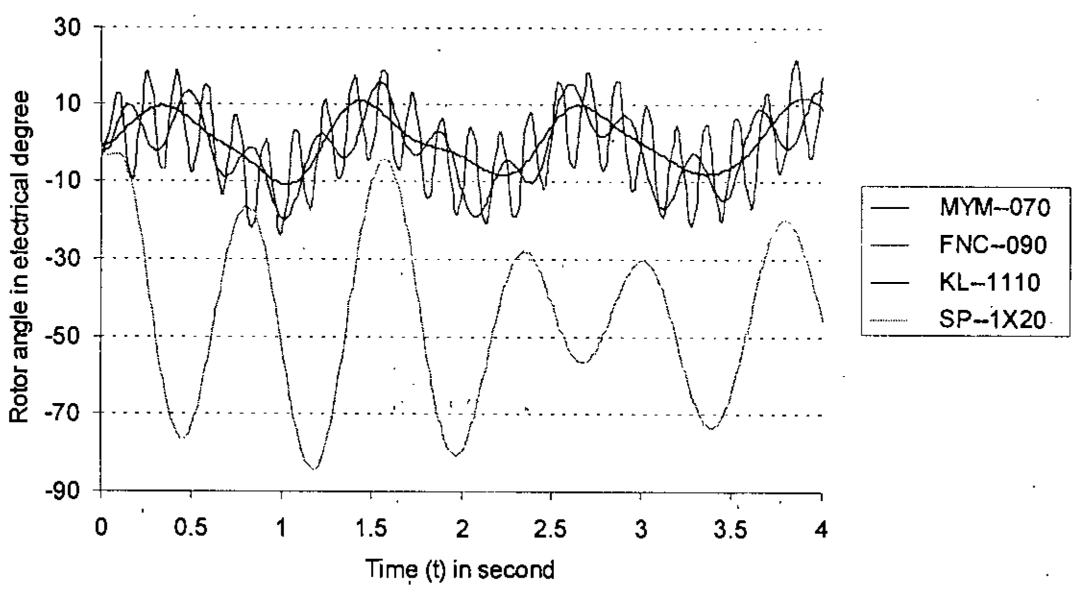

Fig C.18b: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while importing 150 MW power from India through Sreemongal bus in the 2015 system.

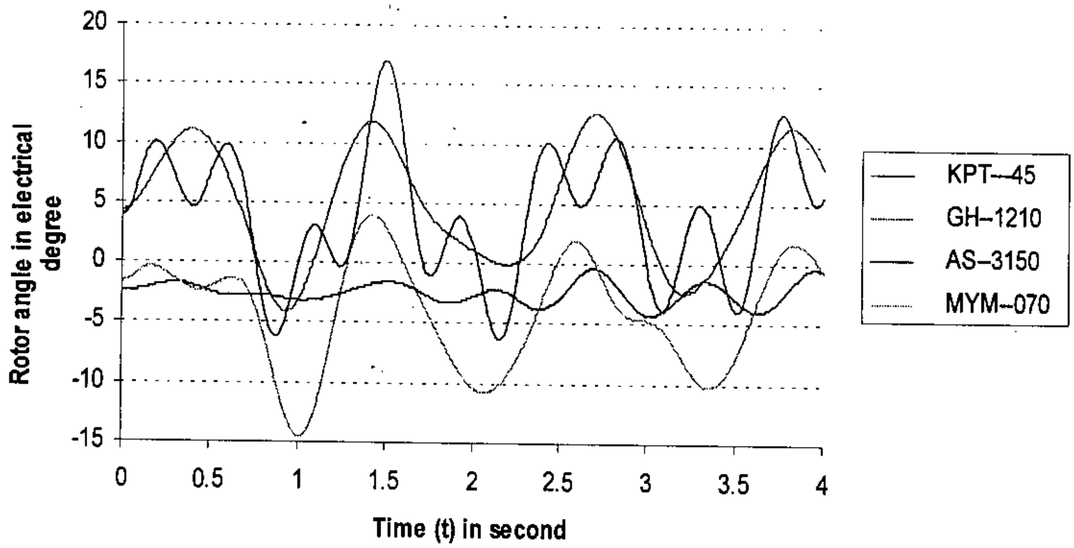

Fig C.19a: Swing curves for selected machines for a fault on the Thakurgaon bus of India-Thakurgaon tie line while importing 150 MW power from India through Thakurgaon bus in the 2015 system.

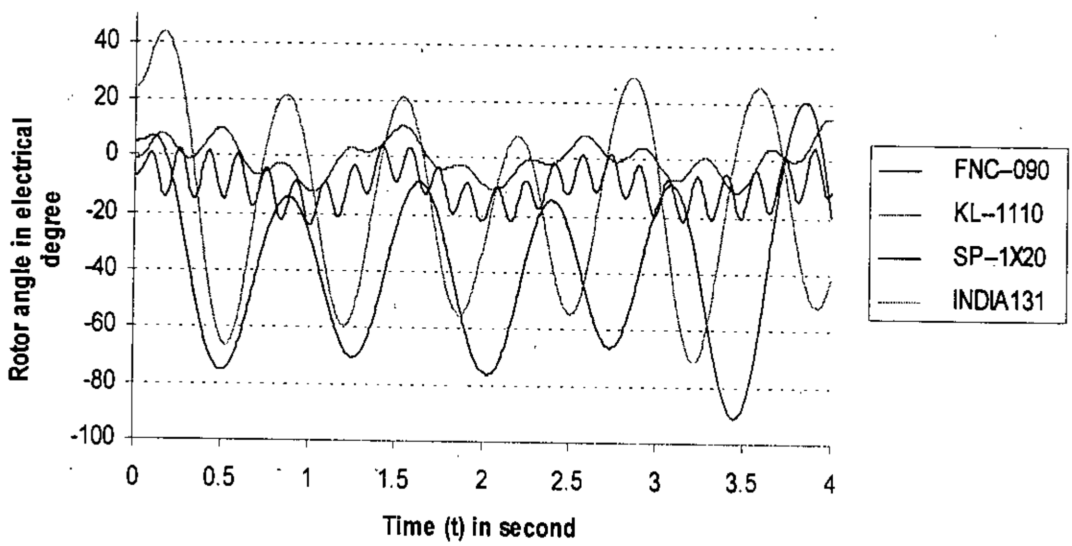

Fig C.19b: Swing curves for selected machines for a fault on the Thakurgaon bus of India-Thakurgaon tie line while importing 150 MW power from India through Thakurgaon bus in the 2015 system.

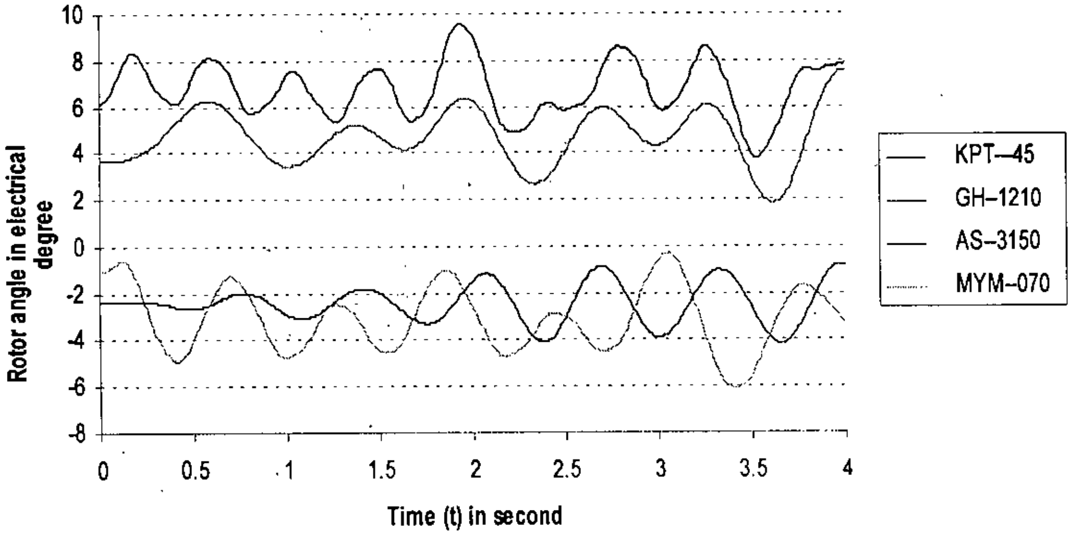

Fig C.20a: Swing curves for selected machines for a fault on the Sreemongal bus of India-Sreemongal tie line while importing 150 MW power from India through Sreemongal bus in the 2015 system.

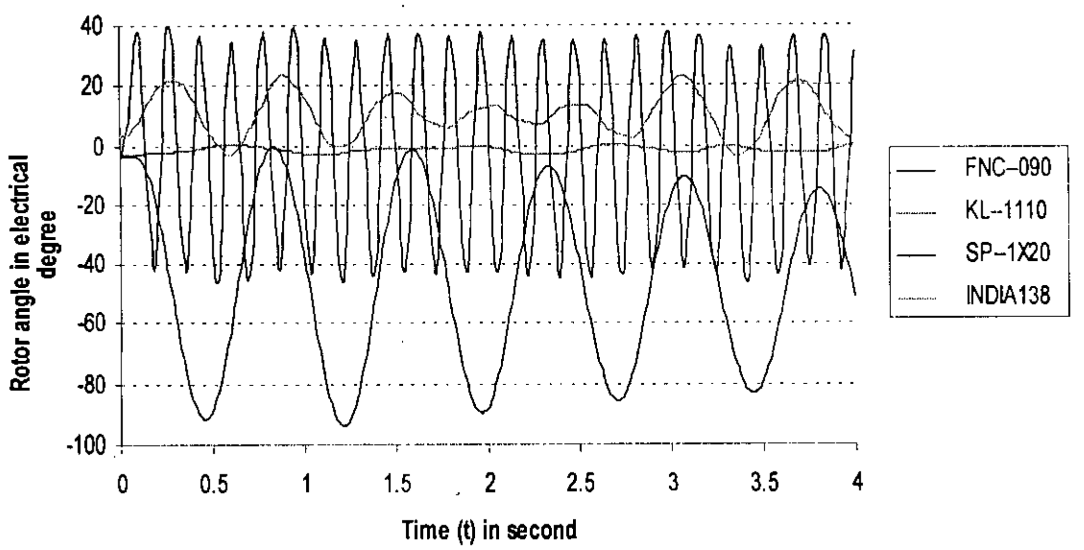

Fig C.20b: Swing curves for selected machines for a fault on the Sreemongal bus of India-Sreemongal tie line while importing 150 MW power from India through Sreemongal bus in the 2015 system.

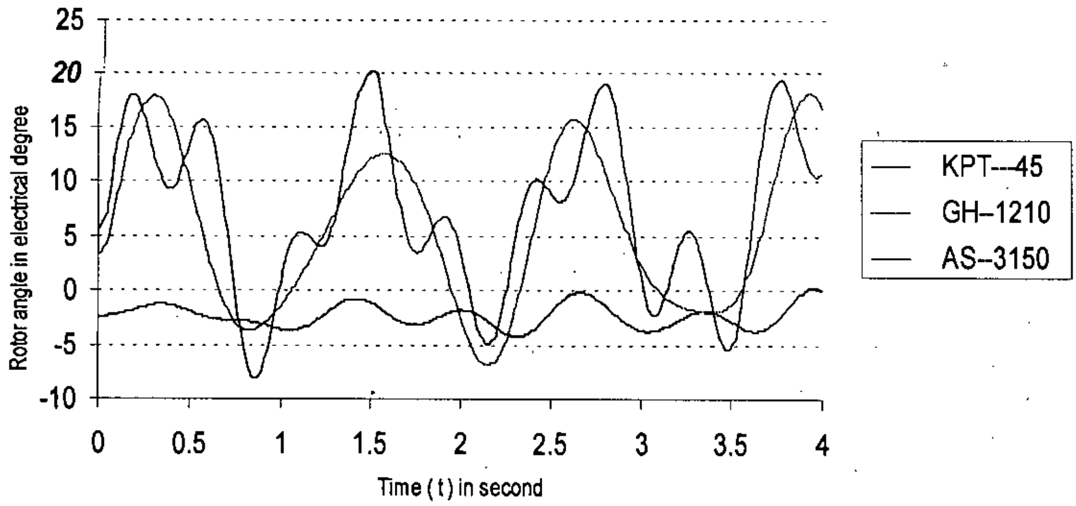

Fig C.21a: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while exporting 150 MW power to India through Thakurgaon bus in the 2015 system.

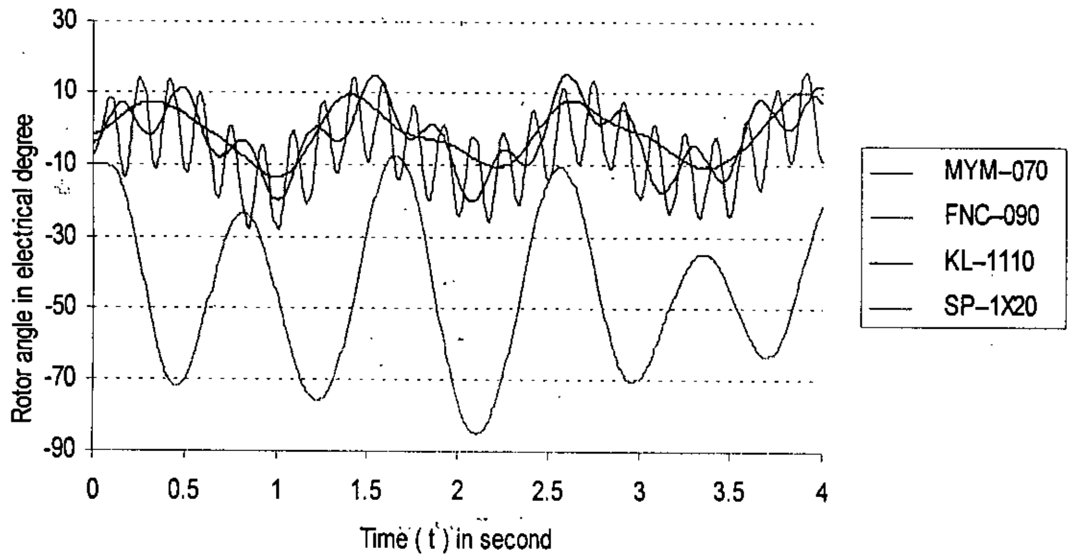

Fig C.21b: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while exporting 150 MW power to India through Thakurgaon bus in the 2015 system.

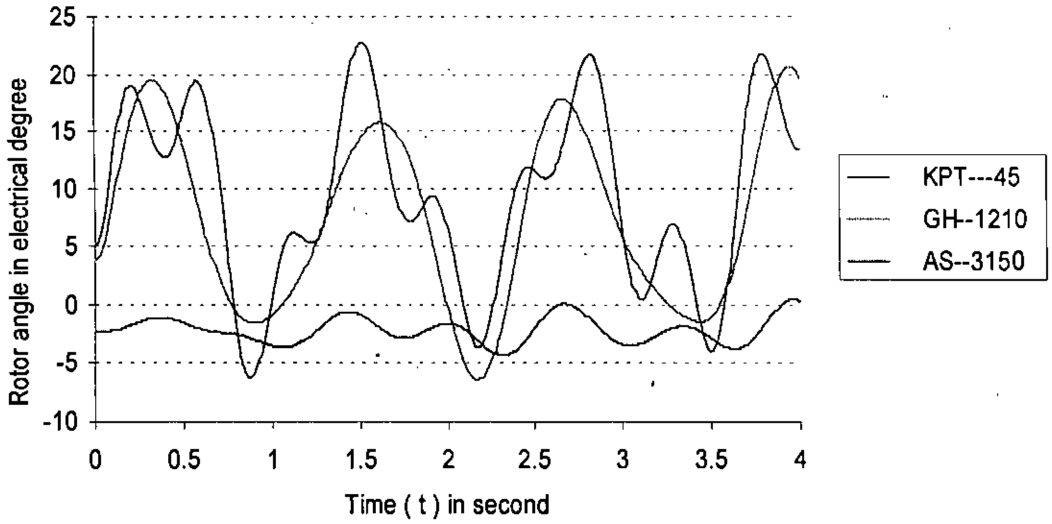

Fig C.22a: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while exporting 150 MW power to India through Sreemongal bus in the 2015 system.

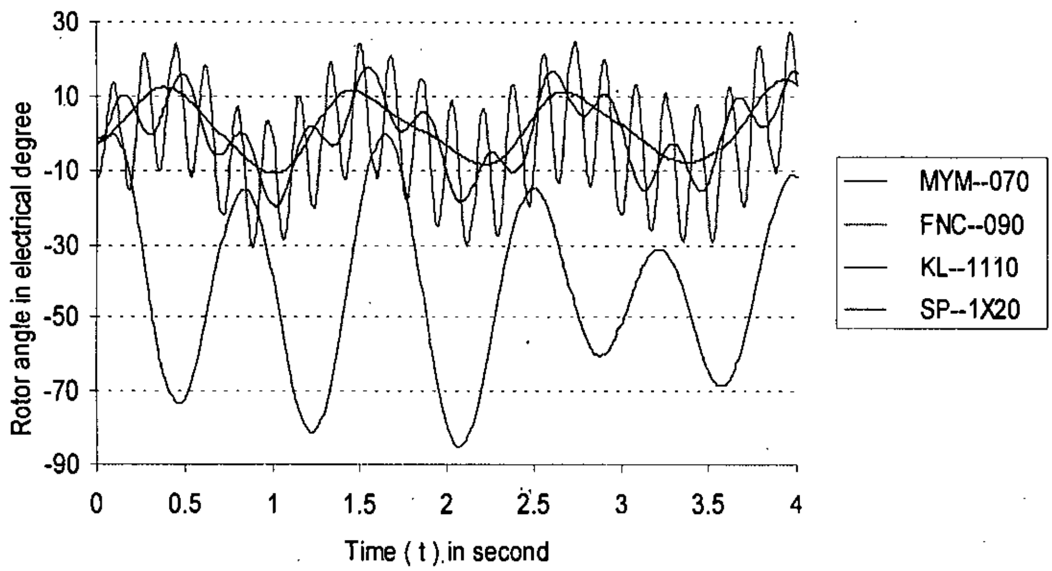

Fig C.22b: Swing curves for selected machines for a fault on Ishurdi-23 bus of EWI lines while exporting 150 MW power to India through Sreemongal bus in the 2015 system.

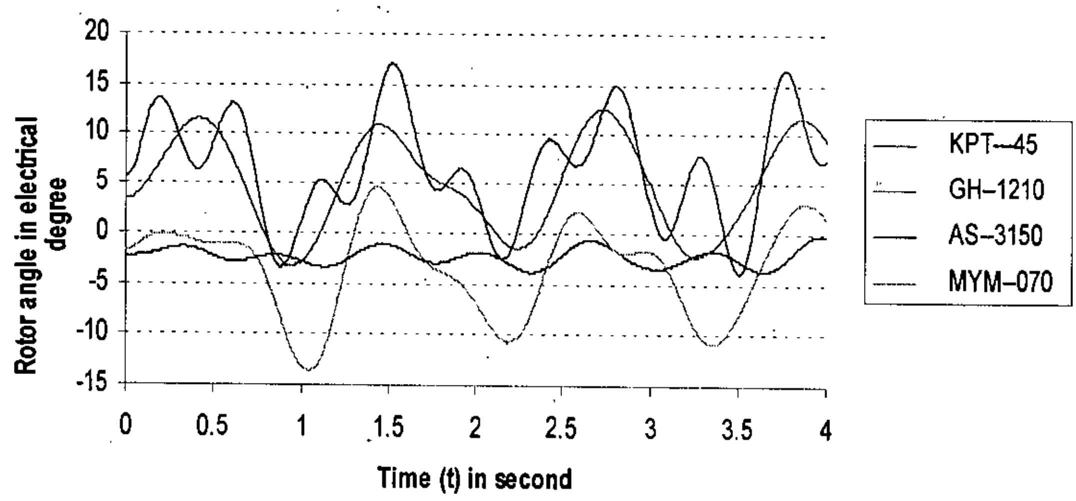

Fig C.23a: Swing curves for selected machines for a fault on the Thakurgaon bus of India-Thakurgaon tie line while exporting 150 MW power to India through Thakurgaon bus in the 2015 system.

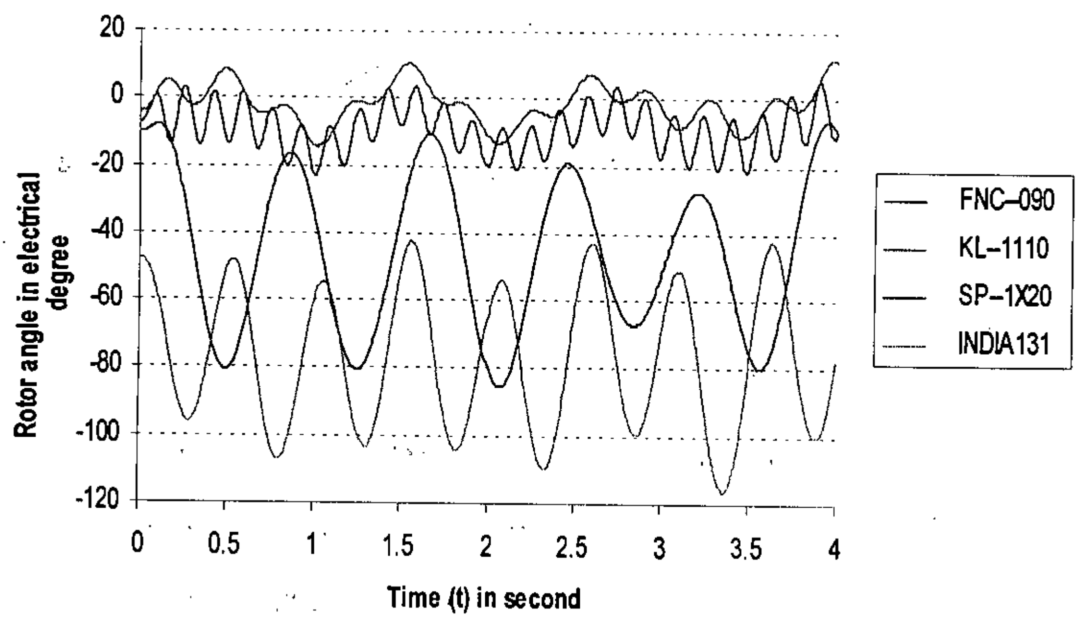

Fig C.23b: Swing curves for selected machines for a fault on the Thakurgaon bus of India-Thakurgaon tie line while exporting 150 MW power to India through Thakurgaon bus in the 2015 system.

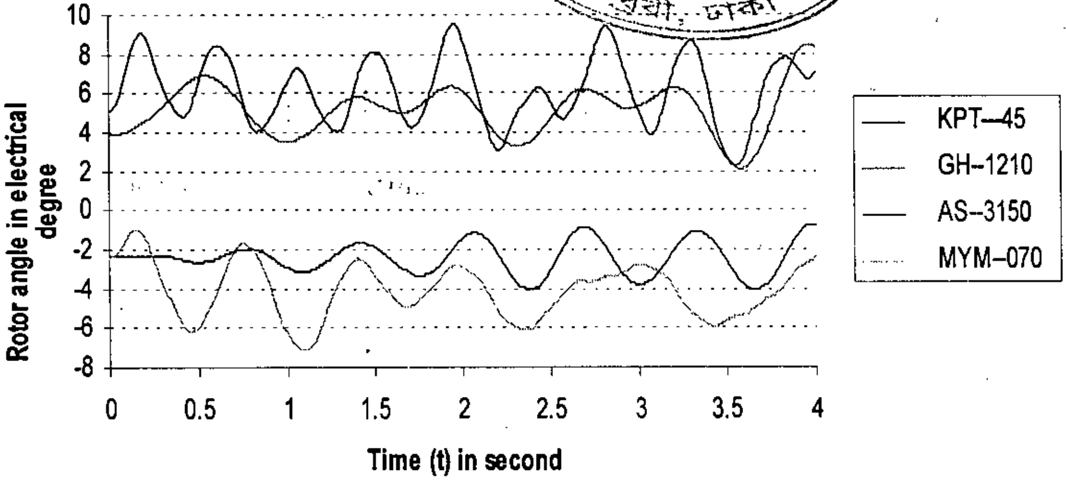

Fig C.24a: Swing curves for selected machines for a fault on the Sreemongal bus of India-Sreemongal tie line while exporting 150 MW power to India through Sreemongal bus in the 2015 system.

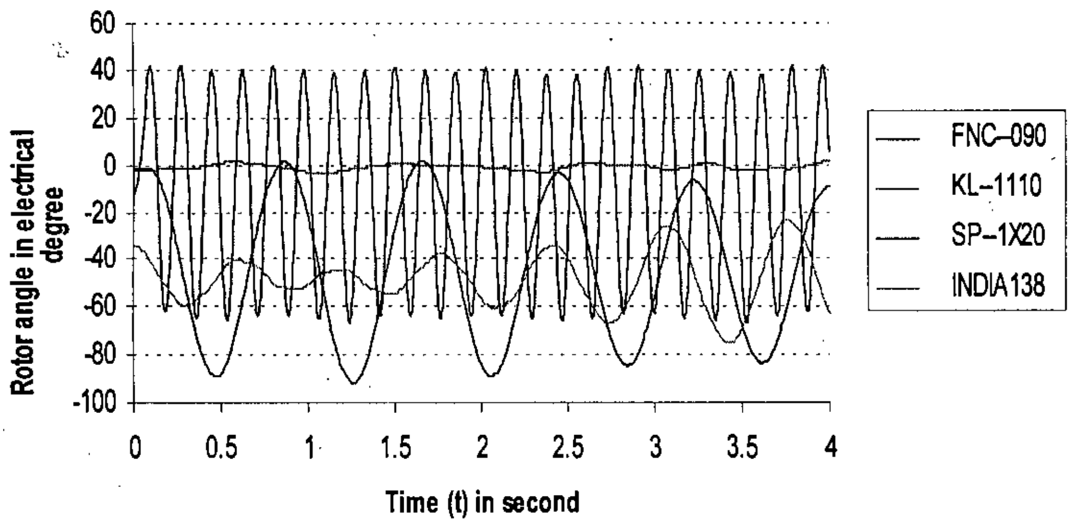

Fig C.24b: Swing curves for selected machines for a fault on the Sreemongal bus of India-Sreemongal tie line while exporting 150 MW power to India through Sreemongal bus in the 2015 system.